WHAT IS THE PREDICTIVE POWER OF PRE-ADMISSION VARIABLES FOR BASIC SCIENCE PERFORMANCE IN MEDICAL SCHOOL?

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ABSTRACT

For students in the first year of medical college, failure in the year-end examinations can have devastating and far reaching consequences. To mitigate the risk of failure, the students at risk should be identified before admission to medical colleges and schools. This enables educators to implement interventional support strategies quite early in the learning cycle so that the support is timely and effective.

To identify students at risk, a mechanism is required to predict future performance based on previously known data. This study examines the available predictor variables, and investigates further to improve the accuracy and efficiency of prediction. The study makes recommendations for using prediction mechanisms to accurately predict future performance and identify students at risk.

1 INTRODUCTION

The Bachelor of Medicine and Bachelor of Surgery (MBBS) is the fundamental medical qualification required to practise as a physician in India. The period of certified study for the MBBS course is four and a half years, followed by a one year of compulsory rotatory resident internship (CRRI), before the MBBS Degree is awarded (Medical Council of India, 2012). The rules and regulations governing the MBBS course are established and monitored by the Medical Council of India (MCI). The Medical Council of India (MCI) is a statutory, independent body that is tasked with maintaining high standards in medical education. The 'First MBBS' is comprised of 40 weeks in the first year, and is referred to as Phase I. Passing the 1st Professional (Phase I) is compulsory before proceeding to 2nd Professional Phase II (Medical Council of India regulations on graduate medical education, 2012). Is it very useful, from the training perspective, to be able to predict which students will successfully complete their first year medical school examinations?

2 STATEMENT OF THE PROBLEM

In India, there are more applicants than places in the MBBS course. All the places are filled on the basis of performance in the entrance examination and marks obtained in the final higher secondary examinations (12^{th} standard school-leaving examinations) (Singhal and Ramakrishnan, 2003). Entrance examinations are conducted at the state and national levels. In private medical colleges, admission is granted on the basis of scores obtained in the separate pre-medical entrance examination (Pre medical test or PMT) and marks obtained in the final higher secondary examinations (12^{th} standard school-leaving examinations). The final higher secondary examinations are also called school-leaving examinations (Singhal

and Ramakrishnan, 2003). Despite these stringent entry tests, some medical students fail in their first year examinations (Yate, 2012; Egwu and Anyanwu, 2010; Omna et al, 2012).

Learning basic sciences in year 1 (pre-clinical year) of the undergraduate medical curriculum plays a key role, acting as a foundation that enhances learning other subjects in the para-clinical and clinical years (Dandekar et al, 2014). Learning basic sciences paves the path for clinical reasoning and provides the basic mechanism for learning about research (Dandekar et al, 2014). If medical students are disconnected and detached from learning the basic sciences, it reflects on their overall future learning (Patel et al, 1988; Prasad, 2013). The first and foremost effect being the inability to proceed to the second year along with their fellow students. Frequently, students find it very difficult to study the basic medical sciences, i.e., Anatomy, Physiology and Biochemistry. This is observed in most of the medical colleges in India and across the world as well (Omna et al, 2012).

In India, students who fail the Phase I examination are held back in the first year until they pass all three subjects. A maximum of four attempts are allowed. (Medical Council of India regulations on graduate medical education, 2012). The additional time taken by the student to complete the first professional year is considered additional time beyond the prescribed one-year duration of the first professional year. For these students, the four and one-half year course duration increases (Medical Council of India regulations on graduate medical education, 2012). The detrimental effects of failing the first year exam are both physical and mental. They are labelled as an “Arrear/Additional” batch throughout their medical career. I have observed students going into depression, which causes them to fail again in their second attempt.

This study was undertaken to determine how pre-admission testing variables could be used to identify students at risk of failing in the pre-clinical year of the medical curriculum.

3 REVIEW OF RELEVANT LITERATURE

3.1 Purpose and method of the literature search

A literature review should provide insight into what is already known in the selected area of research (Boulet and Friedman, 2014). It should give valuable information about the gaps in the area of research chosen. The literature review contextualizes the research in the literature, and provides the rationale for selecting a specific topic for study. (Boulet and Friedman, 2014).

. The review of literature also helps the researcher to understand the faults and weaknesses in existing and published research work, enabling scope for further improvement (Boulet and Friedman, 2014). It helps the researcher to refine and improve the research question and also it helps in shaping the research question (Boulet and Friedman, 2014).

This literature review seeks to explore various factors that affects the performance of students in basic sciences in the first professional year. The literature review also analyses:

- Current research findings
- Gaps in the existing literature
- Areas where further research is necessary
- The variables researchers have currently identified as indicators of the students' performance in their first year examinations
- The findings of various researchers who have reported the predictive power of variables in predicting success of learning outcomes in basic sciences.

The literature review informed my research questions by addressing the gaps in current research.

My research aim is to bridge the existing gap in the literature on by further discovering factors that predict success in the first year MBBS.

The literature review was conducted by searching research articles published in various journals, the primary resources serving as evidence, books and various submitted dissertations. Articles relevant to the context of my topic and research questions were also selected. I identified and located review articles as secondary resources, to gain insight into previously published research.

I have used the following search keywords and phrases in the literature search: “performance”, “medical students”, “factors”, “undergraduate medical curriculum”, “basic sciences”, “preclinical year”, “basic sciences”, “first professional year”, “basic sciences”, “prediction”, “predictive power”, “variables”, “phase-I MBBS”, “quality of life”, “perceptions”, “and difficulties encountered”.

The literature search was conducted using the following search engines:

- Pub Med Central, Medline
- Educational Resource Information Center (ERIC)
- Cumulative Index to Nursing and Allied Health Literature (CINHAL)
- ASSIA
- BNI (British Nursing Index)
- Google and Google Scholar.

MeSH terms were used to conduct the literature search through Pub Med. Boolean logic operators (AND, OR and NOT) were used with various keywords to yield the most maximum number of relevant research articles.

Various search phrases such as “success in preclinical year” for example, were also used by enclosing the phrases within quotation marks. The key articles relevant to my research questions were identified by tracking the citations (Boulet and Friedman, 2014).

Once the relevant articles were collected through the literature search, these were organised and maintained by using Endnote literature management software. The selected articles were read thoroughly and note prepared for every article. Every article was critically reviewed by myself.

3.1.1 Factors affecting medical student performance, the overview of related research

This literature search was conducted to gain insight into the factors or variables that can act as predictors of the success of students in medical school.

The variables that can predict the future academic success of students after their admission into the medical school can be categorised into the following three groups: personal, sociocultural and educational factors**.**

3.1.1.1 Personal factors

Male gender, displeasure with the academic choice of choosing to study medicine were shown to be important in linking directly to poor performance, and could predict success of the medical students in third year examinations of the medical curriculum (Mandal et al, 2012). The results of this study provide evidence that gender is significantly related to the performance of the students in their third year examinations in medical school (Mandal et al, 2012). These researchers documented that the male students showed lower performance in the third year examinations, compared to the female students. A study conducted in the Saudi medical school showed no difference between men and women in their academic

performance, indicating that gender difference had no influence on the overall academic performance of the student in the medical school (Alfayez et al, 1990). A study conducted in India found that female students performed better in the first-professional year end (pre-clinical year) examinations, compared to males. (Biswas and Jain, 2013). Female students scored significantly higher scores in the pre-clinical year examinations than male students in the Saudi medical school (Salem et al, 2013). These differences in the effect of gender on performance in medical school, may be due to the differences in understanding and maturity between the female and male students, it can also be attributed to the cultural differences between India and Saudi Arabia, in particular the differences in liberties enjoyed by females in these countries. Female students succeeded well, compared to the male students, showing evidence that this variable (gender) could be a predictor of the future success of medical school students (Cohen-Schotanus et al, 2006). McManus et al, (2013) suggested that student gender played a key role in determining the success of medical students in the first year or the pre-clinical year of the medical course (McManus et al, 2013). A review of these studies reveals differences of opinion over the role of gender as an indicator of future performance medical school examinations. However, the evidence also shows that gender can predict the future success of medical students at various levels. Little documentary evidence and information exists about the predictive power of gender as a variable to predict the success of students in pre-clinical year. Therefore, I have included this variable in this study to investigate how gender can be used to predict performance in learning the basic sciences.

The students' motivation to choose and study medicine can also predict performance in the pre-clinical year (the first professional year) and thus this factor

acts as a predictor of success at medical school (Salem et al, 2013). It has been documented that 23.3% of the students that were admitted into medical school were coerced into choosing medicine as their career although they were not interested in pursuing a career in medicine (Mandal et al, 2012). This forced career choice resulted in dissatisfaction and caused them to perform badly in the examinations. This variable can affect the performance of students in the various examinations they take in medical school. However, it cannot predict the performance of students in the basic science examinations at the end of the first year (pre-clinical year). For this this reason, I have not considered the forced career choice variable in this study.

3.1.1.2 Sociocultural factors

Lack of proficiency in the English language seems to have profound effects on the performance of the students in the first professional year of their MBBS course. Students having good English language proficiency performed better compared to those students who have poor English language proficiency and comprehension (Mandal et al, 2012; Biswas and Jain, 2013). In their investigation, Mandal et al (2012) found that 14% of the students in their study had low proficiency in English. This negatively impacted the students' performance, leading to poor performance and failure in the university examinations (Mandal et al, 2012). The results of the investigation by Biswas and Jain, suggest that proficiency in the English language and English scores in school-leaving examinations can be used to predict performance in the first professional year (Biswas and Jain, 2013). The study found that students with poor attendance and poor English language skills require special attention and additional support. These studies, conducted in Indian medical schools provide evidence that the student's proficiency in English, had a profound effect on the performance of the students in first year examinations. Therefore, English scores

from school-leaving examinations can be used as a variable to predict the success of the students in first year examinations.

A study conducted in developing countries, found that the scores obtained in examinations of English language proficiency were accurate indicators of academic performance of the students in medical school (Alfayez et al, 1990). The researchers found proficiency in English to be the most accurate indicator of success in medical school examinations. These findings support the findings of Mandal et al, (2012) and Biswas and Jain, (2013), on the usefulness of English test scores to predict learning outcomes of basic sciences at medical school.

A research study found that local students performed better than students from other localities ($p < 0.01$) (Roy and Chadalawada, 2014). The study defines a local student as resident in the same city as the learning institution.

The influence of parents' education and/or occupation was shown to have a fluctuating effect on the academic performance of the students in medical school (Alfayez et al, 1990). Students having a parent with a higher level of education, in particular, having a parent who was a doctor, medical practitioner or a health care professional, showed significantly better academic performance when compared to students with parents having lower education levels and a non-medical background (Alfayez et al, 1990). The socio-economic and sociocultural factors and variables analysed in the study consisted of the educational level and occupations of both parents, the presence or absence of a parent working in the medical or healthcare professions, and the "transportation used to reach the faculty (driving own car/using family driver/with a family member / with a colleague)" (Salem et al, 2013). Among these socio-economic and sociocultural factors, only one factor, the transportation used to reach the faculty alone created a significant impact on the academic

performance of students and was an accurate indicator of the success of students in medical school (Salem et al, 2013). Since students who self drove got more independence, which led them to get into more distractions and got diverted from their regular academic activities & studies in the first professional year of the MBBS course. This led the students to perform badly in the pre-clinical year. This study was conducted in Saudi Arabian medical school, where the female students were not allowed to self-drive. So the students who used the cars with self-driving option were predominantly, the male students and those students who used cars (as transportation) with their own family driver were predominantly female students. So, the effect of this variable ("transportation used to reach the faculty") was a correlate of the other variable i.e., gender (males vs female). Due to this reason, we have not taken this variable ("transportation used to reach the faculty") for study in our present investigation.

