



Academic performance in Iranian medical students during the pre-clinical stage

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Abstract

Background: Better understanding of factors associated with medical school performance is necessary to improve admission processes and to help students succeed in their career. This study follows a group of Iranian med students during their first 2.5 years of medical education, to evaluate their academic success in accordance with their demographic, cognitive and non-cognitive characteristics.

Methods: 143 of 200 matriculants of Iran University of Medical Sciences medical school in 2010, were followed for 5 consecutive semesters of the preclinical stage. Demographic and cognitive characteristics were collected using self-administered data collection forms. The NEO Five-Factor (personality) Inventory (NEO-FFI) was used to assess participants' non-cognitive characteristics. The 5 semesters' cumulative Grade Point Average (GPA) was the measure of academic performance. Pooled t-test, one-way ANOVA, multiple linear regression and logistic regression model, and Spearman coefficients of correlation were applied in data analysis

Results: There was a significant difference in participants' GPA regarding their gender ($p=0.008$), using privilege in National University Entrance Examination (NUEE) ($p<0.0001$), the number of times one has taken part in NUEE ($p=0.034$) and being occupied in paid jobs ($p=0.01$). There were no significant differences in participants' GPA regarding NEO-FFI domains.

Conclusions: Females and students with a better academic performance prior to their admission in medical school had better academic records. We found no association between academic performance and personality because participants were followed through a preclinical stage where non-cognitive characteristics plays a less important role in their performance and evaluations.

Keywords: Students, Medical education, Medicine, Undergraduate, Iran

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Introduction

Medical carriers are noble since physicians are directly involved in the life of human beings. Therefore, medical schools try to select the most promising students who would perform well as undergraduate students and become good practitioners in the future (1).

Many studies have addressed predictors of medical students' academic success. These predictors are mainly categorized into three groups of "Demographic", "Cognitive" and "Non-cognitive" characteristics (2). Commonly addressed demographics are "gender"(3-7), "age"(3), "marital status"(8), "being occupied in paid jobs during education"(3) and "the high school one has attended" (1). The

"academic performance" of students prior to their admission to medical school and "results of university entrance examinations" (2,8-16) are common proxies for cognitive abilities. The non-cognitive personal qualities usually consist of "personality traits" and factors like "moral/ethical reasoning" (1, 5-7, 10, 12-24).

Iran has a direct undergraduate medical school admission system. Applicants should compete in National University Entrance Examination (NUEE). The NUEE is a highly competitive, cognitive ability testing, centralized and governmentally administered examination. It covers high school course topics (e.g. Biology, Math, etc.) and is be-

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↑What is "already known" in this topic:

There are "Demographic", "Cognitive" and "Non-cognitive" predictors of medical students' academic success.

→What this article adds:

Gender, privilege in university admission and frequency of participation in national university entrance examination are predictors of Iranian medical students' academic success after 2.5 years of education.

ing held once a year. The eligible NUEE candidates are high school graduates who have received High School Graduation Diploma (HSGD) and completed the one-year Pre-University Courses (PUC). The best-ranked candidates, according to NUEE scores, are admitted into the public medical schools.

Iran's 7-year medical education program consists of 3 consecutive stages. An initial 2.5 years pre-clinical education, commonly known as "basic science" stage, 3 years of clinical training and a final 1.5 years of "internship" which is supervised medical practice at teaching hospitals.

Every year thousands of NUEE candidates, inspired by socio-cultural and economic motives (25-26), compete for medical school admissions. But not all admitted students do well in terms of in-course examination and/or professional behaviors. Though significant changes in the medical school admission processes are beyond reach in the near future (9,24), any intervention to improve students' academic performance should be based on better understanding of determining factors. The present study aims to find determinants of academic success in Iranian medical students during their first 2.5 years of education.

Methods

Participants

All 200 freshmen of Iran University of Medical Sciences (IUMS) Medical School in 2010, enrolled in the study. IUMS is one of the three highest ranked public medical schools in Iran, located in Tehran.

