

# The Correlation between Medical Students' Scores in their Physiopathology and Clinical Courses in Kerman University of Medical Sciences

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## Abstract

**Background and Purpose:** The relation of comprehensive exams scores and other measures of students' performance has been of great importance. This study is an attempt to assess the associations between medical students' scores in physiopathology and clinical courses and to compare these scores with their scores in the comprehensive exams.

**Methods:** Medical students' scores in their courses and also in their comprehensive exam in six consecutive years were collected. Using Pearson correlation coefficient and linear regression, we assessed the associations between students' scores and their personal characteristics, and the consistency between theoretical and practical courses. In addition, we computed difficulty and discrimination indices of students' scores in their courses by comparing these scores with comprehensive clinical exam (CPE).

**Results:** A total of 481 students' score were included. Females and younger students score higher. CPE were predicted by students' scores and their characteristics rather accurately with the adjusted  $R^2$  of 0.59. Students' scores in pathology and in thesis had the highest and lowest discrimination indices, while the difficulties of these two courses were in reverse order. The strongest association was observed between theoretical and practical scores in internal medicine while the associations between theoretical and practical scores in the other courses were not strong although all of them were statistically significant.

**Conclusions:** Using this approach to explore the students' score, might highlight the weak points of current educational system. For example we found that the students' score in thesis had the lowest association; although students obtained very high score in this course. Using our method with scores of students in other medical schools may provide better understanding of medical students performance's relation with countrywide comprehensive exam.

**Key words:** MEDICAL EDUCATION, IRAN, VALIDITY, DIFFICULTY INDEX, DISCRIMINATION INDEX

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## Introduction

In Iran, medical students study basic sciences in four or five semesters and participate in a comprehensive exam, the Basic Science Comprehensive Exam (BSCE). After that, they study preclinical courses on physiopathology of main body systems and also pharmacology and

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pathology for three semesters. In the next step, they start theoretical and practical clinical courses for two years. A successful completion of these periods makes students eligible to participate in another comprehensive exam, the Comprehensive Pre-internship Exam (CPE). In this exam, students are evaluated for all of pre-clinical and clinical courses.

Association between students' scores in preclinical and clinical courses and also significant associations between scores in these courses and in comprehensive exams may indirectly indicate the validity of these exams. Particularly, this method of validity assessment is more appropriate in course-based educational curriculums (1) such as the model of medical curriculum in Iran.

There are a great deal of studies which assessed the relationship of some of variables such as students' scores in high school (2,3), premedical summer programs (4), and admission tests(5,6) and even their personal characteristics with students' scores in their courses (2,3,7). Most of these studies used those scores and characteristics as predictors of students' achievement. Nonetheless, this paper mainly explored the relation of students' scores in their courses using backward approach by comparing students' scores in CPE with their scores in their courses, using the concepts of difficulty and discrimination indices.

In addition, we computed difficulty and discrimination indices of students' scores in their courses by comparing these scores with CPE score. Additionally, we examined whether the age and gender has any relation with the academic achievements.

### Methods and Materials

Medical students in Kerman University of Medical Sciences (KUMS) were classified into separate cohorts based on the entry year between 1995 and 2000. Then, their physiopathology and clinical course scores were obtained from the registry of KUMS in paper forms. These forms also contained the students' BSCE and CPE scores, sex and date of birth.

However, due to legal restrictions, the forms were anonymous and we could not link their data to other personal records.

The data were double entered and the validity of the data entry process was rechecked.

Six academic achievement indicators (AAIs) were computed as follows:

1. The average of scores in physiopathology courses consisting of basic pharmacology, pathology of diseases, physiopathology of internal medicine, semiology 1 and the epidemiology of common diseases in Iran.
2. The average of scores in practical clinical courses including internal disease, surgery, pediatrics, gynecology & obstetric disease, neurology, psychiatric, semiology 2, forensic medicine, medical ethics & history (deontology), public health, and thesis.
3. The average of scores in theoretical courses including surgery, internal medicine, pediatrics, gynecology & obstetric disease, psychiatry, neurology, infection diseases, and cardiology
4. The total average in physiopathology, theoretical and practical courses; i.e., the weighted average of the above three indicators
5. The score in the BSCE
6. The score in the CPE

The scoring system in KUMS is on a scale of 0 to 20; however, the comprehensive exams are scored on a scale of 0 to 200 points. For easier comparison, BSCE and CPE scores were converted to one on a scale of 20 points.

