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Pre-admission Grades And Student Performance: The Malaysian Medical School Experience

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ABSTRACT

Prior academic achievement is often considered the best predictor and therefore the preadmission criteria for highly competitive medical schools. Most studies that advocate this viewpoint analyzed cohorts based on results of a central examination taken by students who come from various pre-university setups and backgrounds. Far less is known about students who come from a common setup, sit for common assessments, and the effect on their achievement in medical schools. This study sets out to investigate the correlation and association of preadmission grades and various summative results during preclinical year medical program. The association of the whole group is investigated. The association of subgroups (low, intermediate, and high achievers) to preclinical achievement was also investigated to get insight about the consistency. As a group, the pre-university performance (especially in natural sciences) has moderate to high correlations to various results in preclinical phase. As subgroups: low achievers are less consistent and predictable; high achievers are best correlated to various results of preclinical phase; while intermediate achievers are in between. The cumulative grade point and performance in natural sciences in a common pre-university program can serve not only as a predictor of performance, but also as an indicator for consistency of performance in preclinical phase of medical programs. This information may be of use to medical school admission and selection committees.

Keywords: Pre-University Grades; Preclinical Performance; Correlation; Academic Performance

1.0 INTRODUCTION

Preadmission requirement to medical schools varies across the world. Some countries require an undergraduate degree such as Bachelor of Science or Bachelor of Arts, some other nations need post high school certificates such as A-level or International Baccalaureate (IB), while some other systems only require high school certificates. Although varies in nature but all medical schools share a common admission criteria – only best performers are selected. Cognitive domain such as academic achievement remains an utmost important consideration though affective domain such as attitude and empathy are considered.

Studies regarding the correlation and association values between preadmission grade and performance in medical school give conflicting result across the world. However, A-level generally has weak correlation to the classification of degrees including medical degree (Sharban and McLean, 2011; Yates et al., 2009; James et al., 2010; Afolabi et al., 2007; Ghafar, 1997). Similarly various entrance examinations such as UKCAT, MCAT, BMAT, and GAMSAT are generally weak predictors for performance in medical school (Emergy and Bell, 2009; Lynch et al., 2009; Groves et al., 2007; Arulampalam et al., 2007). The findings may give a true picture of the school or schools understudied but they overlook the fact that students come from various preparatory backgrounds although they are admitted based on similar certification. Students may have taken a common examination but the training was done in rural or urban schools, single gender or co-ed schools, or taught by experienced or inexperienced teachers. Authors could not find previous literature based on a common preparatory setup. However,

a few works show that performance in preceding years of a study program is a good predictor for the coming year's achievement (Groves et al., 2007; Hissbach et al., 2011; Ghafar, 1997).

Due to competitive admission criteria, medical schools normally consist of students with homogeneously high preadmission grades. This factor contributes to earlier findings of weak predictability. A medical school with wider range of preadmission score gives better opportunity to investigate correlation, association, and predictability of the multi-phases medical training.

Typical pre-university programs give less emphasis on communication skill. Most established entrance examinations give no grades in English or other communication related subjects. Therefore, correlation of communication skill to academic performance in medicine is much less studied area. In fact there is no evidence that established entrance examinations predict existence or acquisition of communication skills. Typically, it is not until the clinical year in traditional medical curricula that this skill can be assessed (White et al., 2009).

This study intended to fill in the above gap. It investigates to what extend preadmission grades correlate and associate various summative results during preclinical year medical program of students who come from a common pre-university program. In addition, it investigates do students perform consistently at the next level of study? It is hoped that the findings will help schools to identify best candidates among those highly competent candidates. Only the correct most students can embark into expensive, rigorous, and long training to become health care professionals.

2.0 METHOD

2.1 Background

The study was done on medical students in Cyberjaya University College of Medical Sciences (CUCMS). The university is a private university in Malaysia that trains students in health related degree programs. Students in medical program at the university go through four stages of education namely: high school, pre-university, preclinical, and clinical in order to graduate with the Bachelor of Medicine and Bachelor of Surgery (MBBS) degree.