These studies emphasize the importance of social and cultural variables such as English test scores, geographical area of origin, parents' education level and occupation) in predicting the performance of students in medical school examinations. However, there were no studies available in the literature whether these variables could reliably predict the performance of the students in the first year examinations of the MBBS course? This led me include these socio cultural variables into my study.

3.1.1.3 Educational Factors

Biswas and Jain (2013), assert the scores in other pre-admission examinations, defined as pre-admission calibre by the authors; categorised as marks in the 12^{th} Standard exams > 75% and marks in the 12^{th} Standard exams < 75%, can predict performance in the first year examinations (Biswas and Jain, 2013).

Significant association was also found between the marks obtained by students in medical school and the student's attendance of lectures. The authors concluded that students with poor *pre-admission calibre* continued to show poor performance after being admitted into the medical college, confirming the *pre-admission calibre* as an important variable that predicts performance of the students' success in medical school (Biswas and Jain, 2013).

A study conducted in developing countries, documented that the pre-admission variables, the scores obtained in the school-leaving examinations were accurate indicators of academic performance of the students in medical school (Alfayez et al, 1990). Sound prior academic knowledge (prior to the admission into the medical school) was the most accurate indicator of success. The research concluded that sociocultural factors such as, social status, salary, responsibilities of the family members within the culture of Saudi, social demands, expectations of the students that attain higher scores in school-leaving examinations within the context of the societal view had very little impact on the academic performance of the students in medical school, when compared to the scores obtained in school-leaving examinations. Scores in the school-leaving examinations were an accurate predictor of academic performance, when predicting the success of students in the third year examinations at medical school (Alfayez et al, 1990).

Researchers (Salem et al, 2013) analysed the impact of educational factors, such as the usage of student guides, printed text books, electronic text books, and lectures utilising power point presentations, notes prepared by the students, websites related to science etc. (Salem et al, 2013). These educational factors proved to be ineffective in predicting the performance of the medical students in first year examinations Studies conducted in India (Biswas and Jain, 2013) and in other

developing countries (Alfayez et al, 1990; Salem et al, 2013), assert that the scores obtained in the school-leaving examination, is an accurate indicator for predicting the success of students in various examinations at medical school. But, very little information and evidence is available about the use of this variable in predicting the success of the students in basic science examinations in the first year of medical school. The conclusions drawn by this study lead me to further investigate the role of this variable to predicting performance.

Other researchers (Colliver et al, 1989; McManus et al, 2011) have identified variables related to student selection and the admission process that can predict success in medical school. These variables are based on performance in the Medical College Admissions Test (MCAT) in the USA and the United Kingdom's Clinical Aptitude Test (UK-CAT). These pre-admission tests measure the performance of the students in four different domains, "biological sciences, physical sciences, verbal reasoning and writing skills" (Colliver et al, 1989; McManus et al, 2011). These tests measure the student's level of knowledge of physical sciences and biological sciences, their reasoning ability, problem solving skills, critical thinking and writing skills. All these qualities are essential for success of a medical student. Colliver et al (year), found the Medical College Admission Test (MCAT) was useful in selecting students that perform well in basic and clinical sciences (Colliver et al, 1989). This suggests the Medical College Admission Test (MCAT) results could be used to predict success in first year examinations (Colliver et al, 1989). Aptitude tests are widely used in the United Kingdom to select students for admission into medical schools (McManus et al, 2013). It is well documented by McManus et al that the scores obtained in the United Kingdom's Clinical Aptitude Test (UK-CAT) could be used to predict the success of the students in first year examinations at medical

school (McManus et al, 2013). Studies conducted in British medical schools showed that the scores obtained in the following examinations and tests, “A-levels”, “O-levels” or “General Certificates of Secondary Education (GCSEs)”, “AH5” and “United Kingdom’s Clinical Aptitude Test (UK-CAT)” (the aptitude tests) can accurately predict performance in the first year of the medical curriculum (McManus et al, 2013). These findings and the review of these studies support the assertion that results from medical college admission tests in USA and aptitude tests in UK, can be used to accurately predict future success in the first year examinations. These findings are applicable to the Indian context, because admissions into the medical colleges, government or private, are granted on the basis of results in the pre medical test (pre medical entrance examination) conducted either at a pan-India level or at the state level. In some states like Tamilnadu, the students are admitted into government medical colleges by means of the counselling based on the marks obtained in school-leaving examinations. Admissions into the private medical colleges and/or deemed universities, are granted based on performance in the pre-medical test (pre-medical entrance examination) conducted at the Pan-India level. My study investigates the PMT Score variable to understand its power in predicting the performance in the first year examinations at medical school.

Research done by Cohen-Schotanus and Hissbach suggests (Cohen-Schotanus et al, 2006; Hissbach et al, 2011) that performance in the school-leaving examinations, scores in school-leaving examinations, knowledge of natural sciences, high school grades, admission scores, results of structured interviews, previous academic achievement, and skills tests help in predicting the future performance of the students in the first two years of the MBBS course. Among these the performance in the school-leaving examinations (pre-admission factor) was shown to

be highly associated and positively correlated with the performance of the students in medical school (Cohen-Schotanus et al, 2006). Sound prior knowledge of natural sciences is considered a good indicator of future academic performance and achievement during the pre-clinical year (year 1) and para-clinical year (year 2) of the medical curriculum (Hissbach et al, 2011). Between the variables “knowledge of natural sciences” and “high school grades”, the “knowledge of natural sciences” variable was able to predict the success of the student in the first two years after admission into medical school with an odds ratio of 2.0 and the “gender” to some extent. The high school grades were shown to have no role in predicting the future performance of the students in medical school, and the prediction was completely independent of the grades obtained in the high school study (Hissbach et al, 2011). This difference may be attributed to variations such as cultural differences, differences in curriculum, differences in the syllabi, differences in the weightage of the natural sciences and/or biological sciences components of the curriculum between the two high schools used in the study.

The knowledge component of the Biomedical Admission Test (BMAT) (an educational variable), a pre-admission test administered for the selection of students for medicine in the UK, has been cited in predicting the academic performance in the first year of medical school (McManus et al, 2011). In India, scores obtained in the entrance examination for medical school, as well as results obtained during their school-leaving examination (the plus two examinations/matriculation examinations) were also proved to be the important factors (positive correlation with r^2 value of 10-18%) that predict the performance of the students in basic sciences examinations/first year end examinations (Chan-Ob and Boonyanaruthee, 1999). It has been shown that matriculation scores obtained in the Indian school-leaving

examinations, specifically scores obtained in Physics, Chemistry and Biology were positively correlated with the student's overall academic performance in medical school from the first year (year 1) to the final year (year 5). The student's overall academic performances were from first year to the final year (Chan-Ob and Boonyanaruthee, 1999). These studies suggest that the student selection process can play an important role in predicting later performance in medical school (Colliver et al, 1989; Cohen-Schotanus et al, 2006). These studies give evidence that performance in the basic sciences in first year examinations is the key event for the students to progress further in the medical curriculum. If the students succeed in the first year end examinations, they can progress to the second year. This facilitates the student's progress in the successive years of the MBBS course, because in the second professional year, they conclude the transition period from school to medical school and the students become accustomed to the educational environment and culture of the medical school or college. This enables the students to perform well in the successive years of the medical curriculum; the para-clinical and clinical years.

Some non-cognitive factors and characteristics related to individual personality, personal qualities and attitudes, sometimes considered in selection of students for the MBBS course were shown to have no role in predicting success in first year examinations. No significant correlations between the non-cognitive factors and characteristics as per the Personal Qualities Assessment (PQA) questionnaire and the performance of the medical students after admission into the medical college were observed. This suggests that the PQA results cannot accurately predict the academic outcome (academic success) of students in medical college (Dowell et al, 2011). The research suggests that these non-cognitive factors and characteristics

have no predictive power in the performance of students in medical school, I have not considered these variables in my study.

Based on the observations above and a review of educational variables, the key predictors have been summarised as prior academic performance, scores obtained in the pre medical test, scores in school-leaving examinations (Physics, Chemistry and Biology). These variables were correlated with the overall total score obtained in all examinations, starting from first year through fourth year examinations in medical school (Harding and Wilson, 2008; Wilkinson et al, 2008). In particular, the scores obtained in Physics, Chemistry and Biology in school-leaving examinations was found to be good predictors of future academic performance in medical school (Milstein, 1976; Wilkinson et al, 2008).

3.1.1.4Variables that have no predictive power

Emotional intelligence is a social phenomenon that represents the inter-personal and intra-personal characteristics of an individual (Salovey and Mayer, 1990). Other researchers' work has shown that emotional intelligence can be can be measured by an instrument called the, "Mayer-Salovey-Caruso EI Test (MSCEIT)" during the selection of students into the MBBS course. Emotional intelligence does not accurately predict students' performance and their academic outcomes during their medical career (Humphrey-Murto et al, 2014).

In summary, multiple factors; including educational, academic, socioeconomic and demographic factors may play a key role in learning. and influence the performance of medical students in the first year examinations. The literature review shows that existing studies have researched the predictive power of various variables to predict successful outcomes in any one of the subjects of the basic sciences, during the first year. The literature review implies there are no existing

studies that investigated the predictive power of these variables to predict successful learning outcomes in all three subjects, Anatomy, Physiology and Biochemistry. These basic sciences subjects are taught in the first year at medical school. Table 1 below gives the factors used in previous research, the associated variables, their use and predictive power

Table 1: Overview of relevant research

Factor	Variable	Prediction	Predictive Power
Personal	Gender (Male vs Female)	Performance in Pre-clinical year	High
	Age (Matured vs Non-Matured)	Performance in Pre-clinical year	Medium
	Forced Career Choice	Over all Attainment	Nil
	Emotional Intelligence	Over all attainment	Nil
Social & Cultural	Education level of Parents (Education level of father and mother)	Performance in Pre-clinical year	Medium
	Occupation of Parents (Occupation of father and mother)	Performance in Pre-clinical year	Low
	Proficiency in English Language and Comprehension	Performance in Pre-clinical year	High

Factor	Variable	Prediction	Predictive Power
	Geographical area of origin	Performance in Pre-clinical year	Low
Educational	School-leaving exam type / board	Performance in Pre-clinical year	Low
	Scores in School-leaving examinations (Physics, Chemistry and Biology)	Performance in Pre-clinical year	High
	Prior academic knowledge	Over all attainment	Low
	Scores in Common Entrance Test, the Pre Medical Test (PMT) for admission into medical colleges	Performance in Pre-clinical year	High

4 SELECTION AND ADMISSIONS AT SAVEETHA MEDICAL COLLEGE AND HOSPITAL

In addition to the admissions test performance, school-leaving test scores are typically made available to the medical school. These scores include the marks from either the School Board (Plus Two), State Board, Central Board for Secondary Education (CBSE), and the Indian Certification of Secondary Education (ICSE). These are the different boards and options that are available for the student to pursue their Higher Secondary Examination (10+2). The requirements are that students who pursued plus two (Higher Secondary Examination) study from any one of these boards are eligible to write the entrance examination to be admitted into the

MBBS course. Students admitted into MBBS course at Saveetha University Medical School and Hospital have predominantly taken examinations from either the State Board or the CBSE. The CBSE curriculum is the same across all the states of India. In contrast, the State board reflects the curriculum that is been adopted by every state across India, and differs between states. The popular perception is that the CBSE curriculum is superior to the State board curriculum and by inference; the academic standard of the CBSE student is superior to that of State board student.