Instrument

Data on demographic characteristics and cognitive ability measures of students were collected by uniformly designed, self-administered data collection forms consisting multiple choice and open-ended questions. Demographic characteristics included age, sex, local residence of the family, having a paid job, extracurricular activities (i.e. being professionally involved in sport/ art/social/religious/political activities).

The cognitive ability measures consisted of the rank in NUEE, Grade Point Averages of High School Graduation Diploma (HSGD-GPA) in 0-20 scale, Grade Point Average of Pre-University Course (PUC-GPA) in 0-20 scale, number of times one had taken part in NUEE, in addition to his/her Biology, Chemistry and Math scores in NUEE (in 0-100 scale).

There are some limited privileges in NUEE. Compared to ordinary candidates, Privileged ones need lower scores to be admitted to any program. Therefore, students were asked about being eligible for any privileges in NUEE.

The students' personality traits were chosen as delegates for their non-cognitive characteristics. An already validated Persian version of NEO Five-Factor (personality) Inventory (NEO-FFI) was used to serve the purpose (27). The NEO-FFI is a 60-item questionnaire, consisted of 5 domains of Neuroticism (N), Extraversion (E), Openness (O), Agreeableness (A) and Conscientiousness (C). There are 12-items for each domain, and the respondents are asked to rate the extent to which he or she concurs with a statement on a five-point Likert scale, ranging from

strongly disagree (=1) to strongly agree (=5). We used the self-report form of inventory which takes 10-15 minutes to be filled. The raw and T-scores in each domain were calculated according to the Persian translation of user manual (28). T scores of 34 and less were interpreted as very low, 35-44 as low, 45-54 as moderate, 55-64 as high, 65 and more as very high scale scores in each domain. By making different combinations of the 5 major personality factors, 10 personality styles are driven including styles of learning (O+C), character(A+C), interest (E+O), attitude (O+A), interactions (E+A), activity (E+C), well-being (N+E), defense (N+O), anger control (N+A) and style of impulse control (N+C). The respondents' learning styles were categorized in 4 groups of "Good Student" ($O_{T-Score} \Rightarrow 50, C_{T-Score} \Rightarrow 50$), "Dreamer" ($O_{T-Score} \Rightarrow 50, C_{T-Score} \leq 50$), "Reluctant Scholar" ($O_{T-Score} \leq 50, C_{T-Score} \leq 50$) and "by-the-booker" ($O_{T-Score} \leq 50, C_{T-Score} \Rightarrow 50$) (28).

Procedure

In the 3rd week of the first academic semester, at the beginning of a public health course session, the study purpose and protocol were presented to students by one of the authors. Students were assured that the data provided by them, would only serve research purposes; their participation/ refusal would not influence their academic evaluations and their ID would be kept confidential. Following the instructions, a data gathering form and the NEO Five-Factor (personality) Inventory (NEO-FFI) were handed to each audience. Those willing to participate filled and re-stored the forms within 20 minutes. Students were followed for 5 consecutive semesters (September 2010- February 2013).

Outcome measures and analysis

The 5 semesters' cumulative Grade Point Average (GPA), in 0 to 20 scale, was chosen as the main measure of students' academic performance. Traditionally the "A grade" students, those with an overall GPA of 17 or above, are honored as successful students in Iran. So we made further comparisons between "A grade" and "non-A grade" students.

Two independent samples (pooled) t-test and one-way analysis of variance (ANOVA) were used for comparison of means. Since the Kolmogorov-Smirnov test showed that the main dependent variable (i.e. first 2.5 years med school GPA) data was not normally distributed ($p > 0.05$), the linear correlation between variables was assessed by Spearman coefficients of correlation. To determine predictors of academic success, Multiple Linear Regression (GPA score as dependent factor HSGD-GPA, PUC-GPA, Biology, Chemistry and Math scores in NUEE, raw and T scores of NEO-FFI domains as explanatory variables) and Logistic Regression Model (being "A grade" student as dependent factor, and the rest of demographic, cognitive and non-cognitive characteristics as predictors) were used. All analyses were performed by SPSS statistical software (version 16.0, SPSS Inc., Chicago, Ill., USA).

