# Admission To Medical Colleges- Predictive Validity Of Selection Criteria.

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**Abstract:** Background & objective: Appropriate selection criteria for admission to medical college is a fundamental prerequisite where number of aspirants seeking admission to medical college has increased. The selection criteria used by medical colleges has been changing from time to time and not uniform all over India. Hence it is important to validate the selection criteria by observing performance of students during medical course. The study aims to find predictive value of entrance test & science score obtained at HSC level on the performance of medical students in I MBBS University Examination. Methods: The study included marks obtained in science subjects at HSC level, Entrance and I MBBS University examination for four consecutive batches(2009 to 2012).  Correlation between all three variables was found using spearman rank correlation. Results: Performance in I MBBS examination showed no correlation with Entrance score but correlated significantly with science scores at HSC level (p<0.001). Also on Linear Regression Analysis, only HSC score showed strong positive correlation with First MBBS score(p<0.001). Interpretation & conclusion: This study indicates that Entrance test needs revision. Either the test should be modified or several selection tools like giving additional weightage to science score at HSC level should be combined, so as to select the optimum standard students. [Vrushali P NJIRM 2016; 7(4): 98-105]
**Key words:** entrance test, first MBBS, medical students, performance, selection criteria

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**Introduction:** Appropriate selection of medical students is a fundamental prerequisite if medical schools are to produce competent and caring doctors. Medical colleges seek to admit applicants who are competent to complete academic requirements of the course, perform well as practicing physician and have the personal characteristics of Physicians valued by members of the society [1].

 Hence appropriate selection criteria for admission to Medical school is a fundamental prerequisite. The admission criteria for selecting Medical students could be cognitive or non- cognitive, academic or non-academic. The million dollar question is which criteria, if applied, can rightly select best candidates as future doctors? There is continuous research going on for appropriate factors (predictors) that are valid, reliable, cost effective and less time consuming[2].

Entrance examination (admission test) is widely accepted method for selection of students for admission to medical colleges around a globe. In India entrance examination is mandatory for students seeking admission in public or private sector medical colleges. The main objectives of an entrance examination are to select students with academic merit as well as appropriate personality and aptitude. Such a test is very essential in view of the fact that the applicants qualify from different institutions with variable standards or from a variety of Boards whose examinations are of different standards. The principle

of justice demands that the relative merit of the students must be determined by subjecting them to a single common entrance test. This controls the errors and omissions done intentionally or unintentionally by the students, board mal-practices and other confounders at institution and board level in HSC examination[3]

Validating selection criteria in this way is not an easy task. Because validation requires long term follow up and tools to identify "good doctors". However, medical school examinations try to evaluate the knowledge, skills and attitudes that a good doctor should possess. These examination results are relatively easily accessible. Hence examination results have frequently being used as a means of validating criteria for selection of medical students[4].

Studies from developing countries like Nepal[2], Pakistan[3,5,6,7,8] ,Sri lanka [9, 10,11] and India[12] have reported predictivity of various  admission criteria based on cognitive attributes like HSC (10+2) scores , entrance tests, interviews etc. for selecting eligible students for medical courses. Some have reported that those who perform well in entrance tests also performed well in professional medical examinations. But heterogeneity in selection processes exists both between and within countries. There are few studies that report bad performance of these selection criteria in selecting students for admission in medical colleges. A recent study in India supports the same finding [12].

Main purpose of this study is to find out efficacy of entrance test- the only selection criteria for admission in this medical institute in selecting students for MBBS course. We also tried to find out correlation between HSC scores, entrance scores and scores in I MBBS examination at our institution. Gender difference in performance of I MBBS University exam was also studied.

**Methods:** This is descriptive retrospective study, carried out in Dr. Punjabrao Deshmukh Memorial Medical College, Amravati. Here students are admitted through - Asso-CET, the entrance test conducted by Association of Managements of Unaided Private Medical and Dental Colleges, Maharashtra (AMUPMDC). The test is totally objective & consists of 200 Multiple Choice Questions (MCQs) from disciplines of Physics, chemistry & Biology. There is no negative marking for wrong answers. Eligibility criteria for entrance test based on performance of students in science subjects at HSC (10+2) or equivalent examination for which the candidate should score minimum 50% Marks (40% for reserved category) in Physics, Chemistry & Biology subjects taken together [13] (14). Admission to Medical College is according to merit list drawn from marks secured in entrance examination.

