ADMISSIONS CRITERIA AS PREDICTORS OF ACADEMIC SUCCESS IN FIRST- AND SECOND- YEAR OSTEOPATHIC MEDICAL STUDENTS

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DEDICATIONS

TO:

My God, who has strengthened and sustained me and given me more blessings than I even realize...

My husband, Paul, who has been by my side during the last leg of this journey of unfinished business, and who is always ready to provide support and encouragement. I would not have been able to accomplish this without all our combined sacrifices. I am blessed to be sharing my life with him…

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Chapter 1: Design of the Study

The collection of multiple data and qualification information from medical school applicants during the application and interview process is widely expected and necessary throughout medical schools nationwide. "Each year faculty admissions committees, or other groups charged with like functions, must select a limited number of students from a large and, for the most part, qualified population of applicants to medical school" (Best, Diekema, Fisher & Smith, 1971, p. 42). Much of the data includes records from past academic performance and standardized testing scores as well as additional statistics such as age, gender, and ethnicity used for institutional reporting activities. Personal interview scores and letters of reference from practicing physicians are viewed as subjective data and used in more of a holistic manner during the selection process. According to both the American Association of Colleges of Osteopathic Medicine (2007) and the Association of American Medical Colleges (2007), all of this admission information, primarily past academic performance and standardized testing scores, is relevant and traditional data which are used in the decision-making process by the admissions committee to typically indicate which students are more likely to succeed or "make-it" through the arduous medical school curriculum. "Admission committees look for areas in which concrete and precise predictions of persons who will be the more successful students of medicine might be made" (Neufeld, 1972, p. 175). According to Hall and Bailey (1992):

> Assessments of applicants to medical schools that use criteria that can be shown to be valid predictors of performance in medical school and/or subsequent success in a

> medical career are consequential both to schools and to applicants. Applicants have a compelling interest in an assessment process that provides fair and equitable consideration; for a school, finding those candidates best suited to its program is vital. (p. 121)

Formed from an apprenticeship-training model, there were originally no admission criteria for medical school except the ability to pay the required fees and, in some cases, the social standing of the student's family (Osborne, 1998). As the need for more formal training and education became widely accepted, the number of positions within accredited institutions decreased, the number of applicants increased, and the need for more prerequisite admissions criteria was added (Magner, 2005). These criteria were intended to "weed out" unlikely or undesirable candidates. Recent trends in medical education however, are beginning to recognize other desirable characteristics that contribute to being a competent physician such as maturity, personality, humanitarianism, and altruism (AACOM, 2007; AAMC, 2007). Nevertheless, traditional, prior academic credentials remain the most important components. The overall consensus of thought within medical admissions is that the strongest predictors of academic ability remain to be standardized aptitude test scores and measures of previous academic achievement (McGaghie, 2000).

Overall undergraduate grade-point average (GPA), Science grade-point average, and MCAT scores (Medical College Admission Test) are used as the primary indicators for recruitment, admissions, and the primary predictors of academic success in medical schools (Cariaga-Lo, Enarson, Crandall, Zaccaro & Richards, 1997; Mitchell, 1987; Reid & Blain, 1974). While there have been a number of studies conducted over the years as to the predictive value or validity of medical school admissions criteria, the majority have been

completed in allopathic (M.D.) medical institutions, as opposed to osteopathic (D.O.) institutions, and results have shown that admissions criteria have variable value in predicting either academic or clinical success (Hart, Payne & Lewis, 1981; Hendren, 1988; Inglehart & Brown, 1990; Jones & Mitchell, 1986; Jones & Thomae-Forgues, 1984; Keill & Willer, 1985; Mitchell, 1990). While both types of medical school training and/or education are virtually identical, osteopathic institutions focus on a holistic treatment approach for their patients and confer a doctor of osteopathy degree (D.O.) as compared to allopathic institutions that focus on a disease-specific treatment approach and confer a medical doctor degree (M.D.). Regardless of the type of medical school, Neufeld (1972) reports that "neither the score on the Medical College Admission test (MCAT) nor the undergraduate grade-point average (GPA) correlates significantly with a student's performance during his first year in medical school" (p. 75). Opposing theory claims that "research demonstrates the substantial predictive value of traditional academic predictors of performance in medical school" (Collins, White, & Kennedy, 1995, p. 25). Spooner (1990) writes in a summation of the admission process:

> I am continually amazed at the relatively high correlation of under- graduate grades with comparable grading in medical schools… brought about by the selection process of the admission committee whereby we tend to select students who show consistent under- graduate performance, either at the same level or at a gradually increasing academic average through the undergraduate years. (p. 184)

Meanwhile, the Association of American Medical Colleges (AAMC) reported in 2001 that 10% of medical students fail one or more courses in their first year. The bottom line is that medical students that are meeting and/or exceeding admissions criteria are still experiencing

academic difficulties within their first- and second-year of studies, with the number of failures rising.

Problem Statement

Medical school admissions criteria are primarily based upon past academic performance such as overall grade-point average, Science grade-point average and standardized scores from the MCAT (Medical College Admission Test), indicating an academic record that is capable of aptitude and the knowledge base to successfully complete the medical school curriculum (AACOM, 2007; AAMC, 2007). However, research literature has indicated that these traditional criteria are becoming increasingly less accurate in predicting future academic performance and medical student success. An accurate relationship may not be represented between traditional medical school admission criteria and their ability to accurately predict medical student success.

> Complex societal issues affect medical education and thus require new approaches from medical school admission officers. One of these issues – the recognition that the attributes of good doctors including character qualities such as compassion, altruism, respect, and integrity – has resulted in the recent focus on the greater use of qualitative variables, such as those just stated, for selected candidates. (Edwards, Elam, & Wagoner, 2001, p. 1207)

McGaghie (2000) alludes to this apparent contradiction stating "Despite widespread acknowledgement that qualitative factors are crucial for success as a medical student and physician, the variables are rarely measured or considered when medical schools reach decisions about student admission" (p. 145).

It is possible that these realities co-exist because variables that will allow an accurate

prediction of which students are more likely to succeed in medical school have yet to be identified and medical school admission committees are continuing to rely upon the traditional criteria of overall grade-point average, Science grade-point average, and MCAT score. Discriminant analysis (DA) theory, specifically a prediction study, would allow the testing of traditional predictor variables for possible practical significance in medical education.

Purpose of the Study

Medical educators and administrators are continually faced with the concern of selecting the "right" students based on the application data utilized during the admission process and to choose individuals who are likely to become competent medical students, and then physicians. "To be sure, the admission process for most medical schools has been sufficiently refined to select the good 'basic science' student who will survive the difficult biological science curriculum of most medical schools. However, the academic record of most premedical students is replete with tangible evidence of their scientific ability" (Rhoads, Gallemore, Gianturco & Osterhout, 1974, p. 1119). While medical schools across the country are experiencing an overall decline in applications for first year slots, the pool of qualified students is still relatively large (AAMC, 2001). Continually faced with the situation of selecting a few from the many, admissions committees must be able to focus on reliable and definite data in order to make the best decisions (Collins, 1995).

It would be considered valuable for medical education administrators, faculty, and admissions professionals to know those variables that help predict or show a relationship between which students in medical school are likely to experience academic success or failure. A matriculating class in medical school that loses students during the first or second

year not only represents a loss of revenue for the institution but also affects the final number of graduating students into the physician workforce as well as institutional effectiveness and accountability measures (Spooner, 1990). Fogelman and Zwagg (1981) noted:

> The academic, emotional, and financial costs of attrition and delay in medical school education are substantial. For the institution, expenditures involve curriculum design, training, evaluation, tutoring, and counseling. Emotional expenditures by faculty, students, and families are also extensive. All experience a sense of failure and at least situational depression when students flounder. Students often question their own intellectual abilities and their decision to enter medical school, and they may express general disillusionment with the existing curriculum. Parents and faculty may worry about their possible influence on the student's difficulties. (p. 602)

Early identification of students who are at-risk for leaving medical school for academic reasons would enable schools to possibly intervene and provide resources to help them overcome their difficulties and successfully complete the medical school curriculum. Since the greatest number of students leave medical school during the first or second year, primarily due to academic failure, understanding the correlation, if any, between admissions criteria and academic success would be significant for the institution (Cariaga-Lo et al., 1997). "It is important to know whether preadmission data predict adequately how well students will perform in the basic and clinical science programs" (Mitchell, 1990, p. 149).

Due to the multiple justifications outlined, the purpose of this discriminant analysis (DA) research study is to examine the nature of the relationship between traditional admission criteria utilized by medical schools, i.e. overall grade-point average, Science grade-point average, and MCAT score, and student academic success during the first two

years of medical school. Additionally, the purpose is to determine whether or not the predictor variables are correlated (statistically significant) to the criterion variable, academic success.

Research Question

The first two years of the medical school curriculum, characterized by intense classroom instruction, study, and examinations used as performance assessments, must first be successfully completed before students can move on to their clinical portion of training and finish the program. While it can be argued that it is important for caring, compassionate, and technically competent physicians to possess certain noncognitive characteristics (McGaghie, 2000), it is nevertheless true that the majority of medical schools continue to rely most heavily on cognitive factors as the basis of admissions decisions (Mitchell, 1987). To help admissions committees establish criteria that will more accurately identify and select students who will be successful in the medical curriculum, this study is designed to answer the following research questions:

1. What is the relationship between traditional medical school admissions criteria (predictor variables) and student academic success (criterion variable)?
2. Do traditional admissions criteria accurately predict student academic success in first- and second- year osteopathic medical students? Factors (predictor variables) examined will include overall GPA, Science GPA, and MCAT score. Academic success (failure) (criterion variable) will be defined as repeating a course during the first two years of medical school and/or failure on Part I Board examinations (first attempt).

Theoretical Framework

According to Pedhazur (1997) in a work published on applying educational and behavioral research through discriminant analysis:

> DA was developed by Fisher (1936) for classifying objects into one of two clearly defined groups. Shortly thereafter, DA was generalized to classification into any number of groups and was labeled multiple discriminant analysis (MDA). In recent years, DA has come into use as a method of studying group differences on several variables simultaneously. The two purposes for which DA is used have been labeled predictive discriminant analysis (PDA) and descriptive discriminant analysis (DDA), respectively. (p. 900)

Specifically, "in prediction studies, some variables (the predictor variables) are measured at one point in time, and other variables (the criterion variables) are measured at a later point in time. This procedure is followed because the goal of prediction studies is to forecast important future behaviors" (Gall, Gall, & Borg, 2005, p. 226). Using discriminant analysis (DA) statistics theory as the analytical lens in this study, data will be collected for the participants once upon matriculation into medical school and, then collected again, after their second year of coursework, allowing for implications between the two sets to be made.