Admissions decisions are subject to the following criteria pertaining to pre-admission scores:

“Candidates belonging to all categories for admission to the MBBS Degree Course should have obtained not less than 50% marks in English and 50% marks in aggregate in Physics, Chemistry and Biology consisting of botany and zoology at the qualifying higher secondary examination (academic stream) or the Indian school certificate examination which is equivalent to 10 + 2 higher secondary examination after a period of 12 years of study” (Medical Council of India regulations on graduate medical education, 2012).

“The Pre-University course which was in vogue prior to the advent of the higher secondary examination shall not be treated as equivalent to the higher secondary examination (10+2) for purpose of eligibility and admission to the course. For candidates who have studied abroad, the equivalent qualification as determined by the Association of Indian Universities shall form the guidelines to determine the eligibility and should have passed in the subjects of Physics, Chemistry, Biology (botany and zoology) and English up to 12th standard level with 50% aggregate” (Medical Council of India regulations on graduate medical education, 2012).

"The selection of students to medical college shall be based solely on merit of the candidate determined through a competitive All India common Entrance Examination. To be eligible to seek admission into the medical course the student must obtain 50% marks in the competitive All India Common Entrance Examination" (Medical Council of India regulations on graduate medical education, 2012).

"To summarise, applicants for admission to the medical course must have obtained not less than 50% marks in English and 50% marks in Physics, Chemistry and Biology taken together at the qualifying examination (school-leaving examination), and also on the competitive All India Common Entrance Examination" (Medical Council of India regulations on graduate medical education, 2012).

In India, all these standards must be followed strictly by all the medical colleges for the selection of the students and admission of the students into the MBBS course. Unfortunately, after the selection and admission of the students by following these rules and regulations, there exists a significant student failure rate (Omna et al, 2012).

5 PURPOSE OF THE STUDY

The literature review has enabled the discovery of some of the predictors of success in medical school. In this study, I focus on predictors that are readily available in existing extensive admissions data.

In India, passing in all three subjects (Anatomy, Physiology, and Biochemistry) in the first year is a pre-requisite for students to proceed further. There are no studies available in the literature that focus on identifying the factors and issues associated with the student's success (passing) in all three subjects in the first professional (pre-clinical) year of the MBBS course. Although in future studies we may identify the issues and difficulties encountered by undergraduate medical students in learning

basic sciences during the first year in medical school, the objective of my study is to determine the extent to which current selection practices predict success in the first year at medical school.

5.1 RESEARCH QUESTIONS:

5.1.1 Gender (Male vs Female):

1. Do male students perform better than female students in the university examination at the end of first year of the medical curriculum (the pre-clinical year)?
2. What is the predictive power of gender for academic attainment in the pre-clinical year of the MBBS curriculum?

5.1.2 School-leaving exam type / board (State board vs Other Boards):

1. Do the state board students perform better than other board students in the university examination at the end of first year of the medical curriculum (the pre-clinical year)?
2. What is the predictive power of the school-leaving examination type / board to predict successful outcomes in the pre-clinical year of the MBBS curriculum?

5.1.3 Geographical Area of Origin (Rural vs Urban):

1. Is there any difference in the performance in the university examination at the end of first year of the medical curriculum (the pre-clinical year) based on geographical location (Rural vs Urban)?
2. What is the predictive power of the geographical location to predict the academic attainment (success) in the first year of the medical curriculum?

5.1.4 Physiology, Chemistry and Biology (PCB) Scores from School-leaving examinations:

1. Do students with higher Physiology, Chemistry and Biology (PCB) scores in school-leaving examinations perform better than students with lower PCB scores, in the university examination at the end of first year of the medical curriculum (the pre-clinical year)?
2. What is the predictive power of the PCB in school-leaving examinations to predict the success in the pre-clinical year of the MBBS curriculum?

5.1.5 English score in school-leaving examinations:

1. Do students with higher English scores in school-leaving examinations perform better than students with lower English scores, in the university examination at the end of first year of the medical curriculum (the pre-clinical year)?
2. What is the predictive power of the English score in school-leaving examinations for academic attainment (success) in the first year (the pre-clinical year) of the MBBS course?

5.1.6 Pre-Medical Test (PMT) scores:

1. In the university examination at the end of first year of the medical curriculum, are there differences between the performance of students with higher PMT entrance scores compared to those with lower PMT entrance scores?
2. What is the predictive power of the PMT entrance scores for academic attainment (success) in the pre-clinical year of the MBBS curriculum?

5.1.7 Father's Education (Professional medical / health sciences degree vs with non-medical degree):

1. Do students with fathers having a professional medical or health sciences qualification perform better than students having fathers with a non-medical qualification?
2. What is the predictive power of the Father's educational qualification in predicting successful academic outcomes in the pre-clinical year of the MBBS curriculum?

5.1.8 Mother's Education (Professional medical / health sciences degree vs with non-health degree):

1. Do students with Mothers having a professional medical or health sciences qualification perform better than students with Mothers having a non-medical qualification?
2. What is the predictive power of the Mother's educational qualification for academic achievement in the pre-clinical year of the MBBS curriculum?

5.1.9 Father's Occupation (working in non-health sciences (non-medical) fields vs working in health sciences (medical) field):

1. Do students with fathers working in the health sciences (medical) field have better academic outcomes than students whose fathers work in non-health sciences (non-medical) fields?
2. What is the predictive power of Father's occupation to predict academic success in the pre-clinical year of the MBBS curriculum?

5.1.10 Mother's Occupation (working in non-health sciences (non-medical) background vs working in health sciences (medical) field)

1. Do students with mothers working in health sciences (medical) fields have better academic outcomes than students whose Mother working in non-health sciences (non-medical) fields?
2. What is the predictive power of the mother's occupation for academic attainment (success) in the pre-clinical year of the MBBS curriculum?

5.1.11 Research Questions (Cluster of Variables):

- What is the predictive power of personal variables to predict academic achievement in the pre-clinical year (year 1) of the MBBS curriculum?
- What is the predictive power of sociocultural variables to predict the academic success of students in the pre-clinical year (year 1) of the MBBS curriculum?
- What is the predictive power of educational variables to predict the academic success of students in the pre-clinical year (year 1) of the MBBS curriculum?

6 RESEARCH METHODS

Valid statistical methods are used to answer the research questions. The methods used to analyse data gathered for research questions are given in Table 2.

Table 2: Methods used for data analysis

Variable	Research Question	Analysis
Gender (Male vs Female)	Do male students perform better than female students in the university examination at the end of first year of the medical curriculum	Chi-Square Test

Variable	Research Question	Analysis
	(the pre-clinical year)?	
School-leaving exam type / board (State board vs Other Boards)	Do State board students perform better than other board students in the university examination at the end of first year of the medical curriculum (the pre-clinical year)?	Chi-Square Test
Geographical Area of Origin (Rural vs Urban)	Does geographical location influence academic outcomes in the first year examinations of the medical curriculum?	Chi-Square Test
PCB Marks in School-leaving Examinations	Do students with higher PCB scores in school-leaving examinations perform better than students with lower PCB scores, school-leaving, in the university examination at the end of first year of the medical curriculum (the pre-clinical year)?	Independent t-test (Student's t-test)
English Marks in School-leaving Examinations	In the university examination at the end of first year of the medical curriculum (the pre-clinical year, do students with higher English marks in school-leaving examinations perform better than students with lower English marks in school-leaving examinations)?	Independent t-test (Student's t-test)
PMT Entrance Score	In the university examination at the end of first year of the medical curriculum, are there differences between the performance of	Independent t-test (Student's t-test)

Variable	Research Question	Analysis
	students with higher PMT entrance scores compared to those with lower PMT entrance scores?	
Father's Education Level (Professional medical / health sciences degree vs with non-health degree)	Do students with fathers having a professional medical or health sciences qualification perform better than students having fathers with a non-medical qualification?	Chi-Square Test
Mother's Education Level (Professional medical / health sciences degree vs with non-health degree)	Do students with mothers having a professional medical or health sciences qualification perform better than students with mothers having a non-medical qualification?	Chi-Square Test
Father's Occupation (working in non-health	Do students with fathers working in the health sciences (medical) field have better academic outcomes	Chi-Square Test

Variable	Research Question	Analysis
sciences (non-medical) background vs working in health sciences (medical) field)	than students whose fathers work in non-health sciences (non-medical) fields?	
Mother's Occupation (working in non-health sciences (non-medical) background vs working in health sciences (medical) field)	Do students with mothers working in health sciences (medical) fields have better academic outcomes than students whose Mother working in non-health sciences (non-medical) background?	Chi-Square Test
Personal (Gender)	What is the predictive power of personal variables to predict academic achievement in the pre-clinical year (year 1) of the MBBS curriculum?	Binary Logistic Regression
Social & Cultural (Area distribution,	What is the predictive power of sociocultural variables to predict the academic success of the students in	Binary Logistic Regression

Variable	Research Question	Analysis
English score in school-leaving examinations, Father's educational level, Mother's education level, Father's occupation and Mother's occupation)	the pre-clinical year (year 1) of the MBBS curriculum?	
Educational (School-leaving exam type / board, PCB % in school-leaving examinations, PMT entrance score)	What is the predictive power of educational variables to predict the academic success of the students in the pre-clinical year (year 1) of the MBBS curriculum?	Binary Logistic Regression

6.1 Setting

This study has been conducted at the Saveetha Medical College and Hospital, Faculty of Medicine, Saveetha University, Chennai, India. Saveetha Medical College & Hospital has been permitted and recognized by the Medical Council of India (MCI) to admit 150 students each academic year. Seven groups of

students were included in the sample as study subjects; each group consisting of 150 students for a total of 1,050 students.

