Dynamics of changes in scholastic achievement of students during the 6-year medical course at Kindai University Faculty of Medicine

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Abstract

There has been a belief that the scholastic achievement of students in their course work must have a close relationship with their previous performances in the entrance examination. However, this hypothesis has been insufficiently examined based on a longitudinal study of school records of students at Kindai University Faculty of Medicine. This study was aimed to investigate the correlation between current datasets of the students' entrance exam scores and the changes in their achievements throughout the curriculum. By calculating and evaluating correlation coefficients between variables, it was concluded that strong correlations existed between IRT standard scores on CBT in the 4th year and graduation examination II (R=0.679) and also between the comprehensive test scores and graduation exam II (R=0.633), while the students' initial performance in the entrance exams showed a very weak correlation with their course work.

Key words : scholastic achievement, entrance exam scores, correlation coefficient, medical school curriculum

Introduction

Kindai University Faculty of Medicine (KUFM) has about 115 new freshmen every year. Admission to this school is based on various types of entrance examinations: a recommendation-based exam for applicants from university-affiliated, designated, and non-designated high schools, 1st and 2nd round general entrance examinations, 1st to 3rd round National Center Test[i]-based exams, and an essay-interview assessment to test the candidate's agreement with the admission policies.

The college determines the number of successful applicants for each type of exam in such a way that the number can exceed each admission capacity. This is because the presence of a floating population should be considered. As a fact, a certain percentage of those who pass the exam and are going to be enrolled finally select another university to meet their preference and financial situation. Therefore, the college puts a percentage of applicants on a waiting list and keeps enrolling the waitlisted candidates until the total enrollment reaches the ceiling of the admission capacity. Both the variety of entrance examinations and quite large enrollment of applicants from the waiting list, which must be the main causes of the

diverse achievement levels of the incoming freshmen, have also been considered to have caused the variation in the students' educational achievements throughout the 6-year curriculum.

Once enrolled, every student needs to fulfill annual requirements to complete the entire 6-year curriculum in order to graduate; student performances are strictly assessed every year. The 1st year curriculum is mainly composed of general education subjects such as physical education, sociology, psychology, ethology, languages, and basic natural sciences; the 2nd year is made up of lectures and training on basic medicine including anatomy, physiology, pharmacology, immunology, and pathology; the 3rd and 4th years are designed for clinical medicine such as cardiovascular medicine, respiratory medicine, gastroenterology, neurology, nephrology, endocrinology, hematology, gynecology, and pediatrics. Students need to pass the Computer-Based Testing (CBT) and the Objective Structured Clinical Examination (OSCE) at the end of the 4th year in order to progress to the 5th year, when they start clinical training (clinical clerkship) on the inpatient wards and in the outpatient departments of KUFM and affiliated hospitals. After finishing all of the clinical clerkship and several units of courses remaining in the 6th year, students are allowed to take a set of graduation examinations: the 1st exam session is held at the end of September and the 2nd session at the end of November. Each session takes 3 days.

Objective

The aim of this research was to investigate the relationship between students' entrance exam scores and their scholastic achievement throughout the curriculum. It has been considered that the students who enter KUFM with high scores on the entrance examination tend to maintain good performances and high scholastic achievements throughout the courses of the 6-year curriculum. However, this hypothesis has been insufficiently tested using longitudinal survey data of student performances. Analyzing students' recent achievements and assessing the quality of education are necessary to further develop this college, to nurture a large number of successful students with high scores on the National Medical Practitioners Qualifying Examination, and consequently recruit successful graduates from this college as physicians who energetically engage in medical practice and basic research at this faculty.
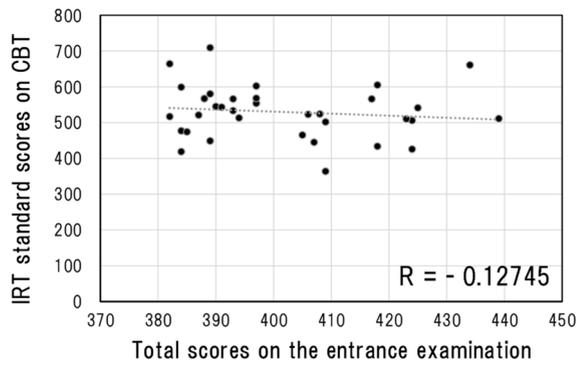
Material & Methods