During first year of MBBS curriculum, every student has to undergo a period of study of pre-clinical subjects (Anatomy, Physiology & Biochemistry) for two semesters, at the end of which I MBBS University examination is held.

We studied four consecutive batches which consist of students who succeeded in getting admission through Asso- CET in academic year 2009, 2010, 2011 & 2012. The study was approved by Institutional Ethical committee. Permission was obtained from the Institute authority to have access to record & documents submitted by the students at the time of admission from student section. Academic performance in I MBBS of each student was recorded for each batch.

Performance of the students was assessed by percentage of scores obtained in I MBBS university examination. However University has also defined eligibility criterion for appearing for I MBBS University examination which includes minimum attendance (75% in lectures & 80% in practicals) and minimum of

35% marks in Internal Assessment examination (Formative assessment) held at college level[14] (15).

Inclusion criteria: All the students who succeeded in getting admission during the academic year 2009, 2010, 2011 & 2012.
Exclusion criteria:
1) Students who didn't appear for Entrance test- Asso-CET & got directly admitted to college through NRI quota.
2) The students who couldn't appear for first year MBBS University examination after completion of two terms because of medical/ personal reasons.
3) Students who were not eligible to appear first year MBBS University examination

The main variables studied -
-Percentage of Combined Score in science subjects- Physics, Chemistry & Biology obtained by students in HSC (10+2) exams (HSC-PCB score);
-Percentage of scores obtained in Entrance Examination (Entrance score);
-Percentage of scores secured by students in first year MBBS University examination at the end of two terms, in 1st attempt ( I MBBS score);Gender distribution was also studied.

Data obtained was entered into excel sheet & using SPSS version-16 the statistical parameters were analyzed. Spearman Rank correlation was used to find Correlation between HSC-PCB score, entrance score & I MBBS score. t-test was used to determine level of significance ($p<0.05$). Also Linear regression analysis and Logistic regression analysis were used to find independent association of various factors.

**Results:** Though 100 students are admitted each year, but sample size of the students in each year varied because students who could not fulfill inclusion criteria were excluded from the study.

Sample size, Mean & SD of percentage of marks obtained by students in various exams– HSC-PCB, Entrance exam & I MBBS are shown in Table 1

**Table 1: Mean & Standard Deviation scores of HSC-PCB, Entrance & First MBBS examination**

| Year | No. of students (n) | HSC-PCB score | Entrance test score | First MBBS score |
|------|---------------------|---------------|---------------------|------------------|
| 2009 | 87 | 71.77 ± 11.09 | 73.86 ± 8.58 | 53.92 ± 8.88 |
| 2010 | 74 | 74.56 ± 10.78 | 82.39 ± 6.78 | 56.03 ± 11.07 |
| 2011 | 84 | 74.06 ± 11.33 | 80.00 ± 6.54 | 59.73 ± 8.78 |
| 2012 | 84 | 75.26 ± 12.08 | 80.98 ± 4.75 | 60.38 ± 7.27 |
| TOTAL | 329 | 73.87 ± 11.37 | 79.16 ± 7.54 | 57.53 ± 9.38 |

**Table 2: Spearman Rank Correlation (r) showing relationship among HSC-PCB, Entrance & first MBBS scores in each batch**

| Year | n | HSC-PCB score – Entrance test score | Entrance score –first MBBS score | HSC-PCB score - first MBBS score |
|------|---|-------------------------------------|----------------------------------|----------------------------------|
| 2009 | 87 | r=-0.098 p=0.367 | r=-0.034 P=0.753 | r=0.529 P< 0.001[**] |
| 2010 | 74 | r=0.007 P=0.954 | r=-0.193 P=0.099 | r=0.499 P< 0.001[**] |
| 2011 | 84 | r=-0.064 P=0.562 | r=-0.028 P=0.799 | r=.674 P< 0.001[**] |
| 2012 | 84 | r=-0.294 P=0.007[**] | r=-0.302 P=0.005[**] | r=0.451 P< 0.001[**] |

*significant(p<0.05)**highly significant (p<0.01)

No significant correlation was seen in between HSC-PCB & Entrance scores as well in Entrance & I MBBS score in batches 2009, 2010 & 2011. On the contrary, in Batch 2012, significant relationship was observed in between HSC-PCB & Entrance score as well in Entrance & I MBBS score but this correlation was negative. Statistically significant positive correlation was seen in between HSC-PCB and I MBBS score in all four batches.