6.2 Sample

The study collected data on students that were admitted into the MBBS course at Saveetha Medical College and Hospital, Faculty of Medicine, Saveetha University from 2008 to 2014. Most of the students in the classes were female (n=611; 58.1%). The groups were aggregated and treated as a single data set. The pass rates for Year 1 of the MBBS course are given in Table 3,

Table 3: Pass Rates for Year 1 of the MBBS Course

Year of Admission	Number Passed	Pass Percentage
2008	115	76.7%
2009	101	67.3%
2010	100	66.7%
2011	116	77.3%
2012	110	73.3%
2013	112	74.7%
2014	119	79.3%
Total	781	74.3%

On entry into medical school, after their schooling, the majority of students found it very difficult to study the basic medical sciences subjects mainly the pre-clinical subjects in year 1, i.e. Anatomy, Physiology and Biochemistry. This phenomenon occurs in most of the medical colleges in India and the world. It manifests not only for average grade students but also for students with very good grades in their plus two or intermediate education. Passing in all the three subjects (Anatomy, Physiology and Biochemistry) is a pre-requisite to enter into Year 2 of the MBBS course. Students failing these subjects in their first year become vulnerable to adverse physical and mental effects. They are labelled an “Arrear/Additional” group

throughout their medical career. I have observed students going into depression, which caused them to fail again in the second attempt. This adversely affects their future educational development in years 2, 3 and 4. It also adversely affects their quality of life.

For instance, at our medical college we have had admitted students having good scores in the Pre-medical test (PMT) entrance examination. However, I have been observing the students struggle to cope with their studies in the pre-clinical subjects. At least 21-27% students fail in one or more subjects and are consequently retained in the year 1, while their fellow students continue their course by passing into year 2. This data provides the basis for our concern to take up this study and investigate the problem.

6.3 Variables for study

To examine current selection practices, personal characteristics and test scores were used to assess their relationship with success in the first year of medical school. Information pertaining to the category of the student's admission (Merit/Non Resident Indian) were collected, since the selection of students to Medical College is based solely on merit of the candidate determined through the competitive All India Common Entrance Examination. Although a provision exists to admit the Non Resident Indian (NRI) students, for the most part there are not many NRI students applying for admission to the MBBS course. So the seats were filled solely by merit, based on the performance in the All India Common Entrance Test conducted by Saveetha University. Virtually all of the students were admitted on merit (n=1,039; 99%); only 11 were admitted on Non Resident Indian status in the years under study.

Performance in the common entrance test and the school-leaving test marks were included in the study. The information pertaining to the Pre-admission Scores

were also collected. The term “pre-admission scores” consists of two components, one being the PCB (Physics, Chemistry and Biology) marks and English marks obtained in the plus two examinations (the school-leaving examination) and the other, being the marks obtained in the PMT (Pre=medical test) entrance examination, which is taken after passing the plus two examinations (the school-leaving examination). The marks and percentages obtained in Physics, Chemistry and Biology in the school-leaving examination and the marks and percentages obtained in English in the School-leaving examination were gathered. The marks obtained in the Pre-Medical Test (PMT) / Entrance Examination and the rank obtained in the Pre Medical Test (PMT) / Entrance Examination were also gathered. The points in English and other subjects can vary within the group, based on the student’s school-leaving examination board, the State Board or CBSE board. I intended to use this data to compare the academic outcomes of CBSE board and State board students.

To understand the correlation between parents’ level of education and occupation and their children’s’ academic success in the first year. Information on the father’s and mother’s level of education was collected. The level of education was categorised as “parents holding a professional medical/health sciences degree” and “holding a professional non-medical degree/uneducated”. The parents’ occupations were collected and categorised as medical field (health sciences and related)/non-medical field (non-health). This information is essential to check whether the father’s and mother’s education and occupation influence the children’s future academic performance in medical school. If there is an association found, this information could be used to identify students at risk in the first year of the MBBS course.

The scores obtained in the University Examination at the end of Year 1, were also collected for all the students included in the study. The marks obtained in the Anatomy, Physiology and Chemistry subjects in university examinations, both written and practical, including the marks obtained in the oral examinations were collected. The minimum pass mark in every subject is 50% of the maximum marks. The overall total score was defined as “the cumulative score obtained in Anatomy, Physiology and Biochemistry along with the internal assessment marks”. The minimum pass mark is 50% of the maximum marks. In each of the three subjects in Year 1, a candidate must obtain 50% in aggregate (with a minimum of 50% in theory including oral examinations and a minimum of 50% in practical assessment examinations) to pass. This is the “passing minimum” (Medical Council of India regulations on graduate medical education, 2012).

The results of the university examination at the end of Year 1 were also collected for all the students participating in the study.

Success in Year 1 (Preclinical Year) was defined operationally as:

“Passing in all the three preclinical subjects; Anatomy, Physiology and Biochemistry with 50 % of the maximum marks in each subject (in written examination including viva-voce examination and practical assessment separately) and with a 50% of the maximum marks in Overall Score” (Medical Council of India regulations on graduate medical education, 2012). Passing in 1st Professional (Phase-I) training is compulsory before proceeding to 2nd Professional (Phase-II training) (Medical Council of India regulations on graduate medical education, 2012).

6.4 Data Sets

The data sets consist of information from all 1050 students participating in this study, with reference to all the variables - gender, school-leaving exam type / board,

geographical area distribution, PCB scores (%) in School-leaving Examinations, English scores (%) in School-leaving Examinations, PMT Entrance Score, Father's Education Level, Mother's Education Level, Father's Occupation, Mother's Occupation. Male vs female has been entered for gender variable. The information pertaining to, whether the student belong to the state board, CBSE, ICSE or any other board was collected and entered into the excel sheet and then categorised into "state board" or "other boards". For the variable, PCB%, the marks obtained in each subject viz. Physics, Chemistry and Biology have been obtained and entered into the excel sheet. T the aggregate of the marks obtained in all three subjects was calculated and the percentage was calculated and entered. The English marks obtained by all 1050 students were collected and entered, and the percentage was calculated. The scores obtained in the PMT was collected and entered and then percentage obtained by the students in PMT was calculated. Information pertaining to the father's education qualification was obtained from the study subjects and then categorised into two categories, those possessing a "Professional medical / health sciences degree" and those possessing a non-health degree". Similarly, information on the mother's education qualification was obtained from the study subjects and then categorised into two categories, those possessing a "professional medical / health sciences degree" and those possessing a non-health degree". All those parents with an educational qualification related to medical filed / health sciences (MBBS, MD, Nursing, BPT, Pharmacy etc.) were categorised as - "holding a professional medical / health sciences degree". Those parents holding qualifications not related to medical filed and/or any health sciences filed (like commerce, law, management, software, engineering etc.) were categorised as – "those possessing a non-health degree". The information on the students' father's occupation was

collected and categorised as; “those working in non-health sciences (non-medical) fields” and second being, “working in health sciences (medical) field”. Similarly, we have collected the information pertaining to the students’ mother’s occupation and categorised this as; “those working in non-health sciences (non-medical) fields” and second being, “working in health sciences (medical) field”. All those parents who working in the fields related to medical sciences / health sciences (doctors, nurses, physicians, medical teachers, pharmacists, nurses etc.) were categorised as - “working in health sciences (medical) field”. Those parents working in areas not related to the medical filed and/or any health sciences filed (like lawyers, management officials, software officials, engineering etc.) were categorised under the category – “those working in non-health sciences (non-medical) background”.

Along with this information the marks obtained by all the 1050 students in the 3 subjects of the pre-clinical year Anatomy, Physiology and Biochemistry were collected and entered into the Excel spreadsheet. This information is essential to determine the “success” of the students in the pre-clinical year. Pass and fail were also entered into the Excel spreadsheet.

The research proposal was submitted to the Institutional Review Board (IRB-Education) and presented before the board. Approval and permission from the IRB-Educations, Saveetha University was obtained prior to the start of this study.

6.5 Data Analysis

Demographic information on the sample of students (gender, rural/urban origin, parent education and occupation) is used to describe the various subgroups of students.

All statistical analysis was done using Statistical Package for Social Science (SPSS, version 17) for Microsoft windows. The data were normally distributed.

Therefore, parametric tests were performed. Descriptive statistics were presented as numbers and percentages. The data were expressed as mean and standard deviation (SD). Independent sample Student's t test was used to compare continuous variables between two groups. A chi-square test was used for comparison between attributes.

A logistic regression analysis was conducted to predict Year 1 (pre-clinical year) success using father's education, father's occupation, mother's education, mother's occupation, performance on the school-leaving examination scores in English and Physics, Biology and Chemistry, and pre-medical test scores as predictors. A two sided p value < 0.05 was considered statistically significant for all analyses.

7 7. FINDINGS

7.1 Descriptive statistics

The descriptive statistics (mean and standard deviation) of all the variables identified for all the students admitted into the MBBS course at Saveetha Medical College and Hospital, Saveetha University, Chennai, India from 2008 till 2014 are given in Table 4.

Table 4: Descriptive characteristics of the study sample with respect to - gender, school-leaving exam type and area distribution

Variable	Count	Percent
Gender		
Male	439	41.8%
Female	611	58.2%
School-leaving exam type / board		
State board	895	85.2%
Other Boards	155	14.8 %

Area Distribution		
Rural	950	90.5 %
Urban	100	9.5 %

Female students form the majority (58.2%), compared to male students (41.8%) in the sample. Among the participants, the majority of the students (85.2%) had taken State board school-leaving examinations and only 14.8% of the students from other boards like CBSE, ICSE etc. Also, out of the 1050 students in the study, a large proportion (90.5%) was from rural areas, and a small portion (9.5%) was from urban areas. Table 5 gives the descriptive characteristics of the study sample.

Table 5: Descriptive characteristics of the study sample with respect to parent's education level and occupation

Variable	Count	Percent
Father's education level		
with non-health degree / qualification	873	83.1%
Professional medical / health sciences degree / qualification	177	16.9%
Mother's education level		
with non-health degree / qualification	911	86.8%
Professional medical / health sciences degree / qualification	139	13.2 %
Father's occupation		
working in non-health sciences (non-medical) fields	869	82.8 %
working in health sciences (medical) field	181	17.2 %
Mother's occupation		
working in non-health sciences (non-medical) fields	915	87.2%
working in health sciences	134	12.8 %

(medical) field		

83.1% of the fathers hold a non-health degree (873/1050) and 16.9% of the fathers hold a Professional medical / health sciences degree. 911 mothers out of 1050, corresponding to 86.8% hold a non-health degree and only 13.2% (139/1050) hold a Professional medical / health sciences degree. A large proportion (82.8%) of the fathers work in non-health sciences (non-medical) fields (869/1050) and fathers of 181 students out of 1050 were working in health sciences (medical) field. Only 134 mothers (out of 1049) work in the health sciences (medical) fields, corresponding to 12.8%. 87.2% of mothers (915 out of 1050) work in non-health sciences (non-medical) fields.

7.1.1 Association between pre-admission variables and performance of the students in pre-clinical year (first year) of the MBBS curriculum

7.1.1.1 Gender (Male vs Female):

To discover whether male students perform better than female students in the university examination at the end of first year of the medical curriculum (the pre-clinical year); I tested the categorical data using chi-square tests. The results of the chi-square test are given in Table 6.

Table 6: Association between gender and performance of the students in pre-clinical year (first year) of the MBBS curriculum

Gender	Performance in Pre-Clinical Year			Pearson Chi-Square Value	Degree of freedom (df)	Significance (p-value)
	Pass	Fail	N			
Male	66.1%	33.9%	439	27.417	1	**0.000*** **
Female	80.4%	19.6%	611			
**** p < 0.001**						

Female students perform better in the first year end exams at 80.4% pass rate compared to male students exhibiting a 66.1% pass rate. The chi-square value is 27.417 with degree of freedom of 1. There is a statistically significant difference ($p < 0.001$) between the performance of the female students, compared to the male students. This result shows that a correlation between the gender and performance of the students in the first professional year examinations.

