



## Comparison and Prediction of Preclinical Students' Performance in the MBBS Stage I Examination at the University of the West Indies, Mona Campus

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**Summary:** This retrospective study involved the analysis of the grades of ninety-four preclinical students who took the Bachelor of Medicine and Bachelor of Surgery (MBBS) Stage I Examination in Anatomy, Biochemistry, Physiology, Social and Preventive Medicine, and Pharmacology between December 1997 and May 1999 at the Mona Campus of The University of the West Indies (UWI). A statistically significant correlation was observed among the basic science subjects. Additionally, a statistically significant prediction was found between the performances of the students in one discipline and the others, with Physiology being the most predicted. The data support the hypothesis that students who performed well in one discipline were likely to perform well in the other disciplines; and also that the performance in some subjects could predict the performance in others. This result may also justify further investigation as to whether the performance in certain basic sciences disciplines at the preclinical stage can be used to predict performance in the clinical disciplines.

**Keywords:** Medical education, Students assessment, Basic sciences, Grades, Correlation.

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### INTRODUCTION

The curriculum at medical schools consists of a variety of courses emphasizing different academic skills. The anatomical sciences emphasize memorization and the ability to identify the location of structures in relation to other structures. Pathophysiology, in contrast, emphasizes the mechanism of diseases and the interpretation of clinical signs and symptoms. Although there are students who are consistently strong (or weak) in all courses, the relationship of grades among the preclinical courses is poorly understood.

Before the introduction of the new integrated, systems-based curriculum in September 2001 at the Faculty of Medical Sciences of The University of the West Indies (UWI), Mona Campus, the Basic Medical Sciences included courses in Social and Preventive Medicine, Biochemistry, Anatomy, Physiology and Pharmacology, which were taught as separate disciplines and examined at various times in the Bachelor of Medicine and Bachelor of Surgery

(MBBS) Stage I Examination. The MBBS Stage I examination is equivalent in content and scope to the USMLE Step 1 examination and was the final examination taken at the preclinical level before students proceeded to the last three years of their clinical training or the MBBS Stage II. Social and Preventive Medicine was the first examination offered in December 1997 at the end of the first semester, followed by Biochemistry in May 1998 at the end of the second semester. Anatomy and Physiology were examined in December 1998 at the end of the third semester, while Pharmacology was examined in May 1999 at the end of the fifth semester (Alleyne et al, 2002).

Previous studies had reported significant correlation for scores in Biochemistry, Pharmacology and Anatomy (Hamdi et al, 2000), Biochemistry and Pharmacology (Kwanashie and Abdu-Aguye, 1990) and Anatomy, Physiology and Biochemistry (Salahdeen and Murtala, 2005), respectively. The performance of students in the basic medical sciences can be used as a predictor of clinical science

performance (Lavine and Watkins, 1999) as well as predictors of performance in licensure examinations (Baker et al, 2006; Donnelly et al, 1986; Hyde et al, 1987; Swanson et al, 1996; Wilkinson and Frampton, 2004). Unlike the USMLE Step 1 examination, which is administered during a single day, the MBBS Stage I examination at UWI was staggered over a five semester period, and requires passing of each component before moving into the clinical years.

We hypothesized that students who performed well in one discipline were likely to perform well overall in the MBBS Stage I examination. The present study was therefore designed to investigate the correlation among the basic science disciplines, if any; and predictive ability of the different subjects taken in the MBBS Stage I examination at the Mona Campus of the UWI.

### MATERIALS AND METHODS

This is a retrospective study involving 94 preclinical students who took the MBBS Stage I examination between December 1997 and May 1999. The study was approved by the Ethics Committee of the Faculty of Medical Sciences, UWI at the Mona Campus. Data were collected from records in the Department of Basic Medical Sciences. Confidentiality was maintained as there was no disclosure of the names of the students from whom the data were derived.