> In prediction studies, researchers are concerned with both the statistical significance of the correlation coefficient and its practical significance. If the coefficient is sufficiently large to achieve statistical significance, we can be fairly confident that the observed relationship is not a chance finding. If the predictor variable is highly correlated with an important criterion variable, it will be useful for improving educational practice, and thus the correlation coefficient also has practical

significance. (Gall et al., 2005, p. 227)

Conversely, if the results are not statistically significant and/or the predictor variables are not highly correlated to the criterion, this information will still be of practical significance for the institution being studied, and theoretically for the medical education profession as a whole. The objective is to discover what is actually happening, or not happening, between the data.

The generalized practice and concept of being able to predict future academic performance based on past academic performance in addition to institutional selected, non-cognitive factors has been utilized in higher education for many years to help colleges and universities select students with the highest probability of succeeding. An example of this practice is that many undergraduate schools rely primarily on cognitive measures of academic performance such as high school grade point averages or scores on nationally administered, standardized tests such as the American College Test (ACT) or Scholastic Aptitude Test (SAT). Both entrance exams are widely used by colleges and universities within the United States as a tool in selecting applicants who perform better than others and who are more likely to be successful in college. Numerous educational researchers have examined standardized tests such as the ACT and SAT and have reported on their ability to predict the academic performance of college students (Feldhusen & Jarwan, 1995; Fleming & Garcia, 1998; Fleming & Morning, 1998; Wright, Palmer, & Miller, 1996). Additionally, in a study by Astin (1971) which examined the correlation of high school GPA and SAT scores with the college freshman grades of over 35,000 students validated the usefulness of the SAT as a primary admission tool.

Likewise, professional and/or graduate schools such as law schools and business schools, including medical schools, have utilized standardized, subject-specific exams such

as the Graduate Record Exam (GRE), the Law School Aptitude Test (LSAT), and Graduate management Aptitude Test (GMAT) to primarily influence admissions decisions (Kuncel, Hezlett & Ones, 2001; Linn & Hastings, 1984; Morrison & Morrison, 1995; Powers, 1982; Young, 1995). Studies looking at various non-cognitive or subjective variables that factor into admissions decisions have also been conducted and establish validity for these factors as well in predicting academic performance in undergraduate and graduate students (Ragosta, Braun & Kaplan, 1991; Hoefer & Gould, 2000; Fleming & Garcia, 1998; Fleming & Morning, 1998; Feldhusen & Jarwan, 1995; Borde, 1998; Dunlap, 1998).

As delineated throughout this study, research literature shows mixed evidence on the correlation and/or predictive validity of medical school admission criteria on academic success in the first two years of the curriculum. However, based on past studies and success in other areas of education, it is reasonable to suggest that professional/graduate medical education should also be able to make use of certain factors to predict the successful academic performance of students in their curriculum. "The variables to be included in a study should be chosen based on a sound rationale growing out of experience or theory. The researcher should have some reason for thinking certain variables may be related" (Fraenkel & Wallen, 2003, p. 345). Since overall GPA, Science GPA, and MCAT score are utilized as primary indicators for medical school admission, these factors will be examined in this discriminant analysis study.

Procedures

The overall design for this study is quantitative in nature. Discriminant analysis (DA) research methods have been chosen since this method is primarily used in studying group differences on several variables simultaneously and in prediction; outcome influenced by

other variables that are correlated to the criterion. In this study, the criterion variable will be academic success and will be measured by failure in any medical school course, (academic performance requiring course remediation or repetition of an academic year) and/or failure to pass Part I of the Comprehensive Osteopathic Medical Licensing Examination (COMLEX) on the first attempt. Prediction variables will be overall GPA, Science GPA, and MCAT score.

Participants/Data Collection

Due to medical institutions' and student confidentiality issues with data collection, the lack of a centralized data collection process among national organizations, and applicant/school demographic differences, a generalized study across medical schools is not feasible. Instead, this was a focused, institutionalized study at Oklahoma State University Center for Health Sciences, College of Osteopathic Medicine (OSU-CHS, COM) in Tulsa, OK (Appendix D).

After approval by the Oklahoma State University Institutional Review Board (IRB), preadmission data were collected from students' medical application documents (archival data) for the matriculating Classes of 1995 through 2003, examining 9 academic years of data and including overall GPA, Science GPA, and MCAT score; approximately 800 participants (Appendix A). "The minimum acceptable sample size for a correlational study is considered by most researchers to be no less than 30" therefore, the sample size for this study is advantageous (Fraenkel & Wallen, 2003, p. 345). 2003 is the most recent year included in the data to allow for the completion of two years of course work upon data collection. For each student, preadmission data were collected from existing application records. Official transcript records were then examined for the students' first two academic years to identify

students who experienced academic difficulty (course failure/remediation). Additionally, initial (first attempt) Pass/Fail results on the Part I Licensing Board examination will also be reviewed. "Dummy" coding will be utilized to analyze these data and to maintain student anonymity. For each student, "0" will represent that the student did not experience either type of failure and "1" will represent that the student did experience at least one type of failure. Once admission files were examined and compared to medical school transcript records, student names were eliminated from the data permanently and cannot be reconstructed. There is no link to individual students in the final data or in statistical analysis.

Analysis

Predictive discriminant analysis (PDA) was then conducted using the Statistical Package for the Social Sciences (SPSS) to analyze any relationship identified. "If the relationship between more than two variables is being investigated, multivariate statistics are used" (Gall et al., 2005, p. 224). "In recent years, DA has come into use as a method of studying group differences on several variables simultaneously," and labeled in this particular study for prediction purposes (Pedhazur, 2007, p. 900). The data were analyzed to determine which, if any, traditional admissions criteria best predicts medical student academic success and the correlation or predictive qualities among all the variables being studied. Results may be utilized by the institution being studied for future planning and recruitment, as well as to serve as an example for other osteopathic medical schools nationwide to develop independent, statistical self-examination.

Significance of the Study

Research in this area is significant because there are relatively few local-level studies that have been conducted that examine relationships between admissions criteria and

student success (Mitchell, 1990). Each medical school pulls applicants from local locales within a geographic region, with similar cultural backgrounds and similar educational experiences.

> The *Standards for Educational and Psychological Testing* and the *Professional Guidelines for Admissions Officers* state that those selection procedures and selection criteria to the subsequent performance of an institution's entrants. Such research will likely increase the validity of admission decision making and the selection of promising physician candidates. (Jones & Thomae-Forgues, 1984, p. 530)

Since the greatest number of students leave medical school during the first or second year, primarily due to academic failure, understanding the prediction and correlation, if any, between admissions criteria and academic success would be significant for the institution. "It is important to know whether preadmission data predict adequately how well students will perform in the basic and clinical science programs" (Mitchell, 1990, p. 149). Under that directive, those concerned, who would have a vested interest in such research, would include the individual medical institution, the medical education profession, and the practicing medical environment.

This study will potentially impact future practices of medical education as well. While national organizations such as the American Association of Medical Colleges (AAMC) and the American Associate of Colleges of Osteopathic Medicine (AACOM) may view the issue of admissions criteria and student success being faced by medical schools today as an "overall" priority, individual institutions are ultimately charged to take matters into their own hands and make research in this area a priority for them. The best change is change that arises from the reality of those that need it the most because it is at that level that

change has its most profound impact (Sarason, 1990). The medical education profession is constantly dealing with change as it strives to be responsive to the increases in medical knowledge, scientific and technological advances, their students, faculty, physicians, and society as a whole. For this reason, individual medical schools should determine which admission data are predictive of successful performance for their student and community cohorts.

Relevance to theory in this area is also significant. Blue, Gilbert, Elam and Basco (2000) recommended school-specific validation studies to be conducted to provide more detailed information about the predictive ability of the MCAT. However, Mitchell (1990) determined that only 47% of North American medical schools analyze the validity of the academic, demographic, and other preadmissions data collected from their students. If the data and conclusions drawn from this study indicate that the prevalent use of overall GPA, Science GPA, and MCAT score are not the best indicators of student academic success, new theory and/or models will then need to be developed and researched to allow individual medical schools to more accurately select their students. While traditional admissions criteria may have the best success outcomes for some institutions, other more subjective, non-cognitive variables may work better for others or in some sort of combination. Applying discriminant analysis (DA) theory, specifically a prediction study, will allow the medical education profession to utilize "tried and true" theory and statistical tests to better admission practices.

Summary

Medical educators and administrators are continually faced with the concern of selecting the "right" students based on the application data utilized during the admission

process and to choose individuals who are likely to become competent medical students, and then physicians. As illustrated throughout theory and literature, a common occurrence for admissions committees is to look for a high MCAT score and for consistently high performance or gradually increasing academic average over the course of undergraduate study in order to estimate subsequent academic performance (Spooner, 1990). McGaghie (2000) concludes that:

> schools pay lip-service to the importance of students' character, motivation, and other personal qualities but continue to select students with high grades in science courses and high MCAT scores while admission officers and committees often confuse selecting students with predicting their achievement in medical school. (p. 136)

Theory, literature, and past research also clearly illustrates that there is varied opinion and continued debate as to the correlation and predictive value of traditional admissions criteria. Because of the significant investment that individuals, institutions, and society as a whole make in the selection of students for admission to medical schools, it is important for individual institutions to be able to accurately identify factors and characteristics of those students who are most likely to be successful; to be able to identify those variables that will allow them to accurately predict which applicants fall into the "successful" category. This study proposes to examine the current strategy utilized in selecting medical students and its effectiveness in predicting academic success.

Reporting

The remaining portions of the dissertation consist of four chapters. Chapter 2 contains a detailed review of related literature including the use of predictive factors in determining the likelihood of academic success of students in undergraduate, graduate, and

professional programs, and specifically, factors that are used to predict the academic performance of students in medical school.

Chapter 3 outlines the research methodology for the study along with methods that were used to collect and analyze the data. Discussion of the technique of using discriminant analyses (DA) to generate distinction between variables as indicators of validity of predictor variables is also discussed.

Chapter 4 and Chapter 5 detail the results and conclusions of the study, respectively.

Chapter 2: Review of the Literature

To understand current medical school admission standards and practices, it is important to be aware of the history behind them. The evolution of medical education, curriculum and training, and admissions standards practiced has been influenced by three primary dynamics, and still continue to be: societal needs and expectations of the practicing medical arena, the economics related to medical education, practice, and the health care industry, and the need for competency of medical school graduates (Osborne, 1998). These forces intermingle with one another, often as competing elements, but always begin at the selection and admission to medical school.

History

By the end of the 1960's, the application process of American medical schools had evolved into a somewhat standardized system. The returning GIs after World War II and the ensuing GI Bill of Rights exploded and overpopulated the American higher education system and created a need to be more selective in the students that were admitted. The Education Testing Service was founded in 1947 and assumed standardized testing activities of the American Council on Education, the Carnegie Foundation for the Advancement of Teaching and the College Entrance Examination Board (What is ETS, 2000). American colleges and universities routinely utilized the ETS's Scholastic Aptitude Test as a tool to identify students qualified for admission. Subsequently, the American College Testing Program (ACT) was founded in 1959 which developed both the ACT and SAT as standardized tests to provide selectivity information about prospective students (History of ACT, 2002).