7.1.1.2 School-leaving exam type/board (State board vs Other Boards):

We have performed chi-square tests to know whether the State board students perform better than other board students in the university examination at the end of first year of the medical curriculum (the pre-clinical year). The results of the chi-square to test the association between school-leaving type / board and performance of the students in pre-clinical year (first year) of the MBBS curriculum are given in Table 7.

Table 7: Association between school-leaving type / board and performance of the students in pre-clinical year (first year) of the MBBS curriculum

School-leaving exam type / board	Performance in Pre-Clinical Year			Pearson Chi-Square Value	Degree of freedom (df)	Significance (p-value)
	Pass	Fail	N			
State Board	73.5 %	26.5%	895	2.361	1	**0.124[NS]**
Other Boards	79.4 %	20.6%	155			
[NS] Not Significant						

These results (chi-square value is 2.361 and degree of freedom of 1), show no significant difference with a p value of 0.124 ($p > 0.05$) between the performance of the students passing the state board exams and those students passing CBSE, ICSE etc., board exams.) No association is observed between the school-leaving

type / board and performance of the students in pre-clinical year (first year) of the MBBS curriculum.

7.1.1.3 Geographical location (Rural vs Urban):

To investigate the relationship between performance in the university examination at the end of first year of the medical curriculum and geographical origin from either rural areas or urban areas; the qualitative data was tested using chi-square. The results of the chi-square test to discover the relationship between geographical location and performance in pre-clinical year (first year) of the MBBS curriculum are given in Table 8.

Table 8: Association between area distribution and performance of the students in pre-clinical year (first year) of the MBBS curriculum

Geographical Location	Performance in Pre-Clinical Year			Pearson Chi-Square Value	Degree of freedom (df)	Significance (p-value)
	Pass	Fail	N			
Urban	74.1%	25.9%	950	0.398	1	**0.528**[NS]
Rural	77.0%	23.0%	100			
[NS] **Not Significant**						

The difference in performance in the first year end university examinations was not statistically significant, with a p value of (0.528) between the students belonging to the urban areas, compared to those students belonging to rural areas. This proves there is no correlation between the geographical distribution and success in the first year examinations.

7.1.1.4 PCB % in School-leaving Examinations:

To determine whether the students with higher PCB% in school-leaving examinations perform better than students with lower PCB% in school-leaving

examinations, in the first year examination, the quantitative data was tested using an independent samples t-test (student's t-test). The results of the student's t- test to determine the relationship between PCB % and performance in the first year examinations of the MBBS curriculum are given in Table 9.

Table 9: Association between PCB % and performance of the students in pre-clinical year (first year) of the MBBS curriculum

Variable	Pass	Fail	Level of Significance
	Mean ± SD	Mean ± SD	(p value)
PCB %	85.72 ± 10.59	75.31 ± 12.14	**0.000*** **
*** p < 0.001			

The results of the student's t-test show a significant difference between mean± SD of the passing students (85.72 ± 10.59) and the students that failed (75.31 ± 12.14) the first year examinations at medical college. The difference between the two groups was statically significant with a p-value of 0.000 (significance at the level of $p < 0.001$). This clearly demonstrates the relationship between PCB % and performance in the first year examinations of the MBBS curriculum.

7.1.1.5 English % in School-leaving Examinations:

To discover whether the students with higher English marks in school-leaving examinations perform better in the first year examination at medical school, than students with lower English marks, the quantitative data was tested using the independent samples t-test (student's t-test). The results of the student's t- test are given in Table 10.

Table 10: Association between English % and performance of the students in pre-clinical year (first year) of the MBBS curriculum

Variable	Pass	Fail	Level of Significance
	Mean ± SD	Mean ± SD	(p value)
English %	87.42 ± 9.56	82.33 ± 12.12	**0.000*** **
*** p < 0.001			

A statistically significant difference with a p-value 0.000 (significance at the level of $p < 0.001$) was observed in the relationship between the percentage of English marks obtained in the school-leaving examinations and success in the first year examinations of the MBBS course, evidencing the relationship between English % and success in first year examinations of the MBBS curriculum.

7.1.1.6 PMT Entrance Score:

To understand the differences in performance of the students with higher PMT entrance score compared to those with lower PMT entrance score in the first year examinations of the MBBS course, the quantitative data was tested using the student's t-test (independent samples t-test). The results of the student's t-test (independent samples t-test) to discover the relationship between PMT score and performance in the first year examinations of the MBBS curriculum are given in Table 11.

Table 11: Association between English % and performance of the students in pre-clinical year (first year) of the MBBS curriculum

Variable	Pass	Fail	Level of Significance
	Mean ± SD	Mean ± SD	(p value)
PMT %	83.78 ± 11.28	75.57 ± 12.92	**0.000*** **
*** p < 0.001			

The results reveal the correlation between PMT scores and performance of the students in the first year examinations of the MBBS course, with a statistically significant difference with a p-value of 0.000 (significance at the level of $p < 0.001$).

7.1.1.7 Father's Education Level (Professional medical / health sciences degree vs with non-health degree):

The categorical data was tested using Chi-square to discover the relationship between success rates in the year end examinations of the MBBS course, for students with fathers possessing a professional medical / health sciences qualification compared to those with fathers having a non-medical qualification. The results of the chi-square test are given in Table 12.

Table 12: Relationship between Father's education level and performance of the students in pre-clinical year (first year) of the MBBS curriculum

Father's Education Level	Performance in Pre-Clinical Year			Pearson Chi-Square Value	Degree of freedom (df)	Significance (p-value)
	Pass	Fail	N			
with non-health degree	73.5%	26.5%	873	1.924	1	**0.165^{NS}**
Professional medical / health sciences degree	78.5%	21.5%	177			
^{NS} Not Significant						

The results of chi-square test showed a Pearson chi-square value of 1.924 and degree of freedom of 1. There is no statistical difference ($p = 0.165$) in the performance of students with fathers possessing a non-medical / non-health sciences degree when compared to students with fathers holding a professional medical / health sciences degree. This shows that there is no correlation

between the father's education level and the students' success in the first year examinations of the MBBS course.

7.1.1.8 Mother's Education Level (Professional medical / health sciences degree vs with non-health degree)

To discover the relationship between the performance in the first year examinations and the mother's education qualifications. The results of the chi-square test to discover the relationship between the mother's education and the performance of the students in the first year of the MBBS course are given in Table 13.

Table 13: Relationship between the Mothers' education level and performance of the students in pre-clinical year (first year) of the MBBS curriculum

Mother's Education Level	Performance in Pre-Clinical Year			Pearson Chi-Square Value	Degree of freedom (df)	Significance (p-value)
	Pass	Fail	N			
with non-health degree	73.9 %	26.1%	911	0.925	1	**0.336[NS]**
Professional medical / health sciences degree	77.7 %	22.3%	139			
[NS] Not Significant						

The results give a Pearson chi-square value of 0.925 with a degree of freedom of 1, exhibiting no significant difference (p = 0.336) in the performance of the students with mothers having a non-medical / non-health sciences degree, compared to those students with mothers having a professional medical / health sciences degree. These results show no correlation between the performance of the student in first professional year and the mothers' educational qualifications.

7.1.1.9 Father's Occupation (working in a non-health science (non-medical) field vs working in health sciences (medical) field)

The qualitative data was tested using Chi-square to discover the relationship between the fathers' occupation and the students' performance in the first year examinations of the MBBS course. The results of the chi-square test are given in Table 14.

Table 14: Association between Father's occupation and performance of the students in pre-clinical year (first year) of the MBBS curriculum

Father's Occupation	Performance in Pre-Clinical Year			Pearson Chi-Square Value	Degree of freedom (df)	Significance (p-value)
	Pass	Fail	N			
working in non-health sciences (non-medical) background	73.5%	26.5%	869	1.903	1	**0.168[NS]**
working in health sciences (medical) field	78.5%	21.5%	181			
[NS] Not Significant						

A Pearson chi-square value of 1.903 and degree of freedom of 1, shows the performance of the two groups students was not statistically different (with a p-value of 0.168) for the father's occupation variables. There is no correlation between the father's occupation and the student's performance in the first year examinations of the MBBS course.

7.1.1.10 Mother's Occupation (working in non-health sciences (non-medical) background vs working in health sciences (medical) field)

The qualitative data was tested using chi-square to determine the relationship between the mothers' occupation and the students' performance in the final year examinations of the MBBS course. The results of the chi-square test are given in Table 15.

Table 15: Relationship between Mother's occupation and performance of the students in pre-clinical year (first year) of the MBBS curriculum

Mother's Occupation	Performance in Pre-Clinical Year			Pearson Chi-Square Value	Degree of freedom (df)	Significance (p-value)
	Pass	Fail	N			
working in non-health sciences (non-medical) background	74.1%	25.9%	915	0.250	1	**0.617[NS]**
working in health sciences (medical) field	76.1%	23.9%	134			
[NS] Not Significant						

There is no statistically significant difference in performance between the two test groups (Pearson chi-square value of 0.250 with a degree of freedom of 1) (p=0.167). These results show no correlation between the mothers' occupation and success of the students in first year of the MBBS course.

7.1.1.11 Comparison between variables with pre-admission mean test scores "(PCB%, English marks & PMT%)

The mean test scores of percentage of aggregate marks obtained in Physics, Chemistry and Biology (PCB) in the school-leaving examination, percentage of marks obtained in English in the school-leaving examination, and percentage of marks obtained in the pre-medical common entrance test, according to the student's gender (male/female) are given in Table 16.

Table 16: Mean test scores by gender (Male vs Female)

Gender	PCB (%)			Eng (%)			PMT Entrance (%)		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	82.6%	12.29	439	85.0%	10.48	439	80.9%	12.56	436
Female	83.4%	11.61	611	86.9%	10.47	611	82.1%	12.01	606
Level of Significance (p-value)	**0.303^{NS}**			**0.004****			**0.119 ^{NS}**		
**** p < 0.01; ^{NS} Not Significant**									

Female students have higher mean test scores. But the higher PCB% and PMT% of the female students were not statistically significant with p values of 0.303 and 0.119 respectively. The higher English marks scores of the female students when compared to that of the male students were statistically significant with a p-value of 0.004 (significance at the level of $p < 0.01$).

The mean test scores as percentage of aggregate marks obtained in Physics, Chemistry and Biology (PCB) in the school-leaving examination, percentage of marks obtained in English in the school-leaving examination, percentage of marks obtained in the pre-medical common entrance test, according to the school-leaving examination Type (State board / Others) is given in Table 17.

Table 17: Mean test scores in school-leaving exam type / board (State board vs Other Boards)

School-leaving	PCB (%)	Eng (%)	PMT Entrance (%)

exam type	Mean	SD	N	Mean	SD	N	Mean	SD	N
State Board	84.1%	10.52	895	87.4%	6.54	895	82.6%	11.93	894
Other Boards	76.9%	16.64	155	78.5%	20.89	155	76.4%	12.85	148
Level of Significance (p-value)			**0.000*** **			**0.000*** **	**0.000*** **		
**** p < 0.001**									

The students that studied in the state board during their schooling have higher PCB%, Eng% and PMT% scores and all were statistically significant with a p-value of 0.000 (significance at the level of $p < 0.001$).