The examinations consisted of both multiple choice and open-ended essay questions with a *viva voce* examination for the students who were on the pass/fail borderline (i.e. achieving a score of between 45% - 49%) and those on the borderline for honors (achieving a score of between 60% - 64%) and distinction (achieving a score of between 70% - 74%). The Social and Preventive Medicine examination lasted two and a half hours and consisted of a multiple choice question (MCQ) paper with 30 questions and an essay paper with 6 questions, where students were expected to answer any 4 questions. The Biochemistry examination also had a MCQ paper with 150 questions with duration of 3 hours and an

essay paper with 6 questions from which students were expected to answer any 4 questions in 3 hours. The Anatomy examination had a MCQ, an essay and a practical component. The MCQ paper had 150 questions with duration of 2 hours, while the essay paper had 5 compulsory questions to be answered within 3 hours. The practical examination was made up of 30 spotters in gross anatomy, 20 spotters in histology and 10 organ slides for identification/diagnosis with duration of 2 hours. The Physiology examination had an essay paper with 6 questions from which the students were expected to attempt any 5 in 2.5 hours, as well as, a MCQ paper with 150 questions with duration of 3 hours. The Pharmacology examination consisted of a MCQ paper with 40 questions to be answered in 30 minutes and an essay paper with 4 questions from which students were expected to answer any 3 in 2.5 hours.

### Statistical Analysis

The data were analyzed using the SPSS Statistical package for means, standard deviation, Pearson's correlation, chi-squared test, ANOVA and stepwise multivariate regression analyses with the level of statistical significance taken at the level of  $p < 0.05$ .

### RESULTS

A total of 94 students sat the Social and Preventive Medicine examination in December 1997, only 89 students sat the Biochemistry examination in May 1998. The remaining five students already had B.Sc (Hons) degrees in Biochemistry and were given exemption. In December 1998, 93 students sat for the Anatomy examination and 92 students took the Physiology examination. There were also 92 students who sat for the Pharmacology examination in May 1999, completing the MBBS Stage I examination period. The mean scores, ranges and number of students who passed (i.e. obtained a grade of 50% - 64%), had honors (65% - 74%) and distinctions (75% - 100%) and those who failed (scored less than 50%) are shown in Table 1. There was a statistically

Table 1: Grades Achieved in the MBBS Stage I Examination in Social and Preventive Medicine, Biochemistry, Anatomy, Physiology and Pharmacology

	Mean ± SD (Range) %	Pass (50% – 64%)	Honors (65% – 74%)	Distinction (75% – 100%)	Fail (0% – 49%)
Social and Preventive Medicine (N=94)	59±6.36 (45 – 75)	73*	18	1	2
Biochemistry (N=89)	58.12±9.47 (30 – 76)	50	23	3	13
Anatomy (N=93)	55.66±11.91 (22 – 76)	65	10	2	16
Physiology (N = 92)	55.36±7.01 (48 – 72)	62	13	2	15
Pharmacology (N = 92)	62.42±9.38† (40 – 84)	40	37	6	9

\* $\chi^2=50.659$ ,  $p<0.001$ ; †  $p < 0.001$  (ANOVA)

Table 2: Correlation Matrix of Scores Obtained in Social and Preventive Medicine, Biochemistry, Anatomy, Physiology and Pharmacology

	Social and Preventive Medicine	Biochemistry	Anatomy	Physiology	Pharmacology
Social and Preventive Medicine	-----	r = 0.637 p = 0.01	r = 0.440 p = 0.01	r = 0.627 p = 0.001	r = 0.588 p = 0.01
Biochemistry	r = 0.637 p = 0.01	-----	r = 0.660 p = 0.01	r = 0.767 p = 0.01	r = 0.747 p = 0.01
Anatomy	r = 0.440 p = 0.01	r = 0.660 p = 0.01	-----	r = 0.742 p = 0.01	r = 0.654 p = 0.01
Physiology	r = 0.627 p = 0.01	r = 0.767 p = 0.01	r = 0.742 p = 0.01	-----	r = 0.723 p = 0.01
Pharmacology	r = 0.588 p = 0.01	r = 0.747 p = 0.01	r = 0.654 p = 0.01	r = 0.723 p = 0.01	-----

Table 3. Predictors of Scores Obtained in Social and Preventive Medicine, Biochemistry, Anatomy, Physiology and Pharmacology using a stepwise multivariate regression analysis