The Research council of Iran University of Medical Sciences approved the study.

Table 1. Comparison of demographic characteristics in male and female participants (n=143)

Variable		Male	Female	P. value
Privilege	No	47(95.9)*	80(92)	0.6
	yes	2(4.1)	7(8)	
Type of high school	Governmental	15(27.8)	30(34.1)	0.620
	Nonprofit	15(27.8)	19(21.6)	
	Sampad	24(44.4)	39(44.3)	
Tehran(or karaj) Native	Yes	19(35.8)	41(46.6)	0.2
	No	34(64.2)	47(53.4)	
Residence of student	With family	27(50)	49(55.1)	0.181
	Dormitory	21(38.9)	37(41.5)	
	Others	6(11.1)	3(3.3)	
Paid Job	Yes	5(9.3)	7(7.8)	0.77
	No	49(90.7)	82(92.1)	
Extracurricular activity	Yes	21(38.8)	23(25.8)	0.1
	No	23(42.5)	66(74.1)	

*n(%)

Results

Demographic characteristics of participants

143 medical students were evaluated. Out of 200 (72% responsiveness) participants 89(62.24%) were males, and 54(37.76%) were females. The majority of respondents (93%) were admitted to med school using no privileges; 17% (n=24) participated in NUEE more than once. 63(44.4%) respondents were educated in "Sampad" high schools, which accept talented students and have a district entrance exam for primary school graduate students. About 91% (n=131) of students were not involved in paid jobs (Table 1).

The cognitive characteristics of participants

The mean (SD) participants' PUC-GPA and HSGD-GPA were 19.14(0.63) and 19.27 (0.64) respectively. The mean (SD) participants' Biology, Chemistry and Math scores in NUEE were 81.5(8.34), 78.56(10.34) and 57.23 (16.94). On average, respondents ranked 368 (95% CI: 316-420) among 442000 NUEE applicants.

Mean±SD PUC-GPA was higher in females (19.25±0.57) versus males (18.94±0.69), (p= 0.01). While there was no statistically significant difference between gender groups regarding HSGD- GPA (p=0.09), Biology (p=0.45), Chemistry (p= 0.32) and Math (p=0.23) scores in NUEE.

Table 2. The personality characteristics of participants according to NEO-FFI domains, comparison by gender

	Variable	Total	Male	Female	P. value
Neuroticism	Mean (SD)	50.08(9.93)	50.15(9.15)	50.03(10.43)	0.93
	Very low	8(5.6)*	1(1.9)	7(7.9)	
	Low	40(28)	18(33.3)	22(24.7)	
	Moderate	49(34.3)	18(33.3)	31(34.8)	
	high	37(25.9)	15(27.8)	22(24.7)	
	Very high	9(6.3)	2(3.7)	7(7.9)	
Extraversion	Mean (SD)	49.80(10.14)	48.92(9)	50.33(10.78)	0.32
	Very low	9(6.3)	4(7.4)	5(5.6)	
	Low	38(26.6)	13(24.1)	25(28.1)	
	Moderate	50(35)	23(42.6)	27(30.3)	
	high	36(25.2)	11(20.4)	25(28.1)	
	Very high	10(7)	3(5.6)	7(7.9)	
Openness	Mean (SD)	49.72(9.71)	49.97(9.04)	49.58(10.14)	0.77
	Very low	8(5.6)	2(3.7)	6(6.7)	
	Low	38(26.6)	15(27.8)	23(25.8)	
	Moderate	55(38.5)	20(37)	35(39.3)	
	high	29(20.3)	13(24.1)	16(18)	
	Very high	13(9.1)	4(7.4)	9(10.1)	
Agreeableness	Mean (SD)	49.80(9.87)	50.66(9.72)	49.27(9.98)	0.31
	Very low	9(6.3)	2(3.7)	7(7.9)	
	Low	35(24.5)	14(25.9)	21(23.6)	
	Moderate	48(33.6)	17(31.5)	31(34.8)	
	high	45(31.5)	18(33.3)	27(30.3)	
	Very high	6(4.2)	3(5.6)	3(3.4)	
Conscientiousness	Mean (SD)	50.11(10.09)	48.41(10.10)	51.14(10)	0.055
	Very low	17(11.9)	6(11.1)	11(12.4)	
	Low	24(16.8)	10(18.5)	14(15.7)	
	Moderate	49(34.3)	24(44.4)	25(28.1)	
	high	44(30.8)	11(20.4)	33(37.1)	
	Very high	9(6.3)	3(5.6)	6(6.7)	