The associations between the AAIs and also between AAIs and the students' scores in their courses were assessed by computing Pearson correlation coefficients. In addition, 27% of students with the top and 27% of students with lowest scores in the CPE were labeled strong and weak groups, respectively; then the discrimination and difficulty indices of all courses were computed using the Whitney and Sabers formula for essay tests(8). The computed difficulty index implies how difficult the course was for students, while the computed discrimination index quantifies the power of the students' scores in a course in discriminating the top and lowest groups.

The analysis was done using the SPSS software

version 11.5; the significant level was 0.05.

## Results

From 1995 to 2000, 481 medical students started their studies at KUMS (39.7% male). The minimum and maximum annual number of enrolled students was 45 (in 2000) and 99 (in 1997 and 1998), respectively.

Females had better scores in all AAIs ( $p<0.001$ ), except in CPE & BSCE scores. In CPE & BSCE, males' scores were slightly higher than females' scores, but the differences were not statistically significant (Table 1).

Negative associations were observed between the entrance age and the academic achievement (Table 1). Students were classified based on their entrance age into three groups: 1) under 19 years of age; most of who successfully started their academic studies right after high school, 2) 19 and 20 years of age; who started their academic studies with a one or two year gap, and 3) over 21 years of age. The trend of all achievement indicators showed that the success rate decreased with age of entrance ( $p<0.001$ ). The greatest correlation coefficient observed between age and BSCE ( $r=-0.2$ ).

There were strong correlations between students' scores in all of the AAIs in both genders. The strongest association was observed between the students' scores in the physiopathology and clinical courses (in males:  $r=0.811$ , in female:  $r=0.802$ ,  $p<0.01$ ) (Table 2). Enrolling all possible predictors of students' scores in CPE, we generate a linear regression model (Table 3). The adjusted  $R^2$  of the model was 0.59 ( $p<0.001$ ). After adjusting for the other variables, there was no significant association between students' age and students' scores. The adjusted mean difference between males' and females' scores was -0.522 ( $p$ -value $<0.001$ ). In addition, the results showed that by one unit increase in student scores in BSCE, physiopathology and practical courses, their score in CPE was increased 0.36, 0.25, and 0.46 units, respectively.

mean difference (0.17,  $p$ -value=0.32); While, the highest mean difference was observed for the pathology of diseases (2.95,  $p$ -value= $<0.001$ ). After that, the mean score in all physio-pathology courses, in internal medicine and in pharmacology had the the highest mean difference (Table 4). In the next step, we compared the students' scores in theoretical and practical exams,

**Table 1.** Academic achievement indicators, classified by age at entrance and gender

Group	Average (SD)				Score in comprehensive exam	
	Physiopathology	Clinical Practicals	Clinical theoreticals	total	Basic science	Pre-internship
<b>Gender</b>						
Female (n=290)	15.35(0.09)	16.76(0.06)	15.53(0.08)	16.27(0.06)	12.84(0.09)	11.64(0.12)
Male (n=191)	14.6(0.11)	16.15(0.08)	15.12(0.1)	15.74(0.08)	12.93(0.11)	11.85(0.15)
p-value	<0.001	0.001	<0.001	<0.001	0.519	0.286
<b>Age group</b>						
<19 (n=188)	15.58(0.12)	15.83(0.09)	16.75(0.07)	16.38(0.08)	13.45(0.12)	12.16(0.16)
19-20 (n=247)	14.83(0.09)	15.12(0.08)	16.46(0.06)	15.92(0.06)	12.59(0.09)	11.54(0.12)
>20 (n=42)	14.39(0.24)	14.97(0.21)	16.09(0.20)	15.63(0.18)	12.15(0.17)	11.02(0.29)
Correlation Coefficient						
p-value*	-.19 <0.001	-.16 <0.001	-.16 <0.001	-.18 <0.001	-.20 <0.001	-.18 <0.001
All students (n=481)	15.08(0.07)	15.38(0.06)	16.54(0.05)	16.08(0.05)	12.89(0.07)	11.74(0.09)

\*  $p$ -values were computed based on one way ANOVA. The results of post-hoc showed significant differences between all age groups in all variables, except the difference between age group 19-20 and >20 in the score of CPE ( $p$ -value=0.105)

**Table 2.** The correlation coefficients between the academic achievement indicators; light and medium shades show the coefficients in males and females respectively

	BSCE	Physio-pathology	Clinical courses	CPE
BSCE		.663	.555	.526
Physio-pathology	.621		.811	.669
Clinical courses	.572	.802		.630
CPE	.685	.624	.626	

All correlation coefficients were significant at the 0.01 level (2-tailed).