We analyzed the data of two groups, the class of 2011 and the class of 2013, and focused on their scores on the 1st and 2nd round general entrance examinations out of all types of entrance exams, because the general entrance exams had a large population of successful applicants who were finally enrolled. We also examined the scores of the 4th year students on CBT conducted in 2016, and compared them with their general entrance examination scores in 2013. We also conducted a longitudinal study on student scholastic achievements (2011-2016) so as to investigate the relationship between the course attainment and general entrance examination scores and also the correlation with annual achievements, by calculating the Pearson correlation coefficients (R) between two variables. We interpret $R<0.4$ as a weak correlation, R between 0.4-0.7 as a moderate correlation, and $R>0.7$ as a strong correlation. The significance (P-value) of the difference between the two mean scores was evaluated by the two-sample t-test. A significant difference exists if the P-value falls to less than 0.05, meaning that the null hypothesis is rejected.
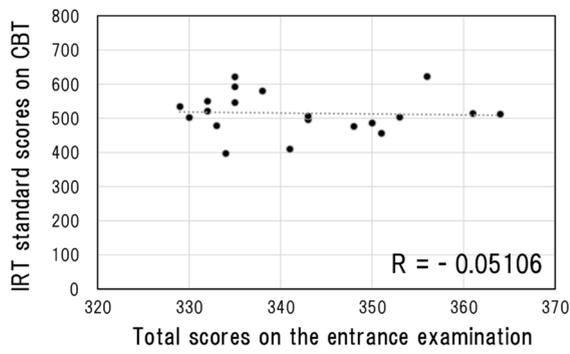
Results

We examined the relationship between the Item Response Theory (IRT) standard scores of the students on CBT in 2016, and compared them with their general entrance examination scores in 2013 (N=35 for the 1st and N=20 for the 2nd round). The coefficient in either case of the 1st and 2nd round examinations was weak and negative (R=-0.12745 for the 1st and R=-0.05106 for the 2nd round), which shows that IRT standard scores on CBT were not correlated with the general entrance examination scores (Figure 1A & 1B).

Several students failed to move up to the 4th year and repeated a year. Figure 2 shows a comparison of the entrance examination scores between the students who successfully progressed to the 4th year and those who did not. There was no significant difference between the mean scores of these two groups on either of the general entrance examinations (P=0.159 for the 1st and P=0.151 for the 2nd round). This result again suggests that the scholastic achievement of the stu-

dents after admission is independent of their performances on the entrance examinations.

Moreover, in order to longitudinally evaluate the changes in scholastic attainment of students during the 6 years, we focused on the data of the students who entered KUFM in 2011 and graduated in March of 2017. First, we examined the relationship between their scores on the 1st and 2nd round general entrance examinations and the integrated total evaluation scores of their 1st year performances. Figure 3 shows a weak correlation between these variables in either case of the students who entered the college through the 1st round general entrance exam (N=40, R=0.20) or through the 2nd round general entrance exam (N=28, R=0.036). We performed the same type of analysis to investigate whether there was a correlation between the entrance exam scores and the comprehensive test scores at the end of the 2nd year. As shown in Figure 4, these scores also did not show a significant correlation (N=40 and R=0.246 for the 1st round, N=27, and R=0.342 for the 2nd round; excluding one student, who left our college in 2012).

(A) 1st round examination (N=35)

(B) 2nd round examination (N=20)