*n(%)

Table 3. Comparison of GPA in different group of participants regarding their demographic and non-cognitive characteristics

Variable	Category	Mean	Standard Deviation	P value	
Demographic characteristics	Gender	male	15.94	1.18	0.008
		Female	16.51	1.26	
	Privilege	No	16.47	1.14	<0.0001
		yes	14.93	1.38	
	Participation in NUEE	once	16.40	1.25	0.034
		More than once	15.81	1.21	
	Tehran native	yes	16.05	1.16	0.052
		No	16.47	1.30	
	Residence in dormitory	yes	16.48	1.35	0.149
		No	16.17	1.19	
	Paid job	yes	15.73	0.65	0.011
		No	16.35	1.29	
	Extracurricular activity	yes	16.40	0.91	0.45
		No	16.25	1.39	
	Type of high school	Governmental	16.32	1.49	0.85
Non-profit		16.45	1.13		
Sampad		16.23	1.23		
Non-cognitive characteristics	neuroticism	Very low	15.46	1.04	0.173
		Low	16.35	1.20	
		Moderate	16.17	1.34	
		high	16.45	1.30	
		Very high	16.87	0.73	
	Extraversion	Very low	16.50	1.11	0.578
		Low	16.10	1.37	
		Moderate	16.51	1.10	
		high	16.19	1.38	
		Very high	16.20	1.27	
	Openness	Very low	16.26	1.77	0.471
		Low	16.14	1.28	
		Moderate	16.48	1.25	
		high	16.38	1.11	
		Very high	15.83	1.24	
	Agreeableness	Very low	16.62	1.39	0.840
		Low	16.41	1.15	
		Moderate	16.15	1.23	
		high	16.29	1.32	
		Very high	16.30	1.72	
Conscientiousness	Very low	16.35	1.34	0.963	
	Low	16.33	1.28		
	Moderate	16.19	1.16		
	high	16.38	1.39		
	Very high	16.22	1.16		
Learning style	Good student	16.26	1.39	0.933	
	Dreamer	16.40	1.19		
	Reluctant scholar	16.22	1.26		
	By-the-booker	16.35	1.20		

The non-cognitive characteristics of participants

The mean±SD of respondents' scores in "Neuroticism" and "Extraversion" domains of the NEO-FFI were 50.08±9.93 and 49.80±10.14 respectively. On average, participants scored 49.72±9.71 in "Openness", 49.80±9.87 in "Agreeableness" and 50.11±10.09 in "Conscientiousness" domains. The personality characteristics of participants according to NEO-FFI T scores are summa-

rized in Table 2.

Regarding the learning style, 40 participants (male: female ratio= 11:29) were categorized as "Good students", 26 (14:12) as "Dreamers", 39 (17:22) and 38 (12:26) as "Reluctant scholars" and "By-the-bookers" respectively. The differences of learning styles in males and females were not statistically significant (p=0.12).