Just as undergraduate institutions routinely made use of standardized tests to help predict students who were more likely to have good academic performance, graduate and professional schools followed suit. The Graduate Record Examination (GRE) administered by the Education Testing Service was developed to forecast the academic performance of students enrolled in various graduate programs (What is ETS, 2000). The Graduate Management Admissions Test (GMAT) was then developed and refined for business and managements programs along with other professional programs such as psychology, veterinary medicine, and social work. And consequently, in the 1960s, the Association of American Medical Colleges (AAMC) developed a standardized exam that was designed to identify students who were most likely to succeed in medical school; the Medical College Admissions Test (MCAT) (Erdmann, 1984). The purpose of the MCAT was:

> ….to give the medical college an independent current common index for all of its applicants. This index reflects certain established abilities and aptitudes. The test is not designed to serve as a single basis to differentiate those who will succeed in medical school from those who will fail. (Erdmann, 1984, p. 387)

However, at the Annual Conference on Research in Medical Education it was reported that "one of the main purposes of the MCAT was to discriminate future performance of applicants who might be considered marginal rather than to identify individuals likely to perform at the top level" (Zeleznik, Veloski, Conly & Hojat, 1980, p. 257). "Nevertheless, it appears that medical schools have utilized MCAT data in such a way that individuals who have higher scores are more likely to be accepted for admission than individuals with lower scores" (Zeleznik, Veloski, Conly & Hojat, 1980, p. 257). While both the intent and use of this exam have changed over the years, the admission processes have remained fairly

standardized across American medical schools ever since. Criteria routinely used include MCAT scores, overall and Science grade-point averages, letters of recommendation, and personal interviews (Collins, 1995). While individual medical schools place varying weights on each component depending on their school's philosophy, mission, or culture, primary attention is still given to standardized test scores and past academic achievement (Collins, 1995).

In the past, academic components or variables have shown the strongest relationship to academic success in medical school. Still today in the admissions process, evaluators look for a high MCAT score in addition to consistently high performance or gradually increasing academic average over the course of undergraduate study in order to estimate subsequent academic performance (Spooner, 1990). While medical colleges use past academic performance and MCAT scores in differing avenues throughout the selection process, one of the main uses across all medical institutions is to indicate possible future performance of applicants and separate students who might be considered marginal from students that are more likely to perform at a high level (Collins, 1995).

Previous Research

Since the adoption of the SAT and ACT standardized exam tools, thousands of studies and articles reporting on their validity and predictive ability have been published. Likewise, studies and resulting controversy have been published regarding graduate exams and in this focus, the MCAT. One study emerged in the early 1970s and served as a catalyst to the system that many medical schools still utilize today in their admissions process: "ranking." Ranking is seen in the 1971 project titled *Multivariate Predictors In Selecting Medical Students* in which weighting of applicant credentials, some being quantitative and

some qualitative, is outlined and studied (Best, Diekema, Fisher & Smith, 1971). The researchers claim that ranking offers a reasonable approach to determining the relative strength of each applicant based on his credentials (Best et al., 1971, p. 42). Because of the large number of medical school applicants, the even larger number of application variables, and the lack of effective communication among members of the selection committee, the admission process was becoming increasingly unpredictable. "It appeared that some of these problems would be solved if, from his credentials, a single number could be computed for each applicant that would realistically predict his performance in medical school" (Best et al., 1971, p. 43). Multiple regression techniques were applied in the study and results indicated various predictors to be operative but at a rather low level of discrimination (Best et al., 1971). "Grade point average (often adjusted for type of college for institutional selectivity purposes), MCAT scores, and excessive age were found to be among the more useful predictors" (Best et al., 1971, p. 49). Even with low levels of prediction, this study indicated the common desire of medical education to somehow rank and "predict" the success of applicants. And studies and the practice of ranking continue through today.

Addressing the predictive value for performance in medical school of undergraduate grades, the MCAT, information on the selectivity of the undergraduate institution, and selected transcript data, Mitchell (1990) reported that "validity data affirm the substantial value of traditional academic predictors of performance in medical school" (p. 149). The multiple correlations ranged from .24 to .66 with a median value of .49. "These data indicate that GPA, MCAT, and selectivity information predict well students' performance in the basic sciences" (Mitchell, 1990, p. 151). The study also clearly suggested however, that preadmission academic criteria should not be used alone in selecting applicants. Supporting

this research, a study published in 2005 by MCAT replicated the criterion focus of Mitchell's 1990 study and followed two cohorts of students from entrance to medical school through residency (Julian, 2005). Results were similar and indicated that "grades were best predicted by a combination of MCAT scores and GPAs, with MCAT scores providing a substantial increment over GPAs" (Julian, 2005, p. 910). One might question the validity or possible conflict of interest however presented with a company conducting research and publishing high correlation results between their own exam scores and medical student success.

In contradiction, Neufeld (1972) reports that "neither the score on the Medical College Admission test (MCAT) nor the undergraduate grade-point average (GPA) correlates significantly with a student's performance during his first year in medical school" (p. 75). This study involved only one class (year) of medical students at the Kansas City College of Osteopathic Medicine whereas the multivariate study and others involved two or more classes. This may be an indication that with larger, perhaps national numbers or a larger sample size, results show positive correlation as opposed to smaller, university-based studies that show varied or no correlation. Many studies have been reported concerned with the predictive validity of the MCAT. Results have been mixed but, in general, low correlations have been found between MCAT scores and performance in medical school during the first two years and very low correlations with performance during the second two years. (Zeleznik, Veloski, Conly & Hojat, 1980, p. 257) In addition, a study published in 1992 found that "The immediate implications of these results are an affirmation of earlier findings that "raw" premedical GPA is not a particularly successful predictor of academic success in distinguishing among students accepted to medical school" (Sarnacki, 1992, p. 168).
But again, medical schools are searching for data that are representative and useful for them,

outside of a national picture.

An alternative view on admission criteria predicting academic success was outlined in a study by Sarnacki in 1992. He states that:

> Repeated experiences with these variables have demonstrated such consistent predictability (or lack of it) of medical school performance that individual admissions committees have been able to create a hierarchy of predictors, weighting and placing them into regression equations in order of their relative utility in predicting desired academic outcomes. (p. 163)

Both MCAT scores and premedical grade-point averages are the primarily focus of admission committees. However, a great deal of variation in correlation may not be indicative of a lack of predictive value but rather due to individual variation in undergraduate GPA. "A strong possibility exists that the observed variation is not a result of actual individual differences in academic abilities, but may be due to some extent to such extraneous factors as educational discrepancies in the undergraduate institutions and the differing grading philosophies" (Sarnacki, 1992, p. 167). Viewing this relevant consideration, admission committees must take into account and therefore "weight" premedical GPAs accordingly. Examining whether entering medical students in one medical school differed in premedical GPA based on their undergraduate school and the extent to which difference were replicated in medical school performance, Sarnacki discovered that there were statistically significant differences however, they did not continue to be apparent in future coursework or overall academic success (Sarnacki, 1992).

Delineating student academic success can be challenging when reviewing literature and research on this subject. While correlations may be found between undergraduate GPA,

MCAT scores, and success within the first two years of medical school, another practical and important viewpoint would be examining these correlations to uncover "the probability of a student having academic problems that delay or impede his progress through medical school" (Jones & Thomae-Forgues, 1984, p. 527). In a massive study conducted by the Associate of American Medical Colleges (AAMC), students were grouped into five categories: "(a) graduated on time, (b) delayed graduation for academic reasons, (c) delayed graduation for nonacademic reasons, (d) withdrawal/dismissal for academic reasons, and (e) withdrawal/dismissal for non-academic reasons" (Jones & Thomae-Forgues, 1984, p. 527). Contradicting the study conducted by MCAT, the research associates found that:

> Even at the very lowest levels of MCAT performance, approximately half of the small numbers of students who were accepted were successful in graduating from medical school on time. This appears to reflect the effectiveness of admissions committees in identifying other factors that predict student success in addition to MCAT scores. The graduation rate also argues against an absolute and rigid use of MCAT scores in admissions decisions but for its use as contributing information to a complete applicant profile. (Jones & Thomae-Forgues, 1984, p. 531)

These results seem to significantly oppose a commentary published by The New England Journal of Medicine (1984), based on the same data obtained in the AAMC study which states "The two most important predictors of medical school performance are the grades earned in college (the grade-point average) and MCAT scores" (Erdmann, 1984, p. 386).

> When grades for medical-school year 1 are used as criterion, the composite of MCAT scores and the composite of all college grades (overall grade-point average) are essentially identical in predictive value for 25 classes at 12 schools. Medical

> correlations are r = 0.41 for each. The same pattern of results are obtained when grades for medical-school year 2 are the criterion (for 22 classes at 12 schools). Medical correlations are r = 0.37. Finally, for all criteria, the combination of MCAT and grade-point-average composites are better predictors than either individually. (Erdmann, 1984, p. 386)

The author fails however to outline the correlation significance for the readers and refers to data and bibliography that is available from the AAMC Division of Educational Measurement and Research. Even with presumably the same data, a consensus cannot be made between the research or authors.

In one of the very few studies conducted and published at an osteopathic medical school, the West Virginia School of Osteopathic Medicine examined the relationship of performance on the Comprehensive Osteopathic Medical Licensing Examination (COMLEX) Level 1 to academic performance during the first two years of medical school, undergraduate GPA, and MCAT score (2000). This study is of interest due to the fact that it was conducted in an osteopathic medical school and is similar in methodology and intent of studying admissions criteria as predictors of academic success in the first two years of medical school. Researchers found that out of the admission criteria studied:

> None of these correlations was statistically significant at the 0.05 level after Bonferroni's adjustment for number of correlations was applied. The highest correlations were with the biological sciences and with overall undergraduate GPA, which both correlated 0.26 with performance on COMLEX-USA Level 1. (Baker, Cope, Fish, Gorby & Foster, 2000, p. 157)

While this study was focused on finding correlation between admissions criteria and board

scores, it found high correlation between biological sciences, otherwise known as the first two years of medical school, and undergraduate GPA. Since this was not the primary area of interest, the authors did not state whether or not the correlation was statistically significant, but provides useful data and rationale for a future university-based study.

Data and Analytical Methods

Several methods for conducting a study as proposed in the research question are evident in the literature. However, overall there have emerged four categories of academic predictors that are predominantly examined: undergraduate grade point average (GPA), admission test scores (MCAT), quality or selectivity of the undergraduate institution attended by the applicant, and other selected transcript information (Mitchell, 1990). The GPA data typically consists of overall GPA and Science GPA (biology, chemistry, and physics). The Medical College Admission Test (MCAT) consists of scores in Biology Knowledge, Chemistry Knowledge, Physics Knowledge, Science Problems, Skills Analysis – Reading, and Skills Analysis – Quantitative. Undergraduate institution is typically weighted by local and/or commercially published rankings of institutional quality while other transcript data analyzed could include such things as the number of repeated courses, incomplete, or withdrawn courses.