The mean test scores of percentage of aggregate marks obtained in Physics, Chemistry, Biology (PCB) in the school-leaving examination, percentage of marks obtained in English in the school-leaving examination, percentage of marks obtained in the pre-medical common entrance test, according to the area the students belong to (rural/urban) are given in Table 18.

Table 18: Mean test scores by geographical location (Rural vs Urban)

Area Distribution	PCB (%)			Eng (%)			PMT Entrance (%)		
	Mean	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**
Urban	82.6%	12.16	950	85.8%	10.85	950	80.9%	12.35	942
Rural	87.7%	7.73	100	88.4%	5.94	100	89.1%	8.16	100
Level of Significance (p-value)			**0.000*** **			**0.021***			**0.000*** **
**** p < 0.001; *p < 0.05**									

Higher scores were obtained by the students from rural areas in the PCB%, English marks and PMT% score. The higher scores in PCB% and PMT% score were highly significant statistically with p-value 0.000 (significance at the level of $p < 0.001$). But the English marks was significance at the level of $p<0.05$ ($p=0.021$).

The mean test scores of percentage of aggregate marks obtained in Physics, Chemistry and Biology (PCB) in the school-leaving examination, percentage of marks obtained in the English in school-leaving examination, and percentage of marks obtained in the pre-medical common entrance test, according to the student's father's education (holding professional non-medical degree / uneducated vs / holding professional medical / health sciences degree) are given in Table 19.

Table 19: Mean test scores by father's education Level (Professional medical / health sciences degree vs uneducated / with non-health degree)

Father's Education	PCB (%)			Eng (%)			PMT Entrance (%)		
	Mean	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**
Holding professional non-medical degree / uneducated	82.9%	12.04	873	85.9%	10.88	873	81.8%	12.27	866
Holding professional medical / health sciences degree	84.0%	11.19	177	86.9	8.48	177	80.8%	12.11	176
Level of Significance (p-value)			**0.248^{NS}**			**0.306^{NS}**			**0.292 ^{NS}**
^{NS} Not Significant									

The PCB%, English marks and PMT% scores obtained by the students' father holding professional non-medical degree / uneducated, compared to those students' with fathers having professional medical / health sciences degrees were not statistically significant with p-values, 0.248, 0.306 and 0.292 respectively.

The mean test scores of percentage of aggregate marks obtained in Physics, Chemistry and Biology (PCB) in the school-leaving examination, percentage of

marks obtained in the English in school-leaving examination, and percentage of marks obtained in the pre-medical common entrance test, according to the student's mother's education (holding professional non-medical degree / uneducated vs / holding professional medical / health sciences degree) are given in Table 20.

Table 20: Mean test Scores by mother's educational qualifications

Mother's Education	PCB (%)			Eng (%)			PMT Entrance (%)		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
Holding professional non-medical degree / uneducated	82.7%	12.27	911	85.9%	10.95	911	81.7%	12.33	904
Holding professional medical / health sciences degree	85.2%	8.85	139	87.3%	6.87	139	81.9%	11.74	138
Level of Significance (p-value)			**0.021***			**0.165^{NS}**			**0.864^{NS}**
***p < 0.05; ^{NS} Not Significant**									

Statistically significant higher mean values of PCB% were observed in the students with mothers holding a professional medical / health sciences degree when compared to those students with mothers holding a non-medical degree, with ap-value of 0.021 (significance at the level of $p<0.05$). A statistically significant difference is not found in the English marks and PMT% scores between the two groups ($p=0.165$ & 0.864 respectively).

The mean test scores of percentage of aggregate marks obtained in the Physics, Chemistry, Biology (PCB) in school-leaving examination, percentage of marks obtained in the English in school-leaving examination, percentage of marks

obtained in the pre-medical common entrance test, according to the student's father's occupation (working in non-health sciences (non-medical) fields vs working in health sciences (medical) fields) are given in Table 21.

Table 21: Mean test scores by fathers' occupation (working in health sciences (medical) field vs working in non-health sciences (non-medical) fields)

Father's Occupation	PCB (%)			Eng (%)			PMT Entrance (%)		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
working in non-health sciences (non-medical) background	82.9%	11.9	869	86.0%	10.87	869	81.9%	12.06	862
working in health sciences (medical) field	83.8%	11.93	181	86.7%	8.56	181	80.8%	13.09	180
Level of Significance (p-value)			0.335[NS]			0.450[NS]			0.275[NS]
[NS] Not Significant									

The PCB%, English marks and PMT% scores were not statistically significant among the two groups, students with fathers working in non-health sciences (non-medical) fields, compared to those students with fathers working in health sciences (medical) fields.

The mean test scores of percentage of aggregate marks obtained in Physics, Chemistry and Biology (PCB) in the school-leaving examination, percentage of marks obtained in the English in the school-leaving examination, and percentage of marks obtained in the pre-medical common entrance test, according to the student's mother's occupation (working in non-health sciences (non-medical) fields versus working in health sciences (medical) field) are given in Table 22.

Table 22: Mean test scores by mother's occupation (working in health sciences (medical) field vs working in non-health sciences (non-medical) fields)

Mother's Occupation	PCB (%)			Eng (%)			PMT Entrance (%)		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
working in non-health sciences (non-medical) fields	82.8%	12.19	915	85.9%	10.11	915	81.6%	12.27	908
working in health sciences (medical) field	85.1%	9.55	134	87.1%	7.19	134	82.1%	12.14	133
Level of Significance (p-value)			0.035*			0.239^{NS}			0.675^{NS}
*p < 0.05; ^{NS} Not Significant									

The students with mothers working in the health science (medical) fields show higher PCB% scores (85.1%), compared to students with mothers working in non-health sciences (non-medical) fields (82.8%). These higher scores were statistically different with a p-value of 0.035 (significance at the level of $p<0.05$). Higher English marks and PMT% scores were also observed, but neither was statistically significant with p-values of 0.239 and 0.675 respectively ($p>0.05$).

7.2 Binary Logistic Regression Analysis

A test of the model against a constant-only model was statistically significant, indicating that the predictors, as a set, reliably distinguished between those passing and failing the first year of study in the MBBS programme (chi square = 161.9, p < .001 with df = 2). The constant-only model had a 74.2% accuracy, while the model containing the combined Physics, Biology, and Chemistry score had a 77.6% accuracy. The English score on the school-leaving test only minimally contributed to the model, and worsened accuracy; that model had 76.9% accuracy.

Nagelkerke's R^2 of 0.22 indicated a minimal relationship between prediction and grouping. The Wald criterion demonstrated that the Physics, Biology, and Chemistry combined score made a significant contribution to prediction ($p < .001$). English score from the school-leaving examination was also a statistically significant predictor ($p < .001$). Father's education ($p=0.43$), father's occupation ($p=0.08$), mother's education ($p=0.48$), mother's occupation ($p=0.89$), and the pre-medical test ($p=0.29$) were not statistically significant predictors. Exp (B) value indicates that for each 1.1 point increase in the Physics/Chemistry/Biology score, the likelihood of passing the first year is increased by 1.5 times. The percent correct score for English contributes minimal additional information to the model. For each 1 point increase in English score, the likelihood of passing the first year increases by 0.45.

This shows that the English scores do not add much predictive power. The model fit was better before the addition of the English scores. The accuracy actually decreases slightly when the English score is added (77.6% accuracy vs. 76.9%). The reclassification table shows the accuracy of the model. We could change the accuracy by adjusting the cut-off value from the default of 0.05 as given in Table 23.

Table 23: Predictive model using binary logistic regression

		Variables in the Equation						**95% CI for Exp(B)**	
		B	**S.E.**	**Wald**	**df**	**Sig**	**Exp(B)**	**Lower**	**Upper**
Step 2	**PCB %**	0.085	0.01	74.719	1	0.000	1.089	1.068	1.110
	Eng %	0.026	0.013	3.869	1	0.049	1.027	1.000	1.054
	Constant	-8.268	1.028	64.651	1	0.000	0.000		

The percent correct score for PCB was entered on the first step and contributes to the model. For each 1.1 point increase in score, the likelihood of passing the first year is increased. The percent correct score for English contributes

minimal additional information to the model. For each 1 point increase in score, the likelihood of passing the first year increases. The percent correct score from the entrance examination does not contribute to the model, and fathers' and mothers' educational qualifications (holding professional non-medical degree / uneducated vs / holding professional medical / health sciences degree), fathers' and mothers' occupations ((working in non-health sciences (non-medical) fields vs working in health sciences (medical) fields)) do not contribute to the model.

8 DISCUSSION

Admission to medical school is extremely competitive with many more aspirants than available places. Although the same level of academic training is given to all students in our medical school, around 24-27% of students fail the assessment exams in each year. This suggests that there are various factors that determine the success rate for a student. It is well established that medical students sometimes find it very difficult to study the basic medical science subjects, Anatomy, Physiology and Biochemistry in the first professional or pre-clinical year (Bhowmick et al, 2009; Abhijeet and Mukul, 2014).

Students who have difficulty in learning basic sciences in the pre-clinical year of the MBBS course may fail one or more subjects in the first professional year. This affects their perception of the educational environment in year 2, 3 and 4 and has an impact on their quality of life (Omna et al, 2012). Success in the preclinical year means passing in all the three preclinical subjects; Anatomy, Physiology and Biochemistry (Medical Council of India regulations on graduate medical education, 2012). Passing in first professional (Phase-I) is compulsory before proceeding to Phase II training: the second professional (Medical Council of India regulations on graduate medical education, 2012). If they fail in the first professional year, they are

not allowed to enter into the second professional year of the medical curriculum and have to repeat the failed subjects at the next university examination, which is conducted within six months. The student will not be able to enter the second year unless all the three subjects of the first professional year are passed. As a result, students may lose their valuable time and face an extension of the duration of their medical course. This causes many adverse effects in the failed students, both physical and mental (Jadhavar et al, 2013; Somnath, 2014). They as also labelled as an “Arrear/Additional” students throughout their medical careers. This may result depression, which causes them to fail again in the second attempt, subsequently losing even more time (Bhowmick et al., 2009; Jadhavar et al, 2013). This affects their future educational environment in years 2, 3 and 4 and also their quality of life (Jadhavar et al, 2013; Somnath, 2014).

Keeping this in mind, I have tried addressing the problem by identifying pre-admission factors and variables that predict the performance of the students in the first professional year and consequently, their success in the pre-clinical year of the MBBS curriculum.

The factors identified were categorised into three different classes, personal (gender), sociocultural (Geographical area of origin), English scores in school-leaving examinations, father’s educational qualifications, mother’s educational qualifications, father’s occupation, mother’s occupation) and educational (school-leaving exam type / board, PCB % in school-leaving examinations, PMT entrance score).