However, on analyzing all four batches together (n= 329), average and standard deviation of score secured by students in HSC-PCB exam, Entrance exam and I MBBS exam were 73.87 ± 11.37, 79.16 ± 7.54 and 57.53 ± 9.38 respectively. Significant positive correlation was seen only between HSC-PCB score & first MBBS score (p<0.001)

(**Figure 1-C**); while Entrance score failed to show any correlation with HSC-PCB score & first MBBS score as demonstrated in scatter diagrams in

**Figure 1-A & 1-B**
**Figure 1: Scatter diagram showing correlation between HSC-PCB & Entrance score (1-A); Entrance & first MBBS score (1-B); HSC-PCB & First MBBS score (1-C)**



1-A

1-B

1-C
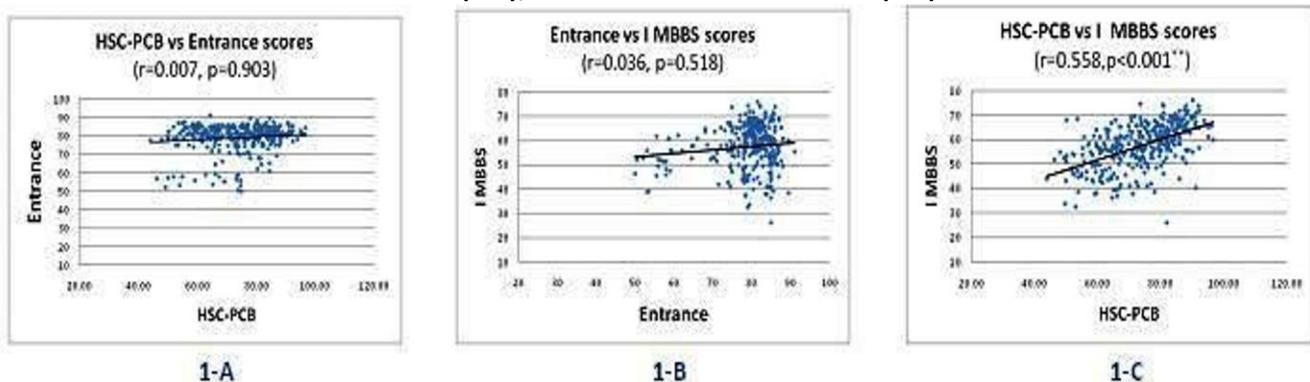
Linear regression model by considering First MBBS score as dependant variable while entrance test and HSC-PCB score as independent variables (**Table 3**), it was found that only HSC-PCB score shown positive significant correlation with First MBBS score ($p<0.001$). Entrance test score did not shown any relationship with First MBBS score.

**Table 3: Linear regression model: Dependent variable - First MBBS score Independent variable- Entrance & HSC-PCB score**

| | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|
| | B | Std. Error | Beta | T | Sig. |
| 1 (Constant) | 21.990 | 5.292 | | 4.155 | 0.000 |
| Entrance score | 0.068 | 0.060 | 0.055 | 1.136 | 0.257 |
| HSC-PCB score | 0.408 | 0.040 | 0.495 | 10.273 | < 0.001 ** |

Out of total students studied (n=329), 179 were males and 150 were females. Their performance at HSC-PCB, entrance & I MBBS level is shown in Figure 2.

**Figure 2: Bar diagram showing Mean & Standard Deviation scores of HSC-PCB, Entrance & First MBBS examination obtained by male & female students**