Additionally, studies primarily utilize four broad categories of performance data when assessing the value of academic data in prediction systems (Mitchell, 1990). The most common category is grades in the first two years of medical school, the basic sciences, considering the cumulative GPA rather than individual course grades or class ranking. The last two years of medical school, the clinical sciences, are also examined again using cumulative GPA rather than individual clerkships or rotations. Scores on licensing Board

exams is also a primary category along with the incidence of academic difficulty resulting in either a delay in graduation, withdrawal, or dismissal from the medical program.

Finally, there also tends to be four analytical methods that are predominantly utilized in local- and national- level validity studies in medical admissions processes (Mitchell, 1990). The majority are correlational, whether it be simple "pairs" correlation or a more detailed analysis. "Most use regression-based technology to present a more parsimonious picture of predictor-criterion relationships; some use simultaneous and others use stepwise multiple regression methods" (Mitchell, 1990, p. 150). Discriminate function analysis is used to predict group membership while structural equation modeling is used to define broad constructs (Mitchell, 1990).

Significance to Practice and Research

Medical educators and administrators are continually faced with the concern of selecting the "right" students based on the application data used during process to choose individuals who are likely to become competent medical students, and then physicians.

> To be sure, the admission process for most medical schools has been sufficiently refined to select the good "basic science" student who will survive the difficult biological science curriculum o most medical schools. However, the academic record of most premedical students is replete with tangible evidence of their scientific ability. (Rhoads, Gallemore, Gianturco & Osterhout, 1974, p. 1119)

While medical schools across the country are experiencing an overall decline in applications for first year slots, the pool of qualified students is still relatively large (AAMC, 2001). Continually faced with the situation of selecting a few from the many, admissions committees must be able to focus on reliable and definite data in order to make the best

decisions (Collins, 1995).

It would be considered valuable for medical education administrators, faculty, and admissions professionals to know those variables that help predict or show a relationship between which students in medical school are likely to experience academic success or failure. A matriculating class in medical school that loses students during the first or second year not only represents a loss of revenue for the institution but also affects the final number of graduating students into the physician workforce as well as institutional effectiveness and accountability measures (Spooner, 1990). Since the greatest number of students leave medical school during the first or second year, primarily due to academic failure, understanding the correlation, if any, between admissions criteria and academic success would be significant for the institution (AAMC, 2001). "It is important to know whether preadmission data predict adequately how well students will perform in the basic and clinical science programs" (Mitchell, 1990, p. 149).

Additionally, a "change" factor needs to be recognized along with examination of the admissions process. Research on change theory recognizes that change can occur on numerous levels simultaneously or in concert (Fullan, 1994; Hall, 2002). Changes in curriculum and admission policies at any academic institution, including medical schools, are by nature slow, labored, and tedious.

> Alterations in present medical education policies are mandated by changes in the economics and organization of medical care, information overload in the preclinical sciences, and attitudinal and demographic changes in applicants to medical school. The precipitating changes are from forces external to the academic medical center, probably fortunately so, because it is very difficult to affect change in the cherished

turf of a faculty. (Spooner, 1990, p. 183)

The research is also clear on the need for change to be just as much a local phenomenon as it is a global one (Sarason, 1990). While national organizations such as the American Association of Medical Colleges (AAMC) or the American Association of Colleges of Osteopathic Medicine (AACOM) may not view the issue of admissions criteria and student success being faced by medical schools today as critical, if individually the medical schools made this type of research a priority, it can in turn affect medical education and admissions processes as a whole system. The old adage is true about the best change being change that arises from the reality of those that need it, because it is at that level that change has its most profound impact (Sarason, 1990). "Change theory is consistent about the effectiveness of change when it is based on the local reality of those needing to be changed" (McNeal & Christy, 2001, p. 8). Medical education is constantly dealing with change as it strives to be responsive to the increases in medical knowledge, scientific and technological advances, their students, faculty, physicians, and society as a whole. Academic medicine literature indicates that to make this or any paradigm shift in admission policy, medical schools must think about all the elements of admission and their interrelationships (Edwards, Elam, & Wagoner, 2001, p. 1207). The "unknown" factors of change- or a lack of understanding of its course- can lead organizations to take a "wait and see" stance and to respond only to serious crises as they emerge (Ellsworth, 2000).

Research in this area is significant because there are relatively few local-level studies that have been conducted that examine relationships between admissions criteria and student success (Mitchell, 1990). Each medical school pulls applicants from local locales within a geographic region, with similar cultural backgrounds and similar educational experiences.

> The *Standards for Educational and Psychological Testing* and the *Professional Guidelines for Admissions Officers* state that those concerned with admission should demonstrate the relevance of selection procedures and selection criteria to the subsequent performance of an institution's entrants. Such research will likely increase the validity of admission decision making and the selection of promising physician candidates. (Jones, 1984, p. 530).

Medical education research professionals are beginning to recognize the importance of conducting validity studies at their own institutions. Mitchell (1987) states that "differences in applicant pools and curricular emphasis are likely to underlie predictive differences among schools" (p. 879). And Erdmann (1984), addressing the use of MCAT in medical school admissions decisions wrote:

> …it is important to remember that admission involves a single person at a single school. Thus the …relations (between MCAT scores and performance) need to be confirmed at the local level, with local criteria. It is also true that test scores sample performance on a single occasion, when it is subject to all the unknown factors inhibiting performance at that time. However, it is also the only directly comparable measure o performance for all applicants that uses a common scale of measurement, is based on evaluation of the same content, and is evaluated according to the same standards or norms. (p. 387)

Under these multiple directives, those concerned and who would have a vested interest in such research would include the individual medical institution, the medical education profession, and the practicing medical environment. Current practices tend to reinforce current literature that states "...it appears that medical schools have utilized MCAT

data in such a way that individuals who have higher scores are more likely to be accepted for admission than individuals with lower scores" (Zeleznik, Veloski, Conly & Hojat, 1980, p. 257). Trends in medical education research and literature are affirming "the complex nature of admissions decision-making and reflect a desire to examine ways of implementing the... panel's recommendation that committees 'consider all of the qualities that characterize each candidate and make selection decisions on the basis of the full spectrum of their potential for a career in medicine'" (Mitchell, 1987, p. 878).

Summary

As illustrated throughout the literature, a common occurrence for admissions committees is to look for a high MCAT score and for consistently high performance or gradually increasing academic average over the course of undergraduate study in order to estimate subsequent academic performance (Spooner, 1990). McGaghie (1990) concludes that:

> schools pay lip-service to the importance of students' character, motivation, and other personal qualities but continue to select students with high grades in science courses and high MCAT scores while admission officers and committees often confuse selecting students with predicting their achievement in medical school. (p. 136)

Literature and research also clearly illustrates that there is varied opinion and continued debate as to the correlation and predictive value of traditional admissions criteria. While future qualitative research would certainly prove useful in examining contributing factors to student academic success or failure and possibly provide some type of measurement for subjective criteria, a local, institutional, quantitative study would provide preliminary data on the ways in which GPA and standardized testing scores (MCAT) are correlated to student

academic success in medical school to begin with. Both are warranted to identify the most accurate and effective process for choosing the best possible student applicants and provide the best outcomes.

Chapter 3: Methodology

The model and practice of using statistical analysis to determine the justifiable use of certain admission criteria to predict academic performance in medical school has been described in the previous chapter. This study used many of the same predictor variables detailed in the literature review however on a local level at one academic institution rather than broadly in a national study. Data from nine years of medical classes matriculating at the medical school were included in the research. This chapter details how the existing student data/databases were used and analyzed by using the Statistical Package for the Social Sciences (SPSS) and predictive discriminant analysis (PDA) to identify any relationship or predictive value.

Research Design

The overall design for the study was quantitative in nature. Discriminant analysis (DA) research methods were chosen for use in this study since this method is primarily used in studying group differences on several variables simultaneously and in prediction. It is used in analyzing the outcome when the outcome is influenced by other variables that have a relationship to the criterion variable. DA was developed by Fisher (1936) for classifying objects into one of two clearly defined groups (p. 900). Using discriminant analysis (DA) statistics theory as the analytical lens in this study, data will be collected for the participants once upon matriculation into medical school and, then collected again, after their second year of coursework, allowing for implications between the two sets to be made.

Relatively few local-level studies have been conducted that examine relationships

between admissions criteria and student success (Mitchell, 1990). Each medical school pulls applicants from area locales within a geographic region, with similar cultural backgrounds and similar educational experiences. Blue, Gilbert, Elam and Basco (2000) recommended school-specific validation studies to be conducted to provide more detailed information about the predictive ability of the MCAT. However, Mitchell (1990) determined that only 47% of North American medical schools analyze the validity of the academic, demographic, and other preadmissions data collected from their students. If the data and conclusions drawn from this study indicate that the prevalent use of overall GPA, Science GPA, and MCAT score are not the best indicators of student academic success, new theory and/or models will then need to be developed and researched to allow individual medical schools to more accurately select their students. The best change is change that arises from the reality of those that need it the most because it is at that level that change has its most profound impact (Sarason, 1990). For all of these rationales, individual medical schools should determine which admission data are predictive of successful performance for their student and community cohorts.

Sample

The sample was drawn from a population of approximately 2500 students who have matriculated at this state-supported medical school, Oklahoma State University Center for Health Sciences, College of Osteopathic Medicine, since its first class in 1972. This study included data gathered from 789 students who matriculated at this medical school from 1995 through 2003. The sample contained approximately 32 percent of the total number of medical students who have matriculated at this institution. Since this study used academic performance in the first two years of medical school as the criterion variable, the students

included in the study were from the last nine matriculating classes for whom performance data through year two of the curriculum were available and had begun being documented.

It is important that the sample size in discriminant analysis fit within the statistical assumptions. There must be at least two cases for each category of the dependent and the maximum number of independents is sample size minus 2 – as a rule of thumb, the smallest sample size should be at least 20 for a few (4 or 5) predictors (Poulsen & French, 2008). While this low sample size may work, it is not encouraged, and it is recommended that there be at least 4 or 5 times as many cases as independent variables (Poulsen & French, 2008). Since three independent or predictor variables are investigated in this study, a sample size of 789 is more than adequate and fits within the statistical assumptions of discriminant analysis.

Instrumentation/Materials

The data used in this study included preadmission data that were collected by the college as part of the students' medical school application. These data were housed in the Office of Student Affairs and Admission and corresponding file rooms, up to the years of digitizing records for space issues. First-attempt pass/fail scores on Part I of the Comprehensive Osteopathic Medical Licensing Examination (COMLEX) were also used. These scores were recorded and housed in the Office of Student Affairs and Admission and corresponding student files as well. And finally, academic difficulty (course failure/remediation/dismissal/repeat) was documented by examining official transcript records for the students' first two academic years to identify students who experienced any type of academic difficulty. Official transcript records were provided by the Office of Students Affairs and Admissions.