The available data included, gender (male vs female), school-leaving exam type / board (State board vs Other Boards), area distribution (Rural vs Urban), Physics, Chemistry and Biology (PCB%) scores in school-leaving examinations,

English score in school-leaving examinations, pre-medical test (PMT) score, father's education qualification level (professional medical / health sciences degree vs with non-health degree), mother's education qualification Level (professional medical / health sciences degree vs with non-health degree), father's occupation (working in non-health sciences (non-medical) background vs working in health sciences (medical) field) and mother's occupation (working in a non-health sciences (non-medical) background vs working in health sciences (medical) field)). These variables were analysed to find the extent to which they influenced the probability of passing the first year of medical school. We did not gather the information pertaining to two "personal" variables, emotional intelligence and "forced career choice of the students", since the literature shows that these two variables do not have predictive power on the performance of students in the pre-clinical year (Mandal et al, 2012; Humphrey-Murto et al, 2014).

After obtaining and gathering the demographics of the sample, I have tried addressing the association of all these three classes of variables (the pre-admission variables) and performance of the students in pre-clinical year (first year) of the MBBS curriculum. We have investigated the comparison between variables with pre-admission mean test scores (PCB, English marks and PMT marks). Finally, using binary logistic regression analysis, I analysed the predictive power of the personal, social and cultural and educational variables. If the factors predicting the success in the first professional year (the pre-clinical year) can be identified early in their academic year, I can then identify the students at risk of failure and offer early interventional support to prevent this.

8.1 The effects of personal variables:

In this present study, I investigated whether male students performing better than female students in the university examination at the end of first year of the medical curriculum (the pre-clinical year). The results show that female students performing better with a pass percentage of 80.4, compared to male students with the pass percentage of 66.1, with a significant difference ($p < 0.001$). The results of this study are in concordance with the findings of a few other studies, which reported significantly higher performance in female than male students (Mandal et al, 2012; Biswas and Jain, 2013; Salem et al, 2013; Roy and Chadalavada, 2014). This may be due to the fact that the female students are more focussed than the male students after their entry into the medical college. The significant difference ($p < 0.001$) between the performances of the female students, compared to male students, showed the correlation between ender and performance in the first professional year. In contrast to the findings of this study, and other reports which support the findings, El-hazmi et al (1987) documented that male students perform better than female students in the pre-clinical year (El-Hazmi et al, 1987). This might be attributed to the cultural differences among the medical schools.

8.2 The effects of sociocultural variables:

We have examined the association between social and cultural variables and performance of the students in pre-clinical year (first year) of the MBBS curriculum. The social and cultural variables included, area distribution, English scores on the school-leaving examinations, father's educational level, mother's educational level, father's occupation and mother's occupation.

I have probed for differences in in the performance of students in the university examination at the end of first year of the medical curriculum (the pre-clinical year) based on their geographical location, either rural or urban. The findings showed that there is no statistically significant difference between the performance of students from urban and rural areas. The findings are similar to those found by various other researchers (Biswas and Jain, 2013; Roy and Chadalawada, 2014), who reported that geographical area distribution of student had no effect on performance. Our study showed no correlation between geographical location and performance in pre-clinical year (first year) of the MBBS curriculum. In contrast to our findings, the majority of students failing in Anatomy were students staying away from home, compared to those staying at home (Pal and Pal, 2013). This might be attributed to the homesickness of the students and / or difficulties in adjusting to the new environment and culture.

We observed a statistically significant correlation ($p = 0.000$) between the percentage of the English marks obtained in the school-leaving examinations and success in the first professional year (pre-clinical year) of the MBBS course. This indicates that students with higher English marks perform better in the university examination at the end of first year of the medical curriculum, than students with lower English marks in school-leaving examinations. This shows a possible linkage between English marks in school-leaving examinations and success in first professional year of the medical curriculum. These findings are similar to various other studies which reported that students with proficiency in the English language perform better than students who have problems with English language (Mandal et al, 2012; Biswas and Jain, 2013; Salem et al, 2013). This might be due to the fact that in all Indian medical schools, the medium of instruction is

English and it is obvious that the students with poor proficiency in English cannot understand the subject material resulting in the poor performance in the first year. Also, these students after their entry into the medical school may not have enough time to adjusted to their new environment, since the first professional year is of one year in duration, whereas the second professional phase is of one and half years in duration. These findings are also supported by another study was conducted in United Arab Emirates (Hrab and El Shaarwai, 2009). This study documented that students with English proficiency showed good academic performance, indicating that good proficiency in English is an important factor that affects academic performance.

The results of my study did not discover any difference in the performance of students whose parents (both father and mother) have a professional medical / health sciences qualification, compared to students whose parents (both father and mother) have a non-medical qualification. This indicates that the student's success in the pre-clinical year of the MBBS curriculum is not correlated to the parent's educational qualifications (those holding professional medical / health sciences degree vs uneducated parents / those with non-health degree). When reflecting on the potential effect of this variable, I expected students with either parent holding a medical degree or possessing a professional medical / health sciences qualification, to perform better than students having parents with a non-medical qualification. However, the presence of a parent holding a medical degree / health sciences degree did not exhibit a correlation with the performance of students in the first professional year and in the first year examinations. Our findings are similar to that reported by Karemera (2003) and Salem et al (2013).

Contrary to our findings, Alfayez et al (1990), assert that students with either parent having a higher level of education and specifically, the presence of doctor, medical practitioner or health care professional showed significant positive influence on the academic performance of their children and showed significant positive correlation with the academic performance, when compared to those students having parents with lower educational qualifications or a non-medical background (Alfayez et al, 1990). The difference in findings might arise from social and cultural differences between the various countries and places where the studies were conducted.

My study sought to discover variations between the performances of the students having either parent working in the health sciences (medical) field compared to those students having either parent working in non-health sciences (non-medical) fields. Our assumptions were that the presence of either parent with a medical or health sciences) occupation would positively influence their childrens' academic performance in medical school. Our findings revealed no correlation between both parents' occupation and the success of their children in first professional year of the medical curriculum. Our findings are in agreement with the reports from other studies obtainable in the literature (Karemera, 2003; Salem et al., 2013).

8.3 The effects of educational variables

In my study I investigated the association between school-leaving type / board and performance of the students in pre-clinical year (first year) of the MBBS curriculum. I queried whether the state board students perform better than other board students with respect to the performance in the university examination at the end of first year of the medical curriculum (the pre-clinical

year). I found no difference in the performance of the students in the first professional year, between who took the State board (Tamilnadu state) and those students who took the other boards (CBSE, ICSE etc.). There is no correlation between the school-leaving type / board and performance of the students in pre-clinical year. This might be attributed to the similarities in the calibre of the students taking all boards, their capabilities in understanding the subjects and capabilities in preparing for the examinations etc. In contrast to our findings, it has been documented that there are differences in the performances in the Anatomy university examinations of the pre-clinical year, between students passing the ISC/CBSE boards and those passing the West Bengal board (Pal and Pal, 2013). The percentage of the students passing was significantly higher among the West Bengal state board than those students from ISC/CBSE board. This might be attributed to the high standards of the West Bengal state board curriculum.

In this present investigation, we found a correlation between PCB % and performance of the students in pre-clinical year (first year) of the MBBS curriculum. The students with higher PCB% in school-leaving examinations perform better than students with lower PCB% in school-leaving examinations, during the pre-clinical year. This is due to the fact that the students that have had good knowledge and understanding of Physics, Chemistry and Biology can obviously understand the Anatomy, Physiology and Biochemistry subjects (subjects in pre-clinical year) better since the content of these subjects is closely related. Also, the association between the higher PCB% and success in pre-clinical year can also be attributed the similar difficulty level and complexity of the subjects of the pre-clinical year to that of the PCB in school-leaving examinations.

The results of Biswas and Jain 2013, suggest that lower pre-admission scores predict weaker performance in the first professional year after the student's admission into the MBBS course (Biswas and Jain, 2013). This is also in concordance with our findings in the present investigation, which showed the ability of the PCB scores in the school-leaving examination (the pre-admission scores) as a prediction tool to identify the students at risk of failure in the first professional year of the MBBS course. Our findings are also supported by the findings of various other studies across the world which documented that students with good PCB scores perform better in pre-clinical year (James and Chilvers, 2001; Cohen-Schotanus et al, 2006; Hissbach et al, 2011; Sitticharoon et al, 2014).

In this present study, we have observed a correlation between the scores obtained in the PMT and the performance of the students in the first professional year of the medical curriculum. The performance of the students with higher PMT entrance score was high in the university examinations at the end of the pre-clinical year, compared to those with lower PMT entrance score. The students with higher PMT scores achieved success, than those with lower PMT scores. Our findings are in accordance with several research reports published India and globally, indicating that the score in PMT is linked to and associated with academic performance (Chan-Ob and Boonyanaruthee, 1999; McManus et al, 2011; Biswas and Jain, 2013; McManus et al, 2013; Simpson et al, 2014).

In contrast to our findings, it was documented that performance in the qualifying medical entrance examination was a key factor that affects learning and performance in Anatomy (Pal and Pal, 2013). But this study was confined

only to the student's performance and success in passing the Anatomy examination only, but not the remaining subjects, Physiology and Biochemistry.

The mean test scores of percentage of aggregate marks obtained in Physics, Chemistry and Biology (PCB) in the school-leaving examination, percentage of marks obtained in English in the school-leaving examination, and percentage of marks obtained in the pre-medical common entrance test, were compared against the other variables., gender (male/female); school-leaving examination Type (State board / Others); area the students belong to (rural/urban); parent's education (holding professional non-medical degree / uneducated vs / holding professional medical / health sciences degree) and parent's occupation (working in a non-health sciences (non-medical) background vs working in health sciences (medical) field). Our study showed that, female students have had significantly higher English marks scores and the students from rural areas had significantly higher PCB%, English marks and PMT% scores. In addition, the students whose mother holding a medical / health sciences degree and working in a medical / health sciences related field have had higher PCB%. All the other variables did not show any significant effect on the PCB%, English marks and PMT score.

8.4 Variables with predictive power to identify students at risk

Although the PCB% of school-leaving examinations, English marks of school-leaving examinations and the PMT score are associated with performance in the pre-clinical year, I wanted to identify and understand the most reliable prediction variables, to predict the future performance of the students in pre-clinical year (first professional year) of the MBBS course. So, to examine the predictive power of personal, social & cultural and educational

variables that predict the academic success of the students in the pre-clinical year (first professional year) of the MBBS curriculum, I performed the binary logistic regression.

The results of the study showed that, among the various personal, social & cultural, and educational variables studied the school-leaving scores (PCB% and the English marks) most accurately predicted the success rate for students in the first professional year (pre-clinical year). Other variables, i.e., gender, geographical location, PMT score, father's education level, mother's education level, father's occupation and mother's occupation did not predict success in the first year of medical school. For every 1.1 point increase in the Physics/Chemistry/Biology score, the likelihood of passing the first year is increased by 1.5 times. The percent correct score for English contributes minimal additional information to the model. For each 1 point increase in English score, the likelihood of passing the first year increases by 0.45. The findings, suggest that the PCB% score in the school-leaving examinations can act as the sole and accurate predictor. The English marks score in the school-leaving examinations can also be useful to predict the academic success to a much lesser extent. These findings of my study are in accordance with the findings of various other studies that document the use of school-leaving exam scores to predict the success and the academic attainment of the students in the pre-clinical year of the medical curriculum (Al-Nasir and Robertson, 2001; Lumb and Vail, 2004).