**Table 3:** Prediction of the student score in CPE using linear regression model

Predictor	Regression Coefficient	P-value
Age	-0.03	0.471
Female	-0.522	<0.001
BSCE	0.361	<0.001
Physio-pathology	0.251	0.003
Clinical theoretical course	0.096	0.365
Clinical practical course	-0.457	<0.001

The adjusted  $R^2$ : 0.59,  $P < 0.0001$

for each course (figure 1). These results showed a wide variation between coefficients, the strongest correlation coefficient was observed in internal medicine ( $r=0.65$ ) and the weakest coefficient in neurology ( $r=0.24$ ). Nonetheless, all of these coefficients were significant ( $p$  values  $< 0.0001$ ).

As shown in table 4 students got the highest and the lowest scores in thesis (19.01) and in pathology of diseases (14.28), respectively. In fact, the score of students in thesis were considerably higher than the score of students in other courses with the minimum standard

deviation ( $SD=0.86$ ) which means that students' scores in thesis were much closer than their scores in the other courses. In contrast, the mean scores of students in BSCE and CPE were much lower than their scores in the other courses (12.88 and 11.72 respectively).

On the other hand, based on the computed discrimination indices, thesis score had the lowest mean difference (0.17,  $p$ -value=0.32); While, the highest mean difference was observed for the pathology of diseases (2.95,  $p$ -value= $<0.001$ ). After that, the mean score in all physio-pathology courses, in internal medicine and in pharmacology had the the highest mean difference (Table 4).

## Discussion

The results showed that the associations between AAIs were relatively strong. Nonetheless, the correlation of students' scores in theoretical and practical courses in some subjects such as neurology, cardiology and infection diseases were much less than that in internal medicine.

Generally, students' scores in thesis were much higher than the other courses, but it had the lowest discrimination function. In contrast, although students got the lowest scores in the pathology of diseases, it had the highest discrimination index which implies that the score of this course could discriminate top and lowest group of students much better than other scores. Moreover, the results of multivariate analysis showed that the students' scores in their theoretical courses did not predict their scores in CPE.

Generally, younger students and females were more successful. There was a strong negative association between entrance age and AAIs which has been reported in many studies (7). In Iran, female students, particularly single ones, have fewer responsibilities in the family and they are mostly dependent on financial support from their families. In addition, they socialize less, and therefore have much more time to dedicate to their studies. Although these factors are cultural, there is evidence that shows females were more successful in some other countries too (8). It

**Table 4.** Difficulty and discrimination indices of student scores in their courses

Courses	Mean of students' score as an indicator of difficulty Index		The difference of scores in top and lowest groups of students as an indicator of discrimination index		
	Mean	SD	Mean Difference	95% CI	P-value
Internal Disease	14.94	1.52	2.38	2.05-2.7	<0.001
Surgery	15.05	1.52	1.94	1.57-2.32	<0.001
Pediatrics	15.52	1.66	2.17	1.73-2.6	<0.001
Gynecology & Obstetric Disease	16.13	1.54	2.02	1.62-2.41	<0.001
Neurology	16.04	1.59	1.39	1.03-1.76	<0.001
Psychiatric	15.81	1.54	1.37	0.94-1.8	<0.001
Pathology of diseases	14.28	2.24	2.95	2.41-3.48	<0.001
Pharmacology	15.47	2.26	2.33	1.74-2.92	<0.001
Semilogy	16.15	1.39	1.41	1.02-1.8	<0.001
Forensic Medicine	15.64	2.29	1.86	1.24-2.48	<0.001
Medical Ethics & History (Deontology)	16.79	1.77	0.87	0.35-1.39	0.01
Public Health**	16.05	1.65	1.32	0.93-1.72	<0.001
Minor courses*	17.37	1.07	1.01	0.76-1.26	<0.001
Thesis	19.01	0.86	0.17	-0.17-0.51	0.32
Physiopathology courses	15.06	1.62	2.46	2.1-2.82	<0.001
Theoretical courses	15.36	1.36	1.83	1.5-2.16	<0.001
Practice clinical courses	16.52	1.05	1.21	0.98-1.45	<0.001
All of the above courses	16.06	1.08	1.46	1.21-1.71	<0.001
BSCE	12.88	1.53	2.36	1.99-2.73	<0.001

\*Minor courses consists of Urology, Radiology, Ophthalmology, Orthopedics Disease, Dermatology, E.N.T

\*\* Public Health consists of Biostatistics & Research Methodology, Epidemiology & Iran's Common Disease, and family medicine

should be added that male students were slightly more successful in the comprehensive exams, which may imply that their long term achievement is at least in the same level as females.