While a number of descriptive and non-cognitive factors were also collected by the

college as part of the students' medical school application including letters of reference from practicing physicians, volunteer work within the medical community, and personal interview scores, these factors were not considered in this study. Non-cognitive factors are typically viewed and treated as subjective data, as a positive addition to past academic performance and standardized testing scores. According to both the American Association of Colleges of Osteopathic Medicine (2007) and the Association of American Medical Colleges (2007), all of this admission information, primarily past academic performance and standardized testing scores, is relevant and traditional data which are used in the decision-making process by the admissions committee to typically indicate which students are more likely to succeed or "make-it" through the arduous medical school curriculum. "Admission committees look for areas in which concrete and precise predictions of persons who will be the more successful students of medicine might be made" (Neufeld, 1972, p. 175). According to Hall and Bailey (1992):

> Assessments of applicants to medical schools that use criteria that can be shown to be valid predictors of performance in medical school and/or subsequent success in a medical career are consequential both to schools and to applicants. Applicants have a compelling interest in an assessment process that provides fair and equitable consideration; for a school, finding those candidates best suited to its program is vital. (p. 121)

For these reasons, the independent variables of interest and specifically selected for examination in this study were: MCAT score, overall undergraduate GPA, and Science GPA. Since it would prove beneficial to be able to identify potentially at-risk students prior to their admission and matriculation into medical school, it was important to utilize pieces of

traditional criteria that would also be readily available from the students' applications. In addition, these variables are quantifiable characteristics and do not require personal interpretation. The non-cognitive (subjective) information compiled throughout the application process from several different individuals do require such interpretation and would be difficult to acquire, quantify, and standardize as a routine part of the admissions application.

The Medical College Aptitude Test (MCAT) is a standardized, multiple-choice examination. The test assesses generalized areas of problem solving, critical thinking, and writing skills as well as knowledge of science concepts and principles prerequisite to the study of medicine. Subject exams are divided in to four sections:

- Biological Sciences: 77 question in Biology & Organic Chemistry – 100 minutes
- Physical Sciences: 77 questions in Physics & Inorganic Chemistry – 100 minutes
- Verbal Reasoning: 65 questions – 85 minutes
- Writing: 2 essays – 60 minutes (What is MCAT?, 2008).

Four scores are reported for the MCAT exam. Scores range from 1 (lowest) to 15 (highest) for Physical Sciences, Verbal Reasoning, and Biological Sciences. The Writing Sample is reported on a scale from J (lowest) to T (highest) (MCAT Basics, 2008). The three numerical scores are then averaged for an average MCAT score used by the medical school, plus the alphabetical Writing score. Nationally, the average subject scores on the MCAT's are:

- Verbal Reasoning: 9.5
- Physical Sciences: 9.9
- Biological Sciences: 10.2 (What is MCAT?, 2008).

All but one of the U.S. medical schools require applicants to submit MCAT scores while applying for admission (AAMC, 2001).

Overall undergraduate GPA is traditionally calculated by dividing the total amount of grade points earned during all undergraduate study by the total amount of credit hours attempted. Grade point average may range from 0.0 to a 4.0. Science GPA is calculated in the same way however includes only those courses taken, either by choice or part of pre-medicine curriculum requirements, in the following subjects:

- Biology
- Physics
- General / Organic Chemistry
- Biochemistry
- Human Anatomy
- Microbiology
- Histology
- Embryology
- Immunology
- Physiology
- Genetics

One dependent (criterion) variable was studied: academic success. Due to the nature of the study and having dichotomous variables, academic success/academic failure, the criterion was used to sort students into two groups, revealing group variance. Academic success was defined in two ways, the first being course failure within either of the first two years of the medical school curricula. Course failure consisted of remediation of a course,

dismissal from the medical program, or the student repeating either their first or second year.

- The evaluation standard for all College courses will be an alpha/numerical system. The numerical system ranges from 0 to 100%, with 70% as the lowest passing grade. A grade of 65%-69% is defined as a marginal ("D") grade and requires remediation. A grade of less than 65% is defined as an unsatisfactory ("U") grade and requires remediation.
- All students will be required to perform remedial work in all courses in which they earned "D" or "U" grades, and all "I" grades must be replaced. No student may graduate from OSU-COM with a "D", "U", or "I" grade. The College reserves the right to require that a student remediate a course or repeat an academic year even though a passing grade may have been earned. This decision may be made when it is in the best interest of a student to repeat an educational experience because there is evidence of insufficient overall progress in the academic program.
- MSI and MSII students may attempt remediation in no more than three (3) courses in total and in no more than two (2) courses in an academic year. MSI and MSII students who earn more than three "D" or "U" grades in total, or more than two "D" or "U" courses in an academic year, or are unsuccessful in remediating a "D" or "U" grade will not be allowed to continue their original program of study. The Committee will recommend to the Chief Academic Officer one of the following:

    1. Repeat the year.
    2. Dismissal from the College (OSU-CHS Academic Standards Handbook, 2008).

The second way in which academic success was defined was through first-attempt pass/fail scores on Part I of the Comprehensive Osteopathic Medical Licensing Examination

(COMLEX).

- A student may not be promoted to the third year of study without passing the COMLEX Level 1. Customarily, the results are not available until the first of August, therefore, second year students will be conditionally promoted to the third year at the conclusion of the second year. Upon receipt of a COMLEX Level 1 passing grade, the conditional promotion will be replaced by a nonconditional promotion. Should a failing grade be received, the student will discontinue all clinical rotations and return to the campus for intensive remediation in preparation for the October reexamination. A second failure of COMLEX Level 1 will result in the student repeating the second semester of the second year of study and retaking COMLEX Level 1 in June. A third failure of COMLEX Level 1 will result in the student being referred to the Academic Standards Committee for disposition and/or dismissal from the College (OSU-CHS Academic Standards Handbook, 2008).

Research Questions

The first two years of the medical school curriculum, characterized by intense classroom instruction, study, and examinations used as performance assessments, must first be successfully completed before students can move on to their clinical portion of training and finish the program. While it can be argued that it is important for caring, compassionate, and technically competent physicians to possess certain noncognitive characteristics (McGaghie, 2000), it is nevertheless true that the majority of medical schools continue to rely most heavily on cognitive factors as the basis of admissions decisions (Mitchell, 1987). To help admissions committees establish criteria that will more accurately identify and select students who will be successful in the medical curriculum, this study is designed to answer

the following research questions:

1. What is the relationship between traditional medical school admissions criteria (predictor variables) and student academic success (criterion variable)?
2. Do traditional admissions criteria accurately predict student academic success in first- and second- year osteopathic medical students?

Factors (predictor variables) examined will include overall GPA, Science GPA, and MCAT score. Academic success or failure (criterion variable) will be defined as failing or repeating a course, dismissal or repeat, and/or failure on Part I Board examinations (first attempt) during the first two years of medical school.

Data Collection

Data were collected from the records of the 789 students who matriculated at OSU Center for Health Sciences, College of Osteopathic Medicine from 1995 through 2003. Admissions data from the students' applications (including MCAT score, overall undergraduate GPA, and Science GPA) were entered into an Excel spreadsheet by the Office of Student Affairs' Graduate Admissions Officer. Next, for each student, first-attempt (pass/fail) scores on the Part I COMLEX exam were entered along with documentation of any evidence of academic difficulty within their first two years (course failure/remediation/ dismissal/repeat). The Director of Admissions and Registrar reviewed the spreadsheets for accuracy and performed periodic random checks for accuracy using official academic documents from the Office of the Registrar. Coding took place prior to the Excel database being imported into the SPSS program for analysis. MCAT score, overall undergraduate GPA, and Science GPA were all coded and academic difficulty was coded as "0" for no incidences and "1" for one or more incidences. Tables 3.1 and 3.2 represent the coding

scheme:

Table 3.1 Coding System for Independent Variables

Variable 1	MCAT Score
Variable 2	Overall Undergraduate GPA
Variable 3	Science GPA

Table 3.2 Coding System for Dependent Variable: Academic Success

ACADEMIC SUCCESS	
NO Academic Difficulty	0
1 or More Academic Difficulty	1

Eleven errors were noted, yielding an accuracy rate of 99.9 percent. Five student data sets were eliminated due to missing or incomplete information. The data in the Excel spreadsheets was then imported into the SPSS software system for analysis. Appendix B shows an excerpt (one matriculating class) from the Excel student spreadsheet that was used. Appendix C represents the student database after coding was complete in SPSS.

Confidentiality

All student information housed in the Office of Student Affairs and Admissions is confidential. Confidentiality was maintained throughout this study by hiding the data columns that contain names, social security numbers, student ID numbers, or any other personal information by which individual students could be identified. The proposal was submitted to the Oklahoma State University Institutional Review Board (IRB) for approval and exemption from rules governing the use of human subjects. Since no human subjects

were used and only archival data from admissions and students records was included in the study, the IRB approved the proposal and granted it exempt status. The approval form from the IRB is appended as Appendix A. Approval for the study and collection of data was also granted by the OSU-CHS Vice President for Academic Affairs and Senior Associate Dean. The granted approval from OSU-CHS is appended as Appendix D.

Bias

According to Gall, Gall, and Borg (2005), bias is the term used to describe deviation of the average value of the statistic from the value in the population (2005). It may exist when the sample studied is not truly representative of the population from which the sample was selected (Gall, Gall & Borg, 2005). Such bias is seen in studies that a researcher solicits volunteers to participate rather than randomly selecting them. A researchers' own opinions and perspectives may prevent information from being objectively gathered and interpreted or exclude data that are not similar with their own theories or expectations.

Sample bias was not a factor in this study as all of the students in the 9 classes under investigation were included. (Students with missing or incomplete data were excluded from the study). The data collection was not subjective since the data utilized was not solicited by the researcher but rather already existed as archival data and not gathered for this specific purpose.

Data Analysis

To answer Research Question #1 - What is the relationship between traditional medical school admissions criteria (predictor variables) and student academic success (criterion variable)? – Discriminant analysis was performed to determine which independent variables (MCAT score, overall undergraduate grade point average, and Science grade point

average) or group of variables discriminate between two or more groups (criterion variable: academic success, defined as failure of a course, repeating a course or year, dismissal, or first-attempt failure on Part I of the COMLEX Licensing Exam).

To answer Research Question #2 - Do traditional admissions criteria accurately predict student academic success in first- and second- year osteopathic medical students? – the results from Research Question #1 were analyzed to determine whether the collection of traditional admission criteria used to select medical students had any effect on student academic success.

Discriminant analysis was conducted using the Statistical Package for the Social Sciences (SPSS) to determine whether groups differ with regard to the variables under study and then to determine whether or not those variables could reliably predict group membership. Discriminant analysis was chosen since the purpose of the study is to determine whether or not individual variables, or as a collection together, could discriminate between two groups. A multivariate F test was performed on the model to determine whether it was statistically significant as a whole and then continued to see which of the variables have significantly different means across the groups. The variables were run together to determine whether as a collection (traditional admissions criteria), the variables contributed to the prediction of group membership, as well as individual contribution of each variable and their value in the prediction of group membership.