.
By controlling Entrance & I MBBS scores by regression, it was found that females scored significantly better than males only in HSC-PCB exam, while no significant difference of performance was seen in males & females in Entrance & I MBBS exams. (Table 4)
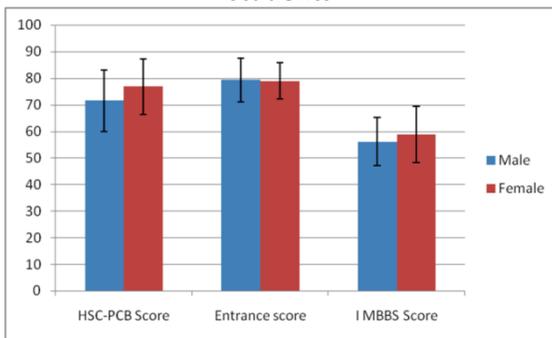
**Table 4: Binary logistic regression dependent variable sex**

| | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|
| Step 1[a] First MBBS | -0.016 | 0.014 | 1.217 | 1 | 0.270 | 0.984 |
| Entrance test | 0.016 | 0.015 | 1.120 | 1 | 0.290 | 1.016 |
| HSC-PCB | -0.038 | 0.012 | 9.876 | 1 | 0.002** | 0.963 |
| Constant | 2.619 | 1.389 | 3.557 | 1 | 0.059 | 13.727 |

a. Variable(s) entered on step 1: First MBBS, Entrance Test, HSC-PCB score.

**Discussion:** Identification of reliable predictors of performance in medical schools is important. It has even been suggested that if 'right' candidates are selected, the majority will become good doctors regardless, or even in spite of, what they are subjected to in their undergraduate programme[15].

The current study assessed the efficacy of preadmission scores i.e., scores of Entrance test (the only selection criteria for selecting the students for admission into this medical college) and scores of science subjects in HSC in predicting students' performance in I MBBS professional examination. Both of these criteria were purely cognitive one.

It is evident from the result of I MBBS professional examination that scores of HSC-PCB strongly correlate with performance of students in I MBBS professional examination in all batches, thus revealing high predictive value of HSC-PCB scores in selecting candidate for MBBS.

However the Entrance test does not show any correlation either with HSC-PCB Score or with performance of students in I MBBS in 1st 3 batches (2009, 2010 & 2011) we studied. This observation clearly shows that getting higher percentage in HSC-PCB does not assure success in getting admitted to medical college through current system of Entrance examination. Also those who secured higher percentage / top ranks in Entrance need not do well in I MBBS professional examination. Similar finding was seen when we analyzed data of all 4 batches combined.

However we observed significant negative correlation of entrance test score with HSC-PCB scores and I MBBS scores in 4th batch we studied (Batch 2012). It is

difficult to find explanation for this. Bhatti M A also reported moderate negative correlation of Entry test with first and second year marks suggesting that there is no significance of having Entry test and its effect on student's future performance[3].

Also, on linear regression by considering First MBBS score as dependent variable, entrance test score did not show any relationship with First MBBS performance. Only HSC-PCB scores showed positive significant correlation with I MBBS score.

In contrast to our findings where science scores at HSC were better predictors of success in Medical Examinations than Entrance test scores, el Mouzan observed that performance on the admission test was a better predictor than high school grades in the first two levels of the medical curriculum[16]. Neame RL et al

in his study stated that there is no significant correlation between outcome and levels of prior academic achievement, and their study did not support selection of medical students in University of Newcastle Medical School only from recent school-leavers who have studied science[17].

N. Huda et al concluded none of the selection criteria (SSC, HSC, ZMU test- the entrance test and interview) predict the performance of the medical students in the professional examinations[6].

On the other hand, Mawhinney B S and Eamonn Ferguson et al in their study advocated the usefulness of O (ordinary) and A (Advance) level British school leaving examination results as predictors of a student's ability to pass pre-clinical examinations in anatomy, physiology and biochemistry[18,19].

Niraula S. R. & Khanal S.S. observed average MBBS score was not dependent on either high school or entrance examination scores, but correlated with intermediate level in science score [20]. Bhatti M A in his study observed that FSC (10+2) results (not the entry test marks) had positive association with 1st & 2nd MBBS results. The study also depicted that the entry test had no statistical significance or superiority on FSC[3]. Neelima Gupta et al concluded prior academic achievement (marks in class XII) was a good measure of subsequent performance in the medical course. All these studies failed to prove significance of entrance test in selecting candidates for Medical course and showed significant association between science scores in HSC (10+2) level and performance in medical colleges especially during pre-clinical years as seen in our study.