High school exit examination consists of at least 2 languages (Malay and English) and 5 sciences (mathematics, additional mathematics, physics, chemistry, and biology). It forms the preadmission criteria to pre-university programs. Pre-university curriculum consists of Mathematics, Chemistry, Biology, and/or Physics as major courses. Typically it also has supplementary courses such as English and Information Technology. Cumulative Grade Point Average (CGPA) of the pre-university is the preadmission criteria to the preclinical phase.

The 2 years of preclinical study is heavily science based. It offers 20 introductory subjects: Anatomy, Behavioural Sciences, Physiology, Molecular Basis of Medicine Nutrition (MBMN), Pathology, Community and Health Exposure Training (CHET), Medical Microbiology and Immunology (MMI), Pharmacology, Cardiovascular System, Musculoskeletal System, Endocrinology, Haematology, Reproductive System, Nervous System, Gastrointestinal System, Respiratory System, Urinary System, Infectious Diseases, Public Health, and Disaster and Relief Medicine. Performance in each subject, CGPA of preclinical phase, and a professional examination at the end of the preclinical years are the admission gauge for the clinical phase.

Finally, the overall performance of preclinical and clinical phases together with professional examination result determines their success in MBBS degree. Table 1 summarizes this education pathway from high school to MBBS degree.

Table 1: Education pathway from high school to MBBS degree

	High School	Pre-university	Pre Clinical	Clinical
Duration	5 years	3 semesters	4 semesters	6 semesters
Product	# of As	CGPA	CGPA after 4 sem.	CGPA after 10 sem.

2.2 Participants

364 medical students who successfully completed preclinical phase in 2009, 2010, and 2011 were considered in this study. They came from 3 major pre-university backgrounds: inbred CUCMS owned Foundation in Science, ministry of education owned Matriculation colleges, or internationally recognised A-level programs. However, only results of students who came from the Foundation in Science were considered in this study. Data of 3 cohorts with a total of 148 students (61 males and 87 females) were used in the study.

2.3 Procedure

Results of the pre-university (i.e. Foundation in Science) and preclinical years were supplied by the university. The following analyses were done on the data set,

i) correlation analysis between pre-university and preclinical results,
ii) profiles of low, intermediate, and high achievers of the pre-university performance to average score in preclinical performances, and
iii) reliability test in the form of Cronbach's alpha internal consistency was employed to complement the above findings.

However, only Foundation elements that correlated to many preclinical components were chosen to go through the analyses (ii) and (iii).

3.0 STATISTICAL ANALYSIS

Since the data was not normally distributed and the result in preclinical was not continuous, Spearman's correlation with significance level of $P<0.01$ (indicated by **) or $P<0.05$ (indicated by *) was employed to identify correlation between grades. Correlation coefficient r was therefore given. Guidelines to interpret correlation coefficient r by Harris and Taylor (2004) were used: r=0-0.2 as 'very low and probably meaningless', r=0.2-0.4 as 'a low that might warrant further investigation', r=0.4-0.6 as 'reasonable correlation', r=0.6-0.8 as 'high correlation', and r=0.8-1.0 as 'very high correlation that might warrant further checking for errors'.

Cronbach's alpha reliability test was also employed to determine the internal consistency or average correlation of items. This reliability test is especially important when derivative variables are intended to be used for subsequent predictive analyses. There are different reports about the acceptable values of alpha ranging from 0.70 to 0.95 (Cronbach, 1951; Nunnaly, 1978; Santos, 1999; Tavakol and Dennick, 2011; Sijtsma, 2009).

4.0 RESULTS

4.1 Matrix of Pre-University and Preclinical Performances

Table 2 tabulates the correlation coefficients of association between Foundation in Science elements and preclinical components. Natural science subjects and overall performance in the Foundation showed reasonable or high correlation to many preclinical subjects. Physics had such correlation to 10 preclinical components; Chemistry had such correlation to 16 preclinical components; Biology had reasonable or high correlation to 14 preclinical components; while CGPA Foundation had the highest number of such correlation i.e. to 17 of 21 preclinical components.