In contrast to the findings of my study, research conducted by the Faculty of medicine and health sciences in the United Arab Emirates University found high school grades are ineffective predictors of the student's

academic performance in medical school, even in the initial stages / periods at medical school (Shaban and McLean, 2011). This discrepancy might be due to differences in the curricula of the school-leaving examinations (higher secondary education) and also can be attributed to the knowledge component of Physics, Chemistry, Biology and the difficulty level at each school.

The percent correct score from the PMT does not contribute to the model, and father's education level, mother's education level, father's occupation, and mother's occupation do not contribute to the model. It is well documented that factors such as types of entrance, motivation to study medicine, relationship with peers, learning behaviours and number of friends play a key role in learning the three pre-clinical subjects of Anatomy, Physiology and Biochemistry (Bhowmick et al, 2009; Biswas and Jain, 2013; Sitticharoon et al, 2014). It has been demonstrated that the updated MCAT (Medical College Admission Test) results are very useful for identifying individuals likely to succeed in medical school (Mitchell et al, 1994). The pre-medical test scores like MCAT in USA and UK CAT in United Kingdom proved to be the key factors that determine the success of the students in year 1 after their entry into the medical school (Colliver et al, 1989; Hissbach et al, 2011; Simpson et al, 2014). This is in contrast to our findings that showed PMT scores to be ineffective in predicting the success of students in pre-clinical year (first professional year) of the medical curriculum. This variation might be due to the differences in the standards of the examinations, subjects covered in the entrance examinations, assessment patterns and various other sociocultural factors in the pre-medical examination patterns and standards. All medical schools desire to mould every student into a competent physician.

My findings suggest and recommend that medical colleges consider the entrants' academic performance in high school during the admission process, to inform the selection process for admission to the MBBS course. Good academic performance in high school is a very accurate indicator of future success in their first year of medical school.

8.5 How can we identify students in need of support?

A previous academic performance in Physics, Chemistry and Biology is an accurate indicator to identify students requiring interventional support. Marks obtained in English in the school-leaving examination and proficiency in the English language also help identify high risk students, to some extent. Creating and implementing effective support strategies for the students at risk increases the overall pass rates in the first professional (pre-clinical) year-end examinations.

8.6 What support can be offered?

Learning basic sciences in the first professional year (pre-clinical year) of undergraduate medical curriculum plays a key role in understanding the other subjects in the para-clinical and clinical years (Dandekar et al, 2014). Learning basic sciences paves the path for clinical reasoning and provides basic mechanism to learn about the research (Prasad, 2013). If the medical student becomes disconnected and detached from learning the basic sciences, it therefore reflects on their overall future learning. So, identifying these students at risk will be helpful for teachers and other stakeholders involved in the medical curriculum. This enhances understanding issues faced by undergraduate medical students when learning basic sciences in the first year of the MBBS curriculum. Educators could reflect on factors that lead to

the disengagement of students when learning basic sciences. This can yield the design for effective solutions.

The support can be in the form of counselling, motivation, mentoring, role modelling, conducting extra classes, offering additional coaching etc., thereby allowing the students to succeed in the pre-clinical year (Jayalakshmi et al, 2011). Such interventions will increase the success of medical students in the pre-clinical year and thereby help students at risk and prevent them from failure in the first professional year (pre-clinical year). This enables them to advance into the second year of the medical curriculum successfully without stigmatization and loss of valuable time from extending the duration of their medical courses. This relieves the student from stress, depression and anxiety, thereby improving their quality of life and easing their progress towards becoming an effective medical practitioner.

For a long time, in the state of Tamil Nadu, the academic performance of a candidate was the only criterion for selection to undergo the MBBS degree. This process consisted of creating a merit list based on the marks/grades obtained by candidates applying for admission to the MBBS course in the school-leaving examinations and calling them in the order of merit for a personal interview to determine their aptitude to undergo the course and become good medical practitioners.

This methodology seemed to work well as the system produced for decades, scores of doctors who performed wonderfully in the field of family medicine and were greatly revered by the families they served. Many of them emigrated to America and England where they were recognised for their intelligence and skills. In the recent past, a centralised process of selection

was created where student selection has been based on a competitive examination.

This process has the advantage of being based on the performance of the students in answering only objective questions. This process however seemed to have created a dire situation in the sense that students who have decided on a career of medicine attend along with regular school leavers, classes run by several institutions which “coach” them in a focussed manner to succeed in the competitive examinations. In this scenario the grounding in the student’s knowledge of the subjects’ Physics, Chemistry and Biology is lost. This grounding serves as a foundation that enhances learning the various pre-and para-clinical subjects that form the core of a medical career. This study drives home strongly the above observation.

8.7 Possible impact of the outcome of our study

Failure in examination(s) is a common occurrence in the MBBS course. Brilliant academicians, great teachers, successful practitioners all have experienced it at some point. Failures can occur as candidates rack their brains for elusive answers, rue the fact that he or she had not studied a particular chapter, flay themselves for not having spent enough time studying – the reasons are innumerable. Failure can lead to several outcomes. People can drop out of the course- a drastic step. Some students feel extremely motivated to improve, perform well henceforth- a positive outcome. The effect of failure on some others is extreme depression, and to overcome this state is very difficult. At this point of time the reaction of the family, teachers and friends is a very important factor in determining the future course of action of a student who has failed. Families should rally around the students, treat the

failure as a common place unfortunate incident, lend complete support and ensure that the student moves on. This has a positive effect. The role of the teacher is to counsel the students. As the students usually have several reservations it is imperative that the teacher in the role of a mentor addresses them. Usually, failing students do not like to be part of the succeeding batch or junior batch. This extremely delicate issue should be addressed. Lectures and workshops could be held separately if a large number of students have failed. Clinical postings may be given imaginatively. If the situation is handled with sensitivity by the teacher, most problems are resolved. A one on one mentorship program would be the icing on the cake.

There are students who mourn by absence. It is here that the college dean/head of the department have a very important role to play. The student must be counselled, ensuring their attendance. Once the initial reluctance is countered, the student realises the importance of moving forward. However, this reaction must stem from the student's determination to complete the course. The role of friends is extremely important. For a failed student, a friend determines the comfort zone in the learning environment. The initial steps taken by the failed student to come back to college is a major factor which determines his or her future and a friend has the major role in this scenario. The level of confidence which the failed student has in tackling the components of the course is extremely low. To reappear for the same examination drains away self-confidence, the belief in one's capabilities. It is here that the local examiners should handle the situation with great sensitivity to ensure that the student prepares and performs to his or her potential.

The learning of basic sciences in year 1 (pre-clinical year) of undergraduate medical curriculum plays a key role in understanding the other subjects in para-clinical and clinical years. Learning basic sciences paves the path for clinical reasoning and provides a basic mechanism to learn about the research. If the medical students become disconnected and detached from learning the basic sciences, it reflects on their overall future learning. So, identifying these students at risk will be helpful for the teachers and other stakeholders involved in the medical curriculum. This helps them to comprehend the difficulties encountered by undergraduate medical students in learning basic sciences of the phase I MBBS curriculum and reflect on ways to address these factors that lead to disengagement.

9 SCOPE FOR FURTHER RESEARCH:

In this present investigation, we have mainly concentrated on the identification of variables and factors that related to the students before they get admitted into the MBBS course, the pre-admission variables. I have focused on these pre-admission variables in my study because very little research has been conducted in India to study the effect of these pre-admission variables in determining the success of the medical student in pre-clinical year (the year 1) of the medical curriculum. These variables may permit the identification of students who are potentially at risk of failing in the first year (Bhowmick et al., 2009; Omna et al., 2012; Abhijeet and Mukul., 2014).

Once we have been able to identify students who may need support, we will be able to further explore the difficulties, issues and problems they encountered in during their first year of study in the MBBS Phase I programme through qualitative methods such as focus group discussions and semi-structured interviews with

students. These methods may be used to examine faculty perceptions as well. This approach to data collection and analysis will allow the researcher to investigate the problem in depth, thereby gathering valuable information. By identifying students considered at risk, according to the statistical model, it may be possible to examine factors that enable them to succeed in the first year, as the model was not without error in classification.

Once this future extensive study has been completed, the researcher can further investigate the important issue – “what support do students need to help them succeed?” A plan can then be developed to design effective solutions. All these contribute for the formulation of new research questions to extend the reach of my study. This study and its findings will form a strong foundation for further research.

This research study mainly focused on the variables and factors directly related to the post-admission experiences of students in medical school such as language proficiency to cope with the English-medium studies. A wide variety of factors might be at play, such as, perhaps, students’ learning styles (Shah et al, 2012). Students might be moulded in their school in such a way that they score good marks in their higher secondary school-leaving examinations. Based on this high score in the qualifying examination, the students gain entry into medical college very easily. On entry into medical college, which is a professional course, it may well be that some students will find it difficult to study in a different way, due to the learning styles that they have adopted during their school years. This might have a profound effect on the student’s learning and motivation to learn (Ranganath and Priya., 2015). The transition between school and the entry into the medical college is extremely important. A study was conducted to explore factors promoting positive adaptation and resilience during the transition to college (Leary and Derosier, 2012).

The prevalence of stress and anxiety in first year college students underscores the need for adequate and appropriate support services to help students successfully transition to post-secondary learning. In fact, the extent to which students are able to cope with stress during the first year of college is related to their academic resilience (Leary and Derosier, 2012). The results of this research indicate that social connectedness and cognitive style were the most important predictors of student stress during the transition to medical college. The results also suggest that providing students the opportunity to develop social connections and learn optimistic and motivated thought processes might be particularly helpful in promoting psychological wellbeing by preparing and assisting students in dealing with the transition to college (Leary and Derosier, 2012).

Future research could also explore these post-admission factors, aligning with the pre-admission variables to develop conceptual frameworks to identify and support students at risk.

10 CONCLUSION:

The findings of this study, provided fascinating insight into the relationship between performance in the entrance examination, used to select the students for admission would not be useful in identifying those at risk of failure in the first year. The PCB and English scores should instead be used to identify students at risk.

10.1 Why are our findings interesting?

The most important finding in this study is that although medical students who pass the first professional year (pre-clinical year) score higher on average, in the PMT tests, than those who don't pass the end of year basic science examination, the best predictor of performance, of all the variables in the study, were the PCB marks. This finding is interesting, because the PCB marks can identify students at risk more

accurately, even if the PMT ranking is used for selection. These findings allow us to extend this study by conducting focus group discussions (FGDs) with the students to explore the difficulties, issues and problems encountered in learning basic sciences. Semi-structured interviews can also be conducted with the faculty who teach basic sciences, in first professional year (pre-clinical year). These interviews can explore the difficulties, issues and problems encountered in learning basic sciences from the context and perspective of the student. Based on the results of FGDs of students and semi-structured interviews of the faculty, we can design a new instrument to explore this information from the first MBBS students and basic science teachers. Using this new instrument, the opinions of students and faculty with respect to the difficulties, issues and problems encountered in learning basic sciences can be obtained. This allows the researchers, to identify what support the students need to help them succeed and also to design solutions.

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