Fig. 1 Relationship between the IRT standard scores on CBT and the scores of the same students on the entrance examination. (Class of 2013)
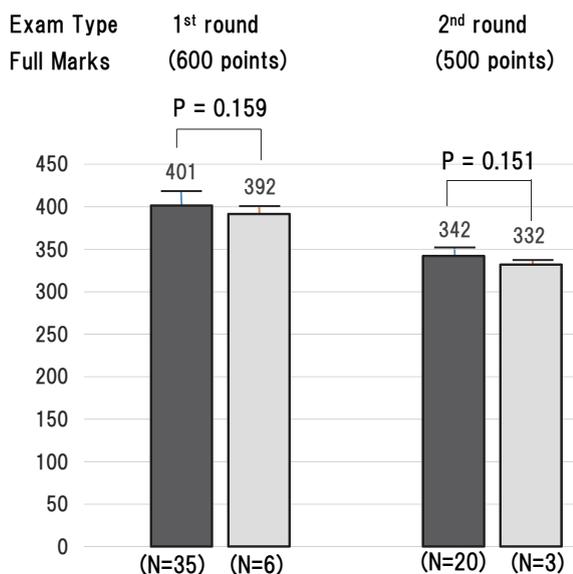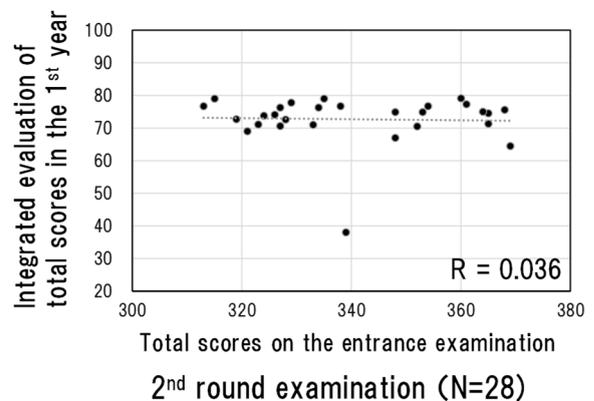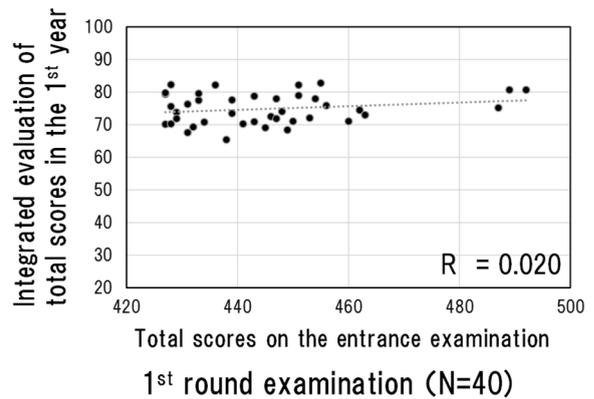

Fig. 2 Comparison of the mean scores on the entrance examinations between the students who smoothly progressed to the 4th year (left) and those who did not (right). The results are shown as the mean + SD. (Class of 2013)

1st round examination (N=40)

2nd round examination (N=28)

Fig. 3 Relationship between the entrance examination scores and average of the total records in the 1st year. (Class of 2011)
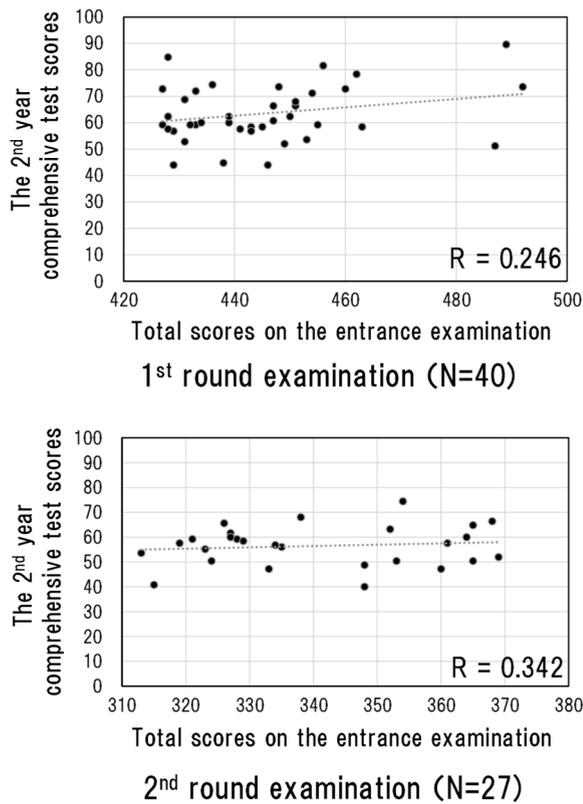
Fig. 4 Relationship between the entrance examination scores and the comprehensive test results at the end of the 2nd year. (Class of 2011)

Fig. 5 Changes in the performance ranking through the 6-year curriculum in comparison with the entrance examination scores. (Class of 2011) X axis: Entrance exam scores, Y axis: Ranking in the class.

Next, we focused on the successful students who smoothly progressed to the final year without any repeating. Figure 5 describes their academic records for 6 years in the form of their ranks in the class (Y axis) and their 1st or 2nd general entrance examination scores (X axis) to indicate the longitudinal changes in their performances. Seen as randomly scattered plots of data, most of the individual academic performances show marked transitions through the years, which are independent of their achievement levels on the entrance examination.