Dependent Variable	Predictors	Beta-coefficient	p - value
Social and Preventive Medicine	Physiology	0.373	0.001
	Biochemistry	0.339	0.008
Biochemistry	Physiology	0.372	0.001
	Pharmacology	0.369	0.001
Anatomy	Social and Preventive Medicine	0.170	0.048
	Physiology	0.432	0.001
	Pharmacology	0.357	0.002
Physiology	Biochemistry	0.275	0.008
	Pharmacology	0.241	0.020
	Anatomy	0.271	0.002
Pharmacology	Social and Preventive Medicine	0.201	0.013
	Physiology	0.320	0.004
	Biochemistry	0.362	0.001
	Anatomy	0.222	0.019

significant ( $p < 0.001$ ) variation in course grades, with Physiology having the lowest average grade (55%) and Pharmacology having the highest average grade (62%). Anatomy had the highest percentage of failures (17%) with Social and Preventive Medicine having the lowest percentage of failures (2%) ( $\chi^2 = 50.659, p < 0.001$ ).

Table 2 shows the correlation matrix of scores in all the subjects. They were all significantly correlated with one another. The predictive values of the subjects using a stepwise multivariate analysis are shown in Table 3. Grade in Social and Preventive Medicine was significantly predicted by the grades in Biochemistry and Physiology. Grade in Biochemistry was significantly predicted by the grades in Social and Preventive Medicine, Physiology and Pharmacology. Grade in Anatomy was significantly predicted by the grades in Physiology and Pharmacology. The grade in Physiology was significantly predicted by the grades in the other four basic sciences while the grade in Pharmacology was significantly predicted by the grades in Biochemistry, Anatomy and Physiology.

## DISCUSSION

The education of physicians is a long, expensive process, with students assessed at multiple points. Each assessment can provide an indication of the likelihood of success during the next phase of training (Reede, 1999). Entry criteria can be used to predict success in the preclinical curriculum (Mitchell, 1990) and preclinical grades can be used to predict success in the clinical curriculum (Baciewicz, 1990). Similarly, clinical grades used to predict success in residency training, and residency performance used to predict success as a physician. In addition to coursework, there are often national or regional licensing examinations, which provide additional points of assessment (Baker et al, 2006; Donnelly et al, 1986; Swanson et al, 1996; Yergan et al, 1988). This study focused on only the correlation of grades obtained within the preclinical curriculum, and their ability to predict the performances in these subjects.

A statistically significant correlation among the basic science disciplines was also observed in the

present study. These results support the observations of previous reports (Hamdi et al, 2000; Kwanashie and Abdu-Aguye, 1990; Salahdeen and Murtala, 2005) that identified significant correlation in the performance of students between two or more preclinical disciplines. Previous studies however investigated these correlations in only some of the preclinical subjects at a time, whilst this present comprehensive study examined all five preclinical subjects taken by the same cohort of students who sat the MBBS Stage I examinations.

The most important finding from this study was the variation in the predictive correlation among the grades in the different basic science courses. The performance in Physiology was significantly predicted by the other 4 basic sciences, while Pharmacology and Biochemistry scores were significantly predicted by 3 other courses. Social and Preventive Medicine and Anatomy were each significantly predicted by 2 courses.

The predictive relationship does not appear to be related to the timing of the examinations in the curriculum. The Social and Preventive Medicine examination, predictive of two other courses, was the first in the sequence. The Anatomy grade, also predictive of two other courses, occurred in the middle of the curriculum, at the same time as the Physiology examination.

Previous studies (Lavine and Watkins, 1999; Wilkinson and Frampton, 2004) had reported that performance in the some basic science disciplines can predict the outcome of the clinical science disciplines. Based on these reports, it might be worthwhile to investigate in those medical schools that still utilize a discipline-based curriculum, if the performance in specific basic science disciplines at the preclinical stage can predict the performance in the clinical science disciplines.

In summary, medical students performance in one subject significantly correlated with the performance in the other subjects, and can also predict the performance in some of these subjects. These predictive values, if they can be extrapolated to the performance in the clinical years, could be used to identify students at risk for early intervention of appropriate academic support.

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