However, two more Foundation elements i.e. Mathematics and English were reasonably associated to only 1 and 2 preclinical components respectively.

On the other hand, three preclinical components did not have reasonable or higher correlation with any Foundation element. They were Community and Health Exposure Training (CHET), General Pharmacology, and Disaster and Relief Medicine.

Table 2: Correlation of pre-university and preclinical performances (darker background indicates higher correlation)

Foundation / Preclinical	Physics Average	Chemistry Average	Biology Average	Math. Average	English Comm.	CGPA Foundation
General Anatomy	.390(**)	.507(**)	.457(**)	.352(**)	.259(**)	.519(**)
Behavioural Science	.328(**)	.373(**)	.466(**)	.123	.423(**)	.467(**)
Intro to Physiology	.403(**)	.428(**)	.385(**)	.285(**)	.328(**)	.501(**)
MBMN	.513(**)	.552(**)	.539(**)	.349(**)	.284(**)	.583(**)
General Pathology	.494(**)	.515(**)	.508(**)	.368(**)	.397(**)	.600(**)
CHET	.050	.222(**)	.123	.258(**)	.272(**)	.311(**)
MMI	.349(**)	.420(**)	.411(**)	.369(**)	.217(**)	.455(**)
Gen. Pharmacology	.289(**)	.368(**)	.309(**)	.234(**)	.199(*)	.387(**)
Cardiovascular Sys.	.512(**)	.627(**)	.530(**)	.376(**)	.282(**)	.602(**)
Musculoskeletal Sys.	.367(**)	.463(**)	.496(**)	.293(**)	.236(**)	.470(**)
Endocrinology Sys.	.469(**)	.514(**)	.532(**)	.281(**)	.286(**)	.552(**)
Haematology	.383(**)	.482(**)	.459(**)	.275(**)	.181(*)	.450(**)
Reproductive System	.321(**)	.434(**)	.393(**)	.203(*)	.252(**)	.428(**)
Nervous System	.356(**)	.417(**)	.320(**)	.286(**)	.205(*)	.434(**)
Gastrointestinal Sys.	.462(**)	.499(**)	.548(**)	.335(**)	.280(**)	.555(**)
Respiratory System	.338(**)	.424(**)	.499(**)	.200(*)	.333(**)	.429(**)
Urinary System	.413(**)	.468(**)	.434(**)	.300(**)	.230(**)	.453(**)
Infectious Disease	.435(**)	.470(**)	.513(**)	.299(**)	.254(**)	.469(**)
Public Health	.402(**)	.348(**)	.372(**)	.284(**)	.147	.363(**)
Disaster Relief Med.	.109	.174(*)	.057	.134	.265(**)	.182(*)
CGPA preclinical	.556(**)	.631(**)	.605(**)	.400(**)	.405(**)	.672(**)

*P<.05, **P<.01, two tailed.

4.2 Profile of Pre-University and Average Preclinical Performance

The group was divided into subgroups of low, intermediate, and high achievers in each of Physics, Chemistry, Biology, and CGPA Foundation performance. The low, intermediate, and high achievers represented bottom 33%, middle 34%, and top 33% of student performance respectively in each category. Take note that these subgroups did not consist of the same students throughout the subjects. Profiles against each subgroup's average performance in preclinical subjects were investigated. The findings are given in Figures 1, 2, 3, and 4.

Physics performance with respect to the average preclinical performance (Figure 1) confirmed the earlier correlation and showed consistency. Those with higher correlation distributed accordingly as in MBMN, Cardiovascular Systems, and preclinical CGPA. On the other hand, those with very low correlation distributed awkwardly as in CHET, General Pharmacology, and Disaster and Relief Medicine. Students remain in the same subgroup when they are in preclinical stage especially for the courses with higher correlation.

Cronbach's alpha showed consistency in measuring Physics and preclinical performances for each subgroup. The low, intermediate, and high achievers have alpha coefficient of 0.88, 0.93, and 0.94 respectively.

Chemistry performance with respect to average preclinical performance (Figure 2) strengthened the finding of correlation and showed consistency. Those subjects with moderate or high correlation gave profiling graph accordingly. But it was not the case for low and very low correlations as in CHET, General Pharmacology, and Disaster Relief Medicine.