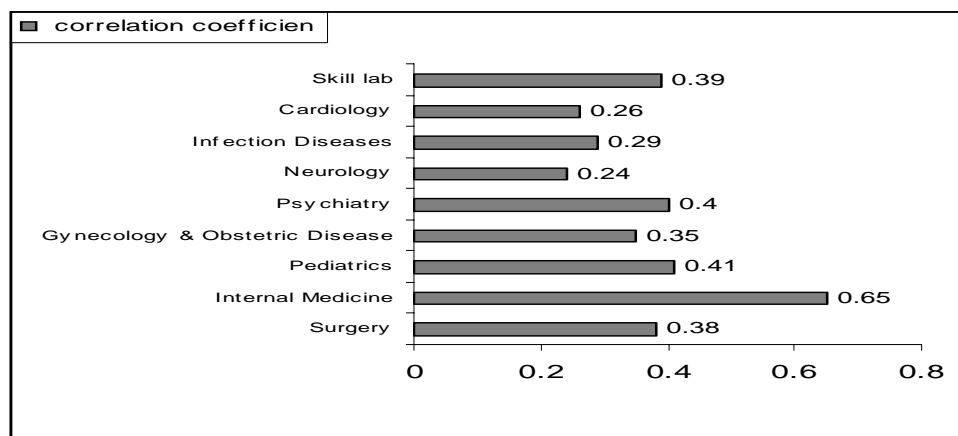
We applied the concept of the discrimination index commonly used in the test analyses to assess the appropriateness of items. The discrimination index is an indicator that shows how perfectly a question can discriminate strong respondents from weak. For this purpose, you define strong and weak respondents based on their scores in an exam; then, you check the proportion of strong and weak respondents who provide correct responses to every question. The

discrimination index for each question is the difference between proportions of correct responses in strong and weak respondents. With an exactly similar logic, we defined strong and weak students based on their scores in the CPE, and compared their scores in courses.

Based on the above logic, we can imply than the students' scores in their thesis had the minimum power to discriminate strong and weak students. Surprisingly students got the best scores in their thesis. Therefore, we can imply that the scores of thesis had the minimum accuracy.

On the other hand, the students' scores in comprehensive exams were considerably lower than their scores in their courses. In means that

**Figure1.** The correlation coefficients between theoretical and practical students' scores in their courses. All of these coefficients were statistically significant ( $p$ -value $<0.0001$ )



students were less successful in national exams than in departmental exams. Although it is reported in other studies as well (9-10), we may think more about the validity of local exams. It is one of the basic concepts in exams that the questions should focus on the topics that students much to know based on the teaching curriculum (11,12). Nonetheless, it is not hard to believe that examiner will focus on those topics that were taught if they had played the role of teacher as well. Therefore, in the best scenario we can suggest independent professionals evaluate students based on their course plan.

The correlations between students' scores in practical and theoretical courses were not as strong as we might expect. In average the correlation coefficients were around 0.4. These low associations also imply that there were some problems in either the teaching methods or in exams. The strongest association was found between students' scores in theoretical and practical exams of internal medicine. In addition, the discrimination index of internal medicine was among the best ones. These findings may show an acceptable validity of the exams in internal medicine courses. Nonetheless, we may remember that internal medicine is the most important course for medical students (13), and students pay more attention to its contents and study internal medicine much deeper than the

other courses.

This study only reviewed the correlation of medical students' scores in different exams in Kerman University of Medical Sciences.

Unfortunately, we could not find similar analysis on the scores of students in other medical school to compare our findings. Therefore, we encourage researchers around the world to explore students' scores with similar methodology. For sure, comparison between the internal consistencies of students' scores in different medical schools can expand our knowledge about the effects of different teaching curriculum on the learning of students.

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