Finally, we analyzed the relationship between the scores on graduation examination II (X axis), which was conducted at the end of November 2016, and a series of their previous annual achievements assessed at the end of each year (Y axis): integrated evaluation in the 1st year, comprehensive test scores in the 2nd, 3rd, and 5th years, and IRT standard scores on CBT in the 4th year. Figure 6 indicates that the integrated scores of students' academic records in the 1st year were not correlated with their graduation examination results (R=0.095). In contrast, their scores on the comprehensive tests in the upper years were weakly asso-
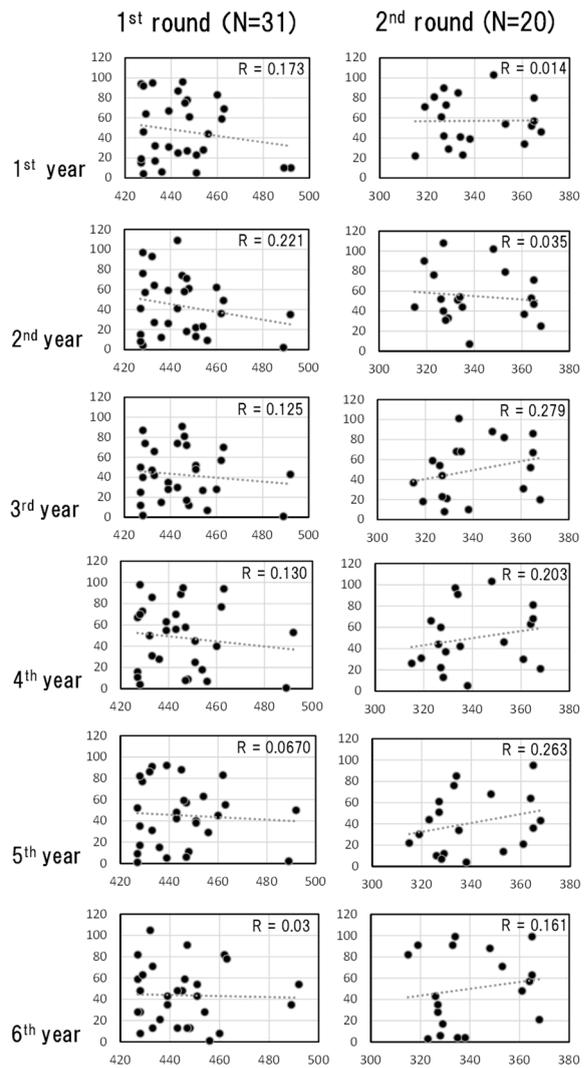
ciated with the graduation examination results (R=0.385 for the 2nd and R=0.417 for the 3rd year). Then, the CBT scores in the 4th year and comprehensive test scores in the 5th year also showed an association with graduation examination scores (R=0.679 for CBT and R=0.633 for the 5th year comprehensive test). The correlation coefficients within each pair of annual achievements are described in Table 1, which indicates that studying hard in as early as the 2nd year is helpful for students to form the basis of the attitude and performance desired for fulfilling later-year requirements up to the graduation examination.
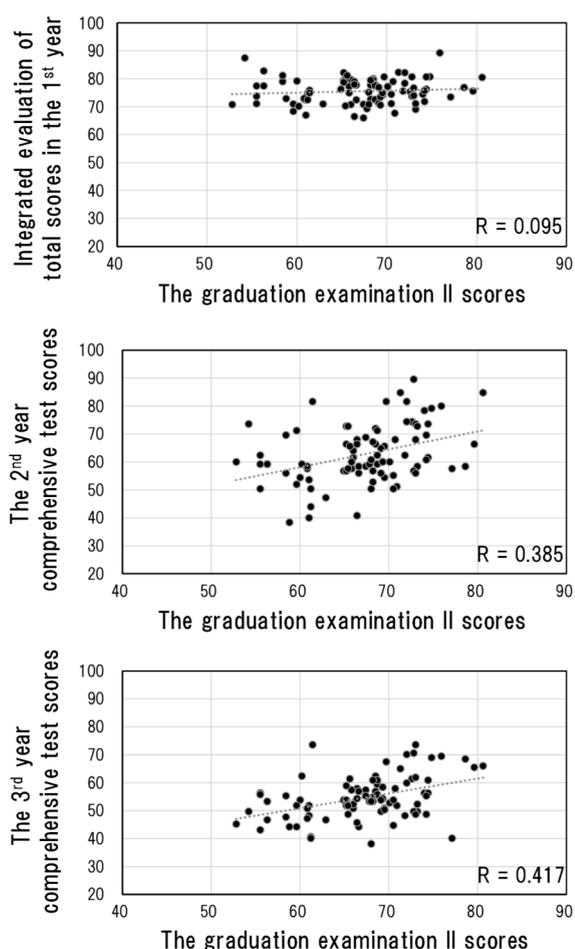
Fig. 6　Relationship between the graduation examination II results and the scholastic achievements from the 1st to 3rd year. (Class of 2011)