Generally, students performed consistently. They remain in the same subgroup when they are in preclinical stage especially for the courses with higher correlation. Interestingly, the intermediate subgroup's graph line was generally closer to the low subgroup than to the high achievers subgroup.

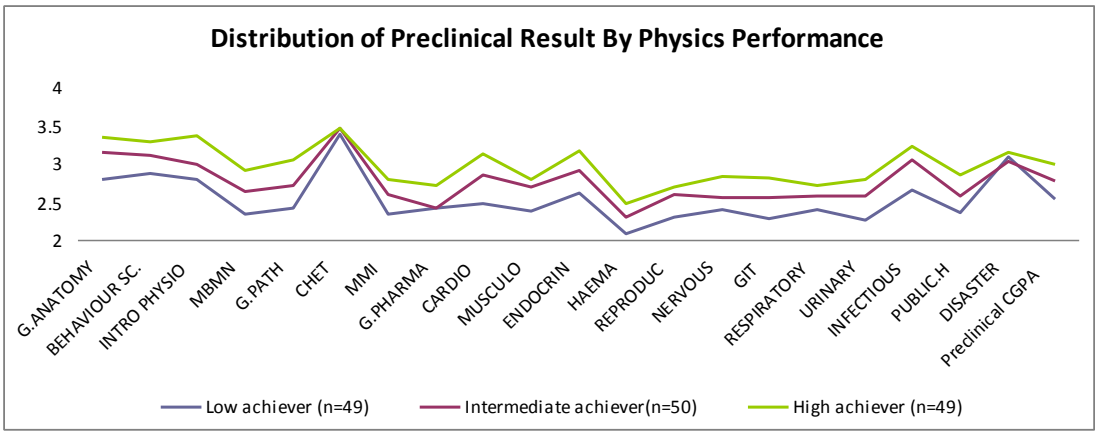

Figure 1: Profiles of low, intermediate, and high achievers in Physics with average scores in preclinical performance

Consistency of performance in Chemistry and preclinical courses for all subgroups was compared by using Cronbach's alpha coefficient of internal consistency. The internal coefficient reliability for low, intermediate, and high achiever subgroups was 0.90, 0.94, 0.94 respectively.

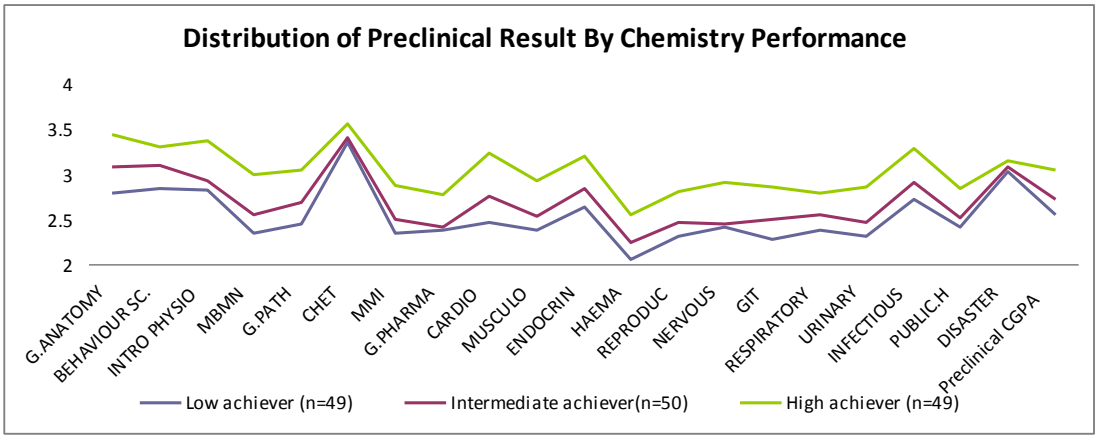

Figure 2: Profile of low, intermediate, and high achievers in Chemistry with average scores in preclinical performance

The profiles of Biology performance with respect to the average preclinical performance (Figure 3) were consistent with previous findings. As in Chemistry, the Biology intermediate subgroup's graph line was generally closer to the low subgroup than to the high achievers subgroup.