Table 4. Comparison of “grade A” and “non-A grade” students regarding their demographic and non-cognitive characteristics

Variable	Category	“grade A” students (n=41)	“non grade A” Students (n=102)	P. value	
Demographic characteristics	Gender	Male	9(21.9)	45(44.1)	0.013
		Female	32(87.8)	57(55.8)	
	Privilege	no	40(97.5)	87(85.3)	0.035
		yes	1(2.4)	15(14.7)	
	Participation in NUEE	Once	38(92.6)	71(69)	0.042
		More than once	2(4.8)	22(21.5)	
	Tehran native	yes	14(34.1)	46(45)	0.230
		no	27(65.8)	56(54.9)	
	Residence in Dormitory	Yes	21(51.2)	37(36.2)	0.1
		No	20(48)	65(63.7)	
Paid job	Yes	0	12(11.7)	0.02	
	No	41(100)	90(88.2)		
Extracurricular activity	Yes	11(26.8)	33(32.3)	0.517	
	No	30(73.1)	69(67.6)		
Type of high school	Governmental	15(36.5)	30(29.4)	0.290	
	Non-profit	12(29.2)	21(20.5)		
	Sampad	14(34.1)	62(60.7)		
	Very low	0(0)	8(7.8)		
Neuroticism	Low	11(26.8)	29(28.4)	0.08	
	Moderate	11(26.8)	38(37.3)		
	high	16(39)	21(20.6)		
	Very high	3(7.3)	6(5.9)		
	Very low	3(7.3)	6(5.9)		0.93
Extraversion	Low	9(22)	29(28.4)		
	Moderate	16(39)	34(33.3)		
	high	10(24.4)	26(25.5)		
	Very high	3(7.3)	7(6.9)		
Openness	Very low	4(9.8)	4(3.9)	0.475	
	Low	8(19.5)	30(29.4)		
	Moderate	18(43.9)	37(36.3)		
	high	8(19.5)	21(20.6)		
Agreeableness	Very high	3(7.3)	10(9.8)	0.98	
	Very low	3(7.3)	6(5.9)		
	Low	9(22)	26(25.5)		
	Moderate	14(34.1)	34(33.3)		
Conscientiousness	high	13(31.7)	32(31.4)	0.74	
	Very high	2(4.9)	4(3.9)		
	Very low	6(14.6)	11(10.8)		
	Low	8(19.5)	16(15.7)		
	Moderate	11(26.8)	38(37.3)		
Learning style	high	14(34.1)	30(29.4)	0.79	
	Very high	2(4.9)	7(6.9)		
	Good student	11(26.8)	29(28.4)		
	Dreamer	9(21.9)	17(16.6)		
	Reluctant scholar	12(29.2)	27(26.4)		
By-the-booker	9(21.9)	29(28.4)			

The Academic performance of participants

The Mean±SD of participants' GPA in their first 2.5 years of med school was 16.30±1.26 (min: 12.55, max: 18.78) and 41 (28.7%) of them were “grade A” students.

Table 3 compares the GPA in different groups of participants. There was a statistically significant difference in participants' GPA regarding their gender ($p=0.008$), using privilege in NUEE ($p<0.0001$), the number of time one has taken part in NUEE ($p=0.034$) and being occupied in paid jobs ($p=0.01$). There were linear correlations between first 2.5 years of med school GPA and PUC-GPA ($r=0.56$ $p<0.0001$), HSGD-GPA ($r=0.52$, $p<0.0001$), Biology score ($r=0.32$ $p<0.0001$) and Chemistry score in NUEE. ($r=0.19$, $p=0.032$). While Math score in NUEE ($r=0.06$, $p=0.949$) and the students' rank in the exam ($r=-0.15$,

$p=0.154$) showed no linear correlation with their GPA. There were no statistically significant differences in participants' GPA regarding NEO-FFI domains. Neither raw nor T scores of NEO-FFI domains had linear correlations with GPA. There was no difference in GPA of students regarding their learning style.