Means and descriptive statistics were examined for significance and Box's M Test of Equality of Covariance Matrices was investigated to evaluate conformity to the assumption of homogeneity of group variances. Referencing StatSoft (2008), if the data do not differ significantly from multivariate normal, the analysis can proceed. The level of significance

for all analysis was set at 0.05. Canonical discriminant functions were also analyzed including Eigenvalue, Wilks' Lambda, as well as classification results.

Validity

Gall et al. (2005) define validity as the degree to which the findings in a research study can be generalized to the population from which the sample was selected. The results of this study may be generalized to future admissions policies and procedures, decisions, and entering students at OSU Center for Health Sciences, College of Osteopathic Medicine. However, since medical schools have unique applicant populations and communities that they serve, as well as distinct missions, the results of this study may not be generalizable to other medical schools. It may instead serve as a catalyst for institutions to conduct their own unique studies.

Summary

Of the 794 students who matriculated at OSU Center for Health Sciences, College of Osteopathic Medicine between 1995 and 2003, 789 were included in this study. The remainder were excluded due to missing or incomplete data. The data spreadsheets containing student information was modified, removing all student names and other identifiers, thereby eliminating the risk of individual student identification and preserving confidentiality. Independent variables of MCAT score, overall undergraduate GPA, and Science GPA were coded into the database. Evidence indicating an academic difficulty (course failure/remediation, dismissal, or repeat) or failure to pass Part I of the COMLEX licensing exam on the first attempt was also coded.

Discriminant analysis (DA) research methods were chosen for use in this study since this method is primarily used in studying group differences on several variables

simultaneously and in prediction; outcome influenced by other variables that have a relationship to the criterion. The studies detailed in the Literature Review used varying multiple regression and/or statistical prediction analysis to identify relationships and correlation of the predictor variables examined. Data were tested to determine if together as a group or individually, any of their parameters could accurately predict and identify students who would experience academic difficulty within their first two years of medical school.

Chapter 4: Findings

This chapter presents the results of the analysis of the student database concerning *Admissions Criteria as Predictors of Academic Success in First- and Second- Year Osteopathic Medical Students* and represents information regarding the parameter characteristics as well as results of the discriminant analysis. The research was conducted at Oklahoma State University Center for Health Sciences, College of Osteopathic Medicine with data from nine (9) years of matriculating medical student classes from 1995 through 2003. The research questions guiding this study were:

1. What is the relationship between traditional medical school admissions criteria and student academic success (criterion variable)?
2. Do traditional admissions criteria accurately predict student academic success in first- and second- year osteopathic medical students? Factors examined included overall GPA, Science GPA, and MCAT score.

The study defined academic difficulty as having met one or more of the following criteria: course failure in either the first or second year of medical school, repeating a course during the first or second year of medical school, failure on the first attempt of the COMLEX Part 1 Licensing Examination, or academic dismissal. A database of 788 students was used to generate descriptive statistics of the study group and to perform discriminant analysis to test two research questions in the prediction of students who would experience academic difficulty.

The first portion of the chapter presents and analyzes descriptive statistics derived

from the database. The remainder of the chapter addresses the results of the discriminant analysis.

Descriptive Statistics

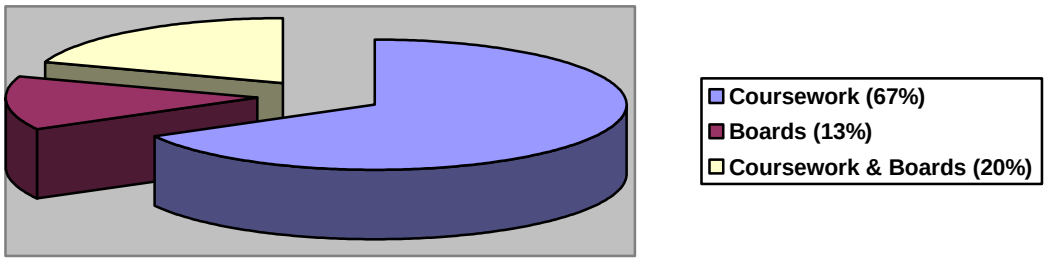
After the data were entered into SPSS, descriptive statistics were run to examine the characteristics of the data. The sample population included 794 students of which six students were eliminated due to incomplete data making this sample size N=788. Of the 788 students included in the study, 121 or 15 percent of the total group met the definition of academic difficulty. Table 4.1 and Figure 1 represent the distribution of those students.

Table 4.1. Distribution of Students by Category of Academic Difficulty

DEFINITION	STUDENTS N=788	PERCENT (%)
Failed single course	42	35%
Repeat academic year	16	13%
Fail Part I first attempt	14	12%
Fail multiple courses/Dismiss	8	7%
Fail multiple courses/ Withdraw	15	12%
Fail boards (x3) / Dismiss	1	1%
Fail boards (x3) / Withdraw	1	1%
Repeat year / Fail boards	2	2%
Fail course and boards	22	18%

Definition = criteria for academic difficulty
Percent = percent of students who encountered academic difficulty by category

Figure 1 Simple distribution of academic difficulty



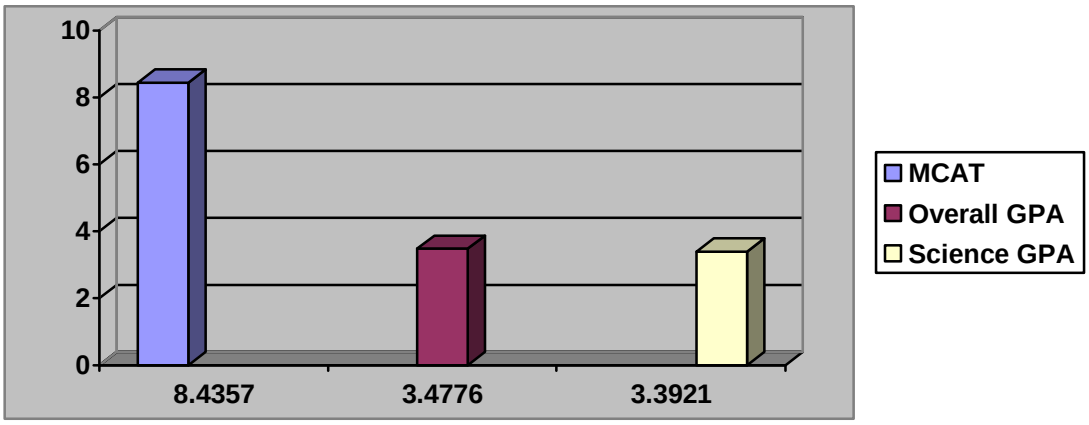
Broken down, the largest category for students who experienced academic difficulty was failure of a single course at 35 percent, followed by failure of a course and Boards at 18 percent, repeating an academic year at 13 percent, and failure of Part I Boards on the first attempt at 12 percent. Of the 788 students in the study, 763 students (97 percent) continued on into their third year of medical school while 25 students (3 percent) withdrew or were dismissed from the institution.

MCAT scores, overall undergraduate GPA, and Science GPA are the most common criteria used when attempting to predict medical school performance, as evidenced through the prior Literature Review. The overall mean of the total 788 students' MCAT scores was 8.4357 while the overall mean of the undergraduate GPAs and Sciences GPAs were 3.4776 and 3.3921 respectively. The means are shown in Table 4.2 and illustrated in Figure 2.

Table 4.2. Total Mean MCAT Scores, Overall Undergraduate GPA and Science GPA

MCAT	OVERALL GPA	SCIENCE GPA
8.4357	3.4776	3.3921

Figure 2 Total standardized admission criteria scores



The two groups of students (academic success / academic failure) did differ in group statistics. The students who did experience some type of academic failure had overall mean scores of MCAT 8.2250, overall undergraduate GPA 3.3634, and Science GPA 3.2345 while the student who did not experience academic difficulty had overall mean scores of MCAT 8.4743, overall undergraduate GPA 3.4985, and Science GPA 3.4210. The group of students not experiencing academic difficulty did display higher overall means. Furthermore, both groups of students, and all students totaled, demonstrated higher overall GPA scores than either of the other two criteria. Both Table 4.3 and Figure 3 display the means of the two academically different groups.

Table 4.3. Group Mean MCAT Scores, Overall Undergraduate GPA and Science GPA

	MCAT	OVERALL GPA	SCIENCE GPA
GROUP 0-SUCCESS	8.4743	3.4985	3.4210
GROUP 1-FAILURE	8.2250	3.2345	3.3634

Figure 3 Group standardized admission criteria scores

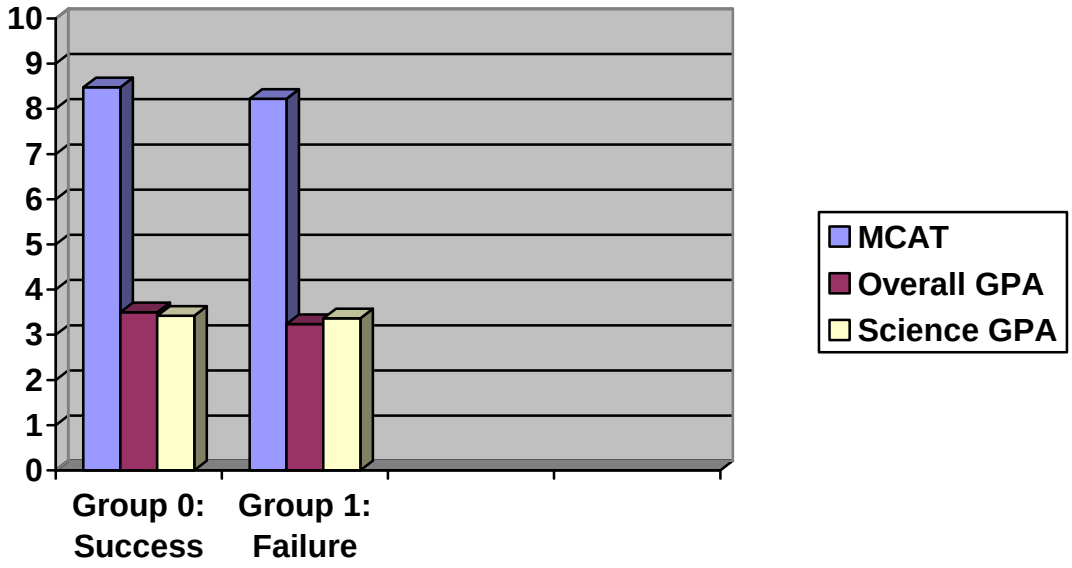


Table 4.4 summarizes the distribution of MCAT scores along with the number of students in each category who experienced academic difficulty.