Cronbach's alpha showed consistency in Biology and preclinical performance for all subgroups. The low, intermediate, and high achiever subgroups have internal consistency reliability of 0.88, 0.94, 0.94 respectively.

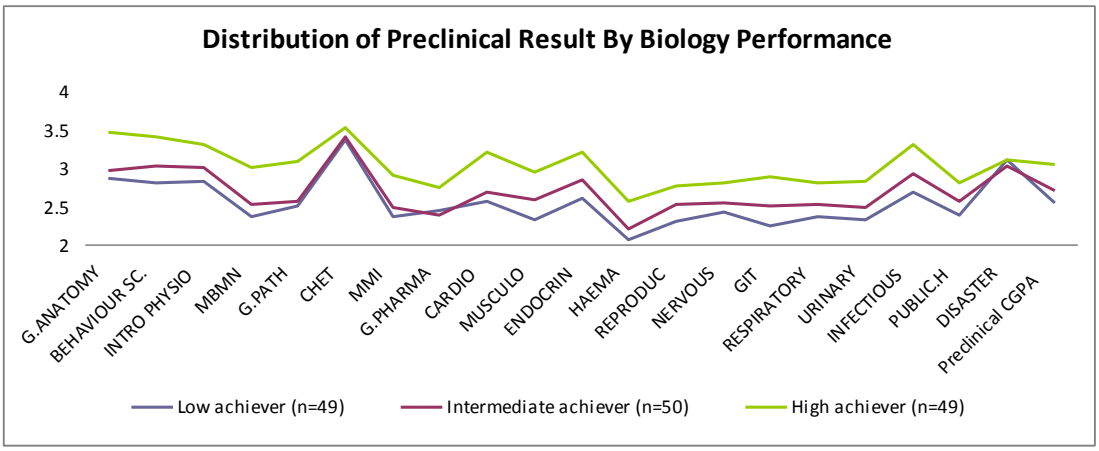

Figure 3: Profile of low, intermediate, and high achievers in Biology with average scores in preclinical performance

Similarly, the profile of CGPA of Foundation (Figure 4) validated the earlier findings. Cronbach's alpha coefficient for low, intermediate, and high achiever subgroups is 0.89, 0.94, and 0.92 respectively. This showed internal consistency in the performances through the pre-university and preclinical stages.

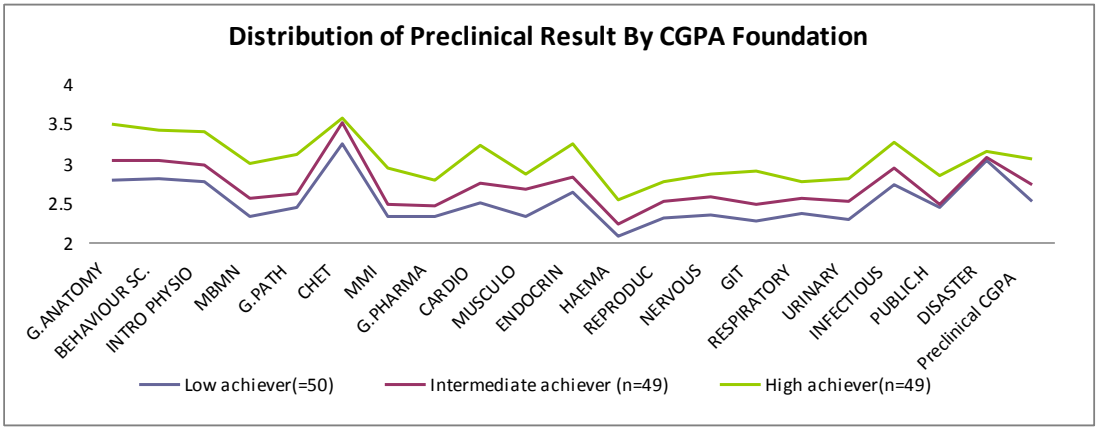

Figure 4: Profile of low, intermediate, and high achievers in CGPA Foundation with average scores in preclinical performance

Figures above and complemented by Cronbach's alpha internal consistency coefficients show that the low, intermediate, and high achievers in Foundation stay consistent according to average score of each subject in preclinical performance particularly in subjects with high correlation. There were instances where low and intermediate achiever subgroups cross each other in non-cognitive-related subjects such as Community and Health Exposure Training (CHET), Public Health and, Disaster and Relief Medicine. However, this is consistent to the correlation analyses earlier.