Table 4, shows the distribution of different Demographic and non-cognitive characteristics in “grade A” and “non-grade A” students. Gender ($p=0.01$), privilege in admission to university ($p=0.03$), frequency of participation in NUEE ($p=0.04$), being occupied in paid jobs ($p=0.02$) significantly differed in two groups. The Biology score in NUEE was significantly different in “grade A” and “non-grade A” students ($p=0.006$); while there were no differences between groups regarding Chemistry ($p=0.093$) and

Math ($p=0.88$) scores as well as NUEE rank ($p=0.123$).

The Multiple Linear Regression model did not explain variations of students' GPA by variations in HSGD-GPA, PUC-GPA, Biology, Chemistry and Math scores in NUEE, raw and T scores of NEO-FFI domains. A logistic regression model also revealed none of the demographic, cognitive and non-cognitive characteristics as "predictors" of being an "A grade" student in the first 2.5 years of Medical school.

Discussion

Academic performance and Demographic characteristics

Female participants academically performed better than males. The same finding was reported in single studies from Sri Lanka, Germany, Turkey, Scotland and Saudi Arabia (1,3-4,6-8, 29). The systematic review by Ferguson *et al.* also concluded that "women tend to perform better than men in their medical training." They suggested "motivation" as the probable explanation for the phenomenon (5).

It has been suggested that extracurricular activities have a negative effect on students' academic performance (3). While we found no differences in academic performance of students regarding their professional involvement in extracurricular activities, it was revealed that those who were occupied in paid jobs, performed less successful compared to others.

Academic performance and cognitive characteristics

It has consistently been stated in the literature that the academic performance of students prior to their admission to the medical school is a strong predictor of their medical school academic success (2, 5-7, 12, 14-16, 30). The same finding was repeated in the current study. Matriculants who passed the NUEE in the first and only time they took the exam, and those who used no privileges in NUEE had better academic results in medical school. The linear correlations between med school GPA and PUC-GPA, HSGD-GPA, Biology and Math points in the NUEE also indicate that medical students' academic performance is correlated to their academic performance prior to med school admission.

The volunteers' Rank in NUEE did not predict the medical school academic performance. A cohort done by Farrokhi-Khajeh-Pasha *et al.* on all public medical schools in Iran also reported the same finding (30). This might probably be due to the small number of variations between students' scores in the highly competitive NUEE.

Academic performance and non-cognitive characteristics

While many studies have emphasized on the role of personality characteristics (1,16-17, 19-21, 23-24, 31-34), particularly the conscientiousness (5-6, 23,33-34) in medical students' academic success, the present study failed to prove such correlations. The fact that we followed the participants just through their "basic science" stage might be an explanation. It has already been shown that during the early pre-clinical years, where success is mostly defined in terms of in-course examination scores, personality

traits play a less important role. As the curriculum changes over the years, the personality, especially interpersonal aspects of it, become more important (21, 33). Another explanation is a lack of heterogeneity amongst participants, which leads to a small number of students in some personality subgroups, not sufficient to show any statistical difference.

We were not able to determine any particular variable as the "predictor" of academic success by applying regression models. Females were the majority of participants. They had better academic performance both before (i.e. higher PUC-GPA) and after admission to medical school. So the gender variable might have adjusted the role of other variables when entered in the model.

Limitations and Strengths

In spite of some generalizability limitations and failing to fit any regression models, the study has its strengths in choosing its measures. Choosing the results of centralized, governmentally administered examinations as indicators of cognitive ability, minimizes the potential bias of using different cognitive ability measurement tools. Applying the validated Farsi version of NEO-FFI inventory provides a better opportunity for comparison of our findings with other studies, since the scale is frequently used as personality assessment tool in the relevant literature.

Conclusion

In conclusion, gender, privilege in university admission and frequency of participation in NUEE were significantly associated with a better academic performance of medical students after 2.5 years of education. Other demographic and non-cognitive measures seem to have a limited role at this stage. The next phase of this study, which evaluates the same participants through their rest of medical education, may provide a better understanding about predictors of academic performance and professional behavior in Iranian medical students.

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