This may be due to difference in assessment pattern of current system of Entrance examination and MBBS professional examination. I MBBS professional examination consists of theory and practical examination. Theory examination consists of MCQs, LAQs (Long Answer Questions) & SAQs (Short Answer Questions). All these combination of assessment tools can test higher levels of cognitive domains. Psychomotor & Affective domains are tested by Practical examination. On the other hand, Current system of Entrance Examination is purely objective assessment having 200 Multiple Choice Questions (MCQs) [13]. In India, MCQs have been commonly used for undergraduate and postgraduate medical entrance

& university examination due to logistic advantage of being able to test large number of candidates in a short period of time and with a minimal human intervention. The acceptability of MCQ due to this reason has made it a preferred tool of written assessment across most academic disciplines[21]

.Despite all these advantages, it only tests recall ability of the students, may fail to test higher order cognitive thinking. It also ignores aptitude and other characteristics; these are characteristics that make a good medical practitioner [22, 23, 24].

Reports suggest that results of MCQ-based selection tests can be influenced by factors such as non-familiarity with MCQs and guess-work; moreover, they may not test what they purport to test [25, 26, 27].

The students read into MCQ more than their authors intended[28]. Literature reports that selection procedure entirely based on a single type of assessment tool-MCQs did not assess applicant's learning skills or ability to succeed in new style of curriculum[29].

So if prior academic achievement specially science subjects scores in HSC are also given weightage in addition to entry test marks for admission into medical colleges, it could be better predictor of performance of students in medical course as seen by el Mouzan[16]; and Baig LA[29] in their studies.

However, selection criteria based on purely cognitive tools do not predict the performance in the final years, which is where the exit competencies are acquired by the graduates necessary for practicing medicine [16, 29, 30].

Preadmission grades and examination scores reflect only the ability to memorize isolated facts and such students may be found quite incompetent in many vital areas essential for a medical doctor[31] (34). Collins JP et al stated that Selection of medical students on the basis of academic criteria alone is inadequate and should be accompanied by assessment of personal qualities [32](32).

The Edinburgh Declaration(1988) has also suggested to "employ selection methods for medical students which go beyond intellectual ability and academic achievement, to include evaluation of personal qualities" as one of the improvements to be made

within the medical school itself for producing doctors who will promote the health of all people [33].

To be a successful medical student; and ultimately an effective and competent doctor, a prospective student needs to possess a range of non-cognitive skills, qualities and positive attitudes along with the academic ability[31].

Further studies need to be conducted to ascertain how and which non-cognitive characteristics influence medical student performance in a medical school curriculum.

Various non-cognitive characteristics, personality domains & skills have been suggested by researchers as the predictors of success in medical course. These include conscientiousness[19], reading skills [30]; motivation, communication skills, problem-solving ability and empathy[34].

A valid instrument for testing the positive attributes, which could predict good performance of medical students, should be designed. We need to find evidence of such or other criteria in our medical education.

An attempt was made to see whether there was any gender relationship in performance in various examinations. From results we obtained, it was clear that females performed significantly better than males in HSC-PCB but no difference in performance was seen in Entrance & I MBBS exam (**Table 4**). Similar finding that all the medical students are equally capable irrespective of gender was observed in other studies by James D & Chilvers C and Ferguson E [35,19]. In contrast to this, some researchers observed that females perform better in medical courses than male students [9, 11, 36, 37, 38].

**Limitations:** Non-availability of data prevented assessment of two factors that could be of importance as predictors of success in medical schools: number of attempts at the ASSO-CET Entrance examination and proficiency in English. The latter is likely to be of importance because all teaching in medical schools is conducted in English, whereas some of our students from states other than Maharashtra had their secondary education and HSC examination in Hindi.

**Conclusion:**The efficacy of ASSO-CET entrance test which was only selection criteria in this medical college was not appropriate for selecting the students, suggesting that entrance test needs revision. Either the test should be modified or several selection tools should be combined, so as to select the optimum standard students.

Our institution has switched to State Level Entrance Test: MH-CET for selecting the students for medical course. We need to assess efficacy of present selection criteria in predicting performance of students not just in preclinical years but also throughout the medical course

Score of science subject at HSC level was good predictor of the performance of students in medical college, we suggest to incorporate this into selection criteria.

But still, relying on a cognitive domain alone is not sufficient. Tools that assess non-cognitive characteristics, skills & personality still need to be identified and incorporated in selection criteria. At the same time, they should be valid, reliable, cost effective and less time consuming.

This study is restricted to single medical college. It would be beneficial if similar studies are carried out in different institutions using different selection criteria.

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