5.0 DISCUSSION

As a whole the inbred pre-university program (in this case the Foundation in Science) has good correlation and association to preclinical performance. The natural science subjects and especially the overall results at the pre-university level are good indicators to performance at preclinical stage. This result suits the concept idea of the establishment of the Foundation in Science program. It is meant to prepare students to pursue studies in medicine and health related degree programs in the university. It also supports the university admission policy which includes the CGPA of pre-university level as the main criteria.

Preadmission performance from inbred preparatory program is much better indicator to achievement in preclinical phase compared to previous studies of conventional pre-university preparations (Sharban and McLean, 2011; James et al.; 2010; Afolabi et al.; 2007; Ghafar, 1997, Yates et al., 2009; Emergy and Bell, 2009; Lynch et al., 2009; Groves et al, 2007; Arulampalam et al., 2007; Wimmers, 2006). Chemistry, Biology, and especially the overall performance in inbred pre-university are good indicators to overall performance in the preclinical stage. As an inbred pre-university program the curriculum development and teaching implementation are suggested and influenced by the receiving faculties. The results show some degree of success in assimilating and preparing students for their future undertaking in the faculty of medicine.

This limited study provides evidence of low association between communication skill and heavily science based preclinical academic performance. Communication skill provided by the English element in the pre-university surprisingly correlates to limited subject in preclinical. It has an association to a component that covers psychological theories and human behaviours that typically involve declarative knowledge presentation and group discussion. Possibly, higher correlation will prevail in clinical stage later when a lot more interaction between students and patients as well as instructors is required.

Students perform consistently throughout the two stages. Students in low, intermediate, and high achiever subgroups in the inbred Foundation stay in the same respective profiles when they are in preclinical stage across subject matters and overall performance. Even though there are some minor inconsistency in lower achiever subgroups, high achievers in the Foundation level maintain the status quo throughout the preclinical stage be it in cognitive or non-cognitive subjects. It can be concluded from the subgroups' data and the Cronbach's alpha coefficients that level of consistency of performance is related to level of preadmission performance.

This indicates that higher achievers adapt better to the next level of study in medical curriculum. Lower achievers however, do not adapt that well. The transition of curriculum does not push them higher. This group requires special treatment in whatever forms to trigger them to better performance. It can be teaching approach, learning approach, syllabus reshuffle, or injection of other elements cognitively or affectively. A lot of emphasis has been put on cognitive domain in curriculum but affective domain is equally important in producing well balance products (Hyland, 2011; Moulaert et al., 2004; Yates et al., 2009). Therefore, affective domain is an area worth to explore.

Cognitive and affective curriculum runs together in multi-stages of medical training. However, this study is limited up to the preclinical stage. It is exciting to see evidence of correlation and association between pre-university and clinical, as well as preclinical and clinical. Is the consistency preserved throughout the stages? On the other hand, study about performance of students who are doing a common MBBS program but come from an external pre-university background is highly seek after. It provides good comparison to the existing result. Furthermore, the study may not be highly valuable to anyone outside Malaysia. Similar if not more in-depth study in a different set-up is required for further knowledge, comparison, and validation.

6.0 CONCLUSION

While this study reflects the situation in one medical school, the principles are generalizable. We hope that the discussion has shown that inbred pre-university program does have good association with academic performance in the preclinical stage of medical curriculum. The inbred prepared students show higher level of correlation and consistency through preclinical stage of medical study than figures found in earlier studies on conventional preparatory programs. This information may be of use to medical school planning, admission, and selection committees.

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