Table 4.4. MCAT Scores and Academic Difficulty

MCAT	STUDENTS N=788	% OF TOTAL	ACADEMIC DIFFICULTY	% OF GROUP
5.0 -5.9	2	0.003	2	1.00
6.0 – 6.9	34	0.04	7	0.21
7.0 – 7.9	183	0.23	27	0.15
8.0 – 8.9	306	0.39	57	0.19
9.0 – 9.9	193	0.24	17	0.09
10.0 -10.9	55	0.07	10	0.18
11.0 – 11.9	11	0.01	1	0.09
12.0 – 13.0	4	0.01	0	0.00

This table shows that the majority of the students in the study (306) had an average MCAT score of between 8.0 and 9.0 and 19 percent of those students experienced some type of academic difficulty. Also of interest, students who scored lower than average MCAT scores, between 6.0 and 7.0, experienced the highest level of academic difficulty at 21 percent however, students who scored higher than average MCAT scores, between 10.0 and 11.0, also encountered academic difficulty at 18 percent. The two students with the lowest MCAT scores, between 5.0 and 6.0, both experienced academic difficulty while the four top scoring students with scores between 12.0 and 13.0 had no academic difficulty.

Overall undergraduate GPAs divided into intervals outlining the number of students in each category who experienced academic difficulty are shown in Table 4.5.

Table 4.5. Overall Undergraduate GPA and Academic Difficulty

OVERALL GPA	STUDENTS N=788	% OF TOTAL	ACADEMIC DIFFICULTY	% OF GROUP
2.5 – 2.79	8	0.01	3	0.38
2.8 – 3.09	81	0.10	21	0.26
3.1 – 3.39	228	0.29	41	0.18
3.4 – 3.69	274	0.35	42	0.15
3.7 – 3.99	177	0.22	14	0.08
4.0	20	0.03	0	0.00

Over 85 percent of the students studied had overall undergraduate GPAs between 3.1 and 3.99. On average, about 14 percent of those students experienced academic difficulty while students who had lower overall undergraduate GPAs, between 2.5 and 3.09, encountered a 27

percent incidence of academic difficulty. The group of students with the highest overall GPAs at 4.0 had no occurrences of academic difficulty.

Science GPAs divided into intervals with details of the number of students in each category who experienced academic difficulty and corresponding percentages are shown in Table 4.6.

Table 4.6. Science GPA and Academic Difficulty

SCIENCE GPA	STUDENTS N=788	% OF TOTAL	ACADEMIC DIFFICUTLY	% OF GROUP
2.1 – 2.49	5	0.01	3	0.60
2.5 – 2.89	52	0.07	16	0.31
2.9 – 3.29	248	0.31	47	0.19
3.3- 3.69	308	0.39	42	0.14
3.7 – 3.99	145	0.18	12	0.08
4.0	31	0.04	1	0.03

The two largest student groups had a Science GPA between 2.9 and 3.69 and 16 percent of the students in those groups experienced academic difficulty. However, the two groups with the lowest Science GPAs, between 2.1 and 2.89, encountered the most academic difficulty of all groups combined at 33 percent.

Finally, tests of equality of group means were produced and each criterion variable was found to be statistically significant at $p.<.05$. Significance levels are shown in Table 4.7.

Table 4.7. Significance for Tests of Equality of Group Means

	SIGNIFICANCE ($p.<.05$)
MCAT	.015
SCIENCE GPA	.000
OVERALL GPA	.000

Summary of Descriptive Statistics

Within the descriptive statistics produced in this study, overall undergraduate GPA and Science GPA seemed to best indicate students who would most likely experience academic difficulty within their first two years of medical school. The lower the GPA, the higher percentage of students encountered at least one factor of failure. MCAT score however did not seem to correlate as well. Students who achieved higher average scores on the MCAT were still experiencing academic difficulty. And as a combined admissions criteria group, there were students with lower GPAs and higher MCAT scores, and vice versa, that had occurrences of academic difficulty.

Discriminant Analysis

A two-group discriminant function analysis was conducted to address the research questions regarding admissions criteria predicting academic success or failure as outlined in this study. One discriminant function is the maximum to be derived from a two-group design (g-1 = 1 *df*). The first analysis was for Box's M Test of Equality of Covariance Matrices, which investigates conformity to the assumption of homogeneity of group variances. Shown in Table 4.8, the result is not significant (Box's $M = 10.139$, $p = .123$), which indicates that the dependent variable covariance matrices are equal across the levels of the independent

variables. Table 4.8 illustrates these results. This observed homogeneity or equality of covariance matrices does not pose a violation, allowing the discriminant function analysis to proceed and for Wilks' Lambda to assess the multivariate effects.

Table 4.8. Box's M Test Results

Box's M		10.139
F	Approx.	1.674
	Df1	6
	Df2	264954.493
	Sig.	.123

Tests null hypothesis of equal population covariance matrices.

The next measure of the function's ability to discriminate among groups is the canonical correlation, which measures the association between the individual function and the set of variables predicted to define group membership. Squaring the canonical correlation identifies the proportion of the variance in each discriminant function explained by the groups. This measurement is also the same as the multiple correlation from regression analysis. Four percent of the variance in function is explained by group membership. The Eigenvalue is a measure of the variance existing in the discriminating variables. The analysis indicates this measure in terms of a relative percentage; the importance of a single function compared to the total discrimination which exists among the variables. 4.4 percent (R^2 = 0.04) of the between group variability is accounted for by the discriminant function; a small amount. The practical significance of this analysis however, must be examined further through actual classification results using this small, but statistically significant, relation to predict academic success or failure. Table 4.9 illustrates these results.

Table 4.9. Canonical Correlation and Eigenvalue

FUNCTION	EIGENVALUE	% OF VARIANCE	CUMULATIVE %	CANONICAL CORRELATION
1	.044(a)	100.0	100.0	.206

a First 1 canonical discriminant functions were used in the analysis.

Since the value for Box's M was significant at 10.139, $p = .123$, indicating that the dependent variable covariance matrices are equal across the levels of the independent variables, this allows the discriminant function analysis to be assessed by Wilks' Lambda and Chi-square for multivariate effects. The results reveal a Chi-square value of 34.100 which is in fact significant ($\chi^2(3) = 34.100$, $p<.05$). Results are displayed in Table 4.10 below.

Table 4.10. Wilks' Lambda

TEST OF FUNCTIONS(S)	WILKS' LAMBDA	CHI-SQUARE	df	SIG.
1	.957	34.100	3	.000

The standardized discriminant function coefficients are a measure of the contribution of each criterion variable to the function. The absolute value of the coefficient indicates its importance in the interpretation of the function. The sign indicates its direction toward the positive or negative end of the continuum. The standardized linear discriminant function coefficients for the three variables chosen in this study are shown in Table 4.11. The variable contributing the most to the function or prediction of students who will most likely not experience academic difficulty during their first two year of medical school is Science GPA with the least contributing variable being overall undergraduate GPA. Furthermore, as

revealed in the structure matrix, Table 4.12, which reflects zero-order correlations of the variables with the discriminant function itself, Science GPA is again the highest variable and most likely to predict student success, however, MCAT score is the least contributing variable.

Table 4.11. Standardized Canonical Discriminant Function Coefficients

	FUNCTION
	1
MCAT	.384
SCIENCE GPA	.853
OVERALL GPA	.072

Table 4.12. Structure Matrix

	FUNCTION
	1
SCIENCE GPA	.923
OVERALL GPA	.749
MCAT	.412

Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions.
Variables ordered by absolute size of correlation within function.

Since the between group variability accounted for by the discriminant function was small (4.4 percent), the practical significance of this study can now be examined through classification results in Table 4.13.

Table 4.13. Classification Results (b,c)

			PREDICTED GROUP MEMBERSHIP		
		ACADEMIC DIFFICULTY	0 SUCCESS	1 FAILURE	TOTAL
ORIGINAL	COUNT	0	666	0	666
		1	120	2	122
	%	0	100.0	.0	100.0
		1	98.4	1.6	100.0
CROSS-VALIDATED (a)	COUNT	0	665	1	666
		1	121	1	122
	%	0	99.8	.2	100.0
		1	99.2	.8	100.0

a Cross validation is done only for those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case.
b 84.8% of original grouped cases correctly classified.
c 84.5% of cross-validated grouped cases correctly classified.

As shown in Table 4.13, the correct classification was achieved in 84.8 percent of the cases. This reflects a fairly high practical value of analysis. It is generally assumed that the baseline for correct classification is set at 50 percent for random classification. Therefore, using this function and these criterion variables to classify cases represents a 34.8 percent improvement over chance. However, implications regarding restriction of criterion variables should be considered.

Summary

121 of the 788 students included in this research met one or more of the definitions for academic difficulty as defined by this study. In other words, 15 percent of the total student group experienced academic difficulty within the first two years of medical school.

The average MCAT score of students with academic difficulty was 8.23, while the average score for the rest of the students was 8.47. Overall undergraduate GPA was also close in range, with an average of 3.36 for students with difficulty and an average of 3.50 for students who did not experience problems. And Science GPA averaged 3.24 and 3.42 for students who experienced academic difficulty versus those who did not respectively.

Discriminant function analysis for the 2-group model showed that overall, although there seemed to be a couple of variables (Overall GPA and Science GPA) that showed statistical significance, the variables as a group did not appear to be effective as a model in predicting student academic success or failure. The variables examined do suggest a stronger predictive relationship for Science GPA and overall undergraduate GPA rather than MCAT score. Furthermore, while between group variability accounted for by the discriminant function was small, the practical significance of this study gives the impression of significance for establishing a model for admissions criteria to medical school, while not generalizable to other medical programs, but for OSU Center for Health Sciences, College of Osteopathic Medicine.

Chapter 5: Study Summary, Recommendations for Further Study, and Discussion

Using predictive discriminant analysis, this study examined admissions criteria as predictors of academic success in a group of first- and second- year medical students at OSU Center for Health Sciences, College of Osteopathic Medicine. This study sought to discover, through discriminant analysis, if these criteria could individually or as a group be reliable predictors. A summary of the study will be examined first followed by findings and conclusions. Next, limitations of the study and areas of possible further research will be presented. And finally a discussion of the study will follow.

Study Summary

The purpose of this study was to examine the nature of the relationship between traditional admission criteria utilized by medical schools, i.e. overall grade-point average, Science grade-point average, and MCAT score, and student academic success during the first two years of medical school. Additionally, the practical significance of the results was to be determined. Medical educators and administrators are continually faced with the concern of selecting the "right" students based on the application data utilized during the admission process and to choose individuals who are likely to become competent medical students, and then physicians. Continually faced with the situation of selecting a few from the many, admissions committees must be able to focus on reliable and definite data in order to make the best decisions (Collins, 1995). It would be considered valuable for medical education administrators, faculty, and admissions professionals to know those variables that help

predict or show a relationship between which students in medical school are likely to experience academic success or failure. Since the greatest number of students leave medical school during the first or second year, primarily due to academic failure, understanding the correlation, if any, between admissions criteria and academic success would be significant for the institution (Cariaga-Lo et al., 1997). "It is important to know whether preadmission data predict adequately how well students will perform in the basic and clinical science programs" (Mitchell, 1990, p. 149).