Table 1　Relationship between the results of graduation examination II and the performance status of the same students at the end of each year. (Class of 2011)

	1st *1	2nd *2	3rd *2	4th *3	5th *2	6th *4
1st	1.00	0.52	0.40	0.25	0.35	0.10
2nd		1.00	0.69	0.61	0.54	0.39
3rd			1.00	0.55	0.55	0.42
4th				1.00	0.71	0.68
5th					1.00	0.63
6th						1.00

*1: Integrated evaluation of total scores in the 1st year.
*2: Comprehensive test scores.
*3: IRT standard scores on CBT.
*4: Graduation examination II scores.

Discussion

We revealed that the entrance examination scores of incoming freshmen were not correlated with their scholastic attainment after admission and that their scholastic achievement scores after the 2nd year showed a close relationship with their performances on taking the graduation examination. This suggests that keeping the students motivated for their constant and diligent study of the medical subjects should be the most important factor to nurture successful students, rather than being too sensitive on screening applicants during entrance examinations. However, it is also true that many graduates from national or public universities, who would probably have achieved high scores on the National Center Test and our entrance examinations if they had taken them, performed better on the National Medical Practitioners Qualifying Examination than most graduates from a private college of medicine, with a 4-5 % higher pass rate [1]. So, we should still keep in mind that we need to screen and select not only qualified but also talented and well-motivated applicants through the series of entrance examinations. Nonetheless, the most remarkable finding in this research is the suggestion that we have to pay more attention to the quality of our education and improve it further so that we can help students motivate themselves for further and deeper studies during the medical courses.

The scores on the 2nd, 3rd, and 5th year comprehensive tests as well as CBT in the 4th year were correlated with the scores on graduation examination II. In contrast, the integrated evaluation (total scores) of their 1st year performances did not show a significant correlation with the graduation examination scores. There may be complex reasons for this. The 1st year curriculum consists of not only medical and science units but also a

variety of general education courses such as physical education, sociology, psychology, ethology, and languages, and the integrated evaluations for the 1st year were calculated as the average of all the final scores of the courses. Therefore, this variation in the 1st year subjects may have resulted in the low correlation in the scores between the 1st year and upper years. This is supported by the fact that the students' scores on the medical unit exams held for the 1st year in 2014 (genomic medicine and biochemistry) demonstrated a significant correlation with their 3rd year achievements in 2016. Curiously, the final scores of several 1st year science units held in 2014 (chemistry for medicine, mathematical sciences, and statistics) also showed a correlation with their 3rd year comprehensive test scores in 2016, but with a slightly lower coefficient than that of medical units. If these observations are verified later with more data, it would suggest that the closer to medicine the subject is and the more appropriately the courses are conducted for the student levels, the greater the students' motivation to study. Therefore, we will consider whether it is worthwhile to enhance the medical curriculum so that students can develop active attitudes towards study in as early as the 1st year, and keep acquiring high scores on upper-year assessments and graduation examinations.

In addition, it will be necessary to collect more data and examine the procedure carefully in further research. The marked diversity of the subjects and difference in evaluation criteria in the 1st year course leave open the possibility of the existence of opaque moderator variables, which would have affected the correlation results of two variables, the 1st year integrated evaluation and the scholastic attainment in upper years.

Several observations about entrance examination scores' low or negative correlation with course work achievements after admission have been reported by not only KUFM but also other faculties of medicine in Japan [2,3,4,5], one of which suggests that the learning attitude and motivation for study during the 1st year curriculum play important roles to determine the scholastic achievements in the upper years [5]. In order to scrutinize the causal correlation of KUFM's 1st year education with the upper-year scores, determining possible moderator variables, conducting analysis of variance (ANOVA), and measuring causal relationships using regression coefficients could be the next steps of this research.

As a conclusion, we recognized the importance of improving the quality of education after admission in order to nurture successful students. Under the well-organized curriculum for outcome-based education, we are responsible for educating our students with good lectures, training, and formative and summative evaluations of their academic performances.

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[i] National Center Test for University Admissions is a standardized test held for university applicants at 706 sites across Japan, annually conducted for two days in the middle of January.