In Chapter 2 of the Literature Review, numerous investigations were outlined that have used MCAT scores, overall undergraduate GPA, and Science GPA as variables to correlate and/or predict medical school performance. The review also provided the background on multiple regression and discriminant analysis statistical theory, which provides the theoretical lens for this study. These previous studies however, show varying results on the predictive validity of medical school admissions criteria on academic success in the first two years of the curriculum as well as differing practical significance for institutions. It must be remembered that each medical school is unique in its mission, service area, and applicant pool. Since medical schools recruit applicants from locales within a geographic region with similar educational experiences, local-level, institutional studies provide practical data for student academic success within a particular medical school. Medical schools should closely examine the characteristics of its own student population to try to identify variables that it can use to identify potentially at-risk students. However, caution should be exercised in applying the findings of this study to other institutions.

This study attempted to analyze the variables traditionally used and readily accessible from application information contained in medical student files. Scores from the

standardized MCAT, overall undergraduate GPAs and Sciences GPAs were collected as well as academic performance indicators of course failure, repetition of an academic year, Part I Board failure, and withdrawal and dismissal records.

In predictive discriminant analysis, variables are used to classify objects into groups. Admissions criteria variables were examined for statistical significant in predicting group membership; students who experiences academic difficulty and those who did not.

Findings

After analysis of the data, there was evidence that 15 percent of the total student group met the definition of academic difficulty. The largest category for students who experienced academic difficulty was failure of a single course at 36 percent, followed by failure of a course and Boards, repeating an academic year, and failure of Part I Boards on the first attempt. The two groups of students (academic success / academic failure) did differ in group statistics as alluded to in previous research. "Grade point average (often adjusted for type of college for institutional selectivity purposes, MCAT scores, and Science GPA were found to be among the more useful predictors" (Best et al., 1971, p. 49). Mitchell (1990) reiterates this thought by stating "These data indicate that GPA, MCAT, and selectivity information predict well students' performance in the basic sciences" (p. 151). The students who did experience some type of academic failure had overall mean scores of MCAT 8.2250, overall undergraduate GPA 3.3634, and Science GPA 3.2345 while the student who did not experience academic difficulty had higher overall mean scores of MCAT 8.4743, overall undergraduate GPA 3.4985, and Science GPA 3.4210. Furthermore, both groups of students demonstrated higher overall GPA scores than either of the other two criteria.

MCAT

The majority of the students in the study had an average MCAT score of between 8.0 and 9.0 and 19 percent of those students experienced some type of academic difficulty. Students who scored lower than average MCAT scores, between 6.0 and 7.0, experienced the highest level of academic difficulty at 21 percent however, students who scored higher than average MCAT scores, between 10.0 and 11.0, also encountered academic difficulty at 18 percent. These results perpetuate previous research that shows mixed outcomes of the predictive value of the MCAT. "The immediate implications of these results are an affirmation of earlier findings that "raw" premedical GPA is not a particularly successful predictor of academic success in distinguishing among students accepted to medical school" (Sarnacki, 1992, p. 168).

Overall Undergraduate GPA

Over 85 percent of the students studied had overall undergraduate GPAs between 3.1 and 3.99. On average, about 14 percent of those students experienced academic difficulty while students who had lower overall undergraduate GPAs between 2.5 and 3.09 encountered a 27 percent incidence of academic difficulty. The group of students with the highest overall GPAs at 4.0 had no occurrences of academic difficulty.

Science GPA

The two largest student groups had a Science GPA between 2.9 and 3.69 and 16 percent of the students in those groups experienced academic difficulty. However, the two groups with the lowest Science GPAs, between 2.1 and 2.89, encountered the most academic difficulty of all groups combined at 33 percent.

Overall undergraduate GPA and Science GPA seemed to best indicate students who would most likely experience academic difficulty within their first two years of medical school. This contradicts previous research that indicated that "grades were best predicted by a combination of MCAT scores and GPAs, with MCAT scores providing a substantial increment over GPAs" (Julian, 2005, p. 910). In this study, the lower the GPA, the higher percentage of students encountered at least one factor of failure. MCAT score however, did not seem to correlate as well. Students who achieved higher average scores on the MCAT were still experiencing academic difficulty. And as a combined admissions criteria group, there were students with lower GPAs and higher MCAT scores, and vice versa, that had occurrences of academic difficulty.

Discriminant Analysis

In the two-group discriminant function analysis that was conducted, only 4.4 percent of the between group variability is accounted for in the function; a small amount. Again, this result supports preceding studies that showed:

> When grades for medical-school year 1 are used as criterion, the composite of MCAT scores and the composite of all college grades (overall grade-point average) are essentially identical in predictive value for 25 classes at 12 schools. Medical correlations are r = 0.41 for each. The same pattern of results are obtained when grades for medical-school year 2 are the criterion (for 22 classes at 12 schools). Medical correlations are r = 0.37. Finally, for all criteria, the combination of MCAT and grade-point-average composites are better predictors than either individually. (Erdmann, 1984, p. 386)

The test of function was significant with evidence showing the variable contributing the most

to the prediction of students who will most likely not experience academic difficulty during their first two year of medical school as Science GPA. The least contributing variable was shown to be overall undergraduate GPA with MCAT score in between, but still relatively low. The correct classification was achieved in 84.8 percent of the cases, which reflects a fairly high practical value of analysis. It is generally assumed that the baseline for correct classification is set at 50 percent for random classification; therefore selecting medical students using these criterion variables represents a 34.8 percent improvement over chance. While this may sound better than chance from a practical standpoint, one must remember that only 4.4 percent of the variable between these two groups of students was accounted for by the three variables of MCAT score, undergraduate GPA, and Science GPA. Although the correlation coefficient derived from this analysis would be considered negligible to moderate by most statistical standards, it is nevertheless consistent with the findings of other studies using similar methods.

Limitations of the Study

This study was conducted with a convenience sample of participants at one particular institution. While the design of the research this way was intentional and the need for it derived from previous research, this specific group of students could have influenced the results.

Additionally, this study did not address individual student learning or curricular differences in courses taught during the first two years throughout the span of nine years. Differing learning and teaching styles, as well as content, could have affected student classification as success or failure.

Finally, this research used post-selection analysis. Students at this institution were

not randomly admitted to medical school but were selected based on admission criteria and therefore, the range of the independent variables were restricted.

Recommendations for Further Study

The opportunities for further research within the admissions area of medical education are abundant. This specific study could be expanded to include additional variables such as age, gender, and undergraduate major. Furthermore, demographic factors such as race/ethnicity and socio-economic status could be included.

The results of this study, while statistically significant, seem to underscore the limited practical reliability of commonly used admissions criteria to predict academic performance. Another area for further research could include non-cognitive parameters. McGaghie (2000) suggested a number of qualitative variables that should be included in the admissions decision-making process, including altruism, integrity, work ethic, attitude, social competence, and leadership skills. Valid instruments that measure non-cognitive attributes of students applying for medical school could be used in a similar study, for example scaled through the personal interview, and scores could be included for analysis along with quantitative data.

And, although medical school admissions committees may be understandably reluctant to modify admission policies to allow academically weaker students to attend their institution, pilot programs could be designed for this purpose on an institutional level. This would not only allow expanded opportunities for possibly disadvantaged students with other positive non-cognitive criteria but would also allow an increase in the range of variables for statistical analysis.

Conclusions

The ability to accurately predict which students are at higher risk for possible academic difficulty during the first two years of medical school is a high priority for both schools and students. Although a number of studies have claimed that overall undergraduate GPA, Science GPA, and MCAT score are significant predictors of medical school performance, this study at Oklahoma State University Center for Health Sciences, College of Osteopathic Medicine, corroborates that there is little predictive value or practical significance between those admission criteria and academic performance.

Approximately 15 percent of the students included in this study met the definition of academic difficulty. overall undergraduate GPA and Science GPA seemed to best indicate students who would most likely experience academic difficulty within their first two years of medical school. The lower the GPA, the higher percentage of students encountered at least one factor of failure. MCAT score however did not seem to correlate as well. Students who achieved higher average scores on the MCAT were still experiencing academic difficulty. And as a combined admissions criteria group, there were students with lower GPAs and higher MCAT scores, and vice versa, that had occurrences of academic difficulty. Discriminant function analysis for the 2-group model showed that overall, although there seemed to be a couple of variables (Overall GPA and Science GPA) that showed statistical significance, the variables as a group did not appear to be effective as a model in predicting student academic success or failure. Only 4.4 percent of the between group variability was accounted for by the discriminant function.

The practical significance of this study gives the impression of significance for establishing a model for admissions criteria to medical school, while not generalizable to

other medical programs, but certainly for OSU-CHS, COM; however, a large (95.6) percent of the group variation is left to be explained by other factors. Since the factors most commonly used to admit students into medical school and predict academic performance were shown to have only minimal to moderate value in both statistical and practical significance, other factors such as non-cognitive factors should be investigated as to their value and usefulness in predicting academic success. Establishing measures to be taken during the interview process, which currently is not often practiced, could prove extremely advantageous. It seems logical to assume that non-cognitive criteria such as motivation, emotional stability, and maturity could prove beneficial in identifying students potentially at risk for academic difficulty who are embarking on an intense and stressful experience such as medical school.

The successful practice of medicine requires a collection of basic science knowledge, technical skills, and the ability to effectively communicate and interact with others. Patients not only want these cognitive characteristics in their physician, but also for them to be compassionate, humane, and considerate. It seems reasonable that there is a significant need to accurately assess medical school applicants not only for their potential ability to learn and perform well on objective tests but to develop methods of identifying students who will be successful in all aspects of the science of medicine, including non-cognitive aspects. Medical schools should continue to do institutional research and seek more accurate measures of predicting medical student performance, not just in the cognitive domain but the affective domain as well. Such efforts will require medical administrators to refocus attention away from strictly quantitative factors that are more commonly used today to

include factors that address equally important qualitative ones which combined, create the ideal physician.

References

AAMC curriculum directory. (2000). Washington, DC: Association of American Medical Colleges.

AAMC data book: Statistical information related to medical education. (2001). Washington, DC: Association of American Medical Colleges.

Astin, A. (1971). *Predicting academic performance in college: Selectivity data for 2300 American colleges.* New York, NY: The Free Press.

Baker, H., Cope, M., Fish, R., Gorby, J. & Foster, R. (2000). Relationship of preadmission variables and first-and-second-year course performance to performance on the national board of osteopathic medical examiners' COMLEX-USA level 1 examination. *The Journal of the American Osteopathic Association, 100*(3), 153-161, quiz 203.

Best, W., Diekema, A., Fisher, L. & Smith, N. (1971). Multivariate predictors in selecting medical students. *Journal of Medical Education, 46,* 42-50.

Blue, A., Gilbert, G., Elam, C. & Basco, W. (2000). Does institutional selectivity aid in the prediction of medical school performance? *Academic Medicine, 75*(10 suppl), S31-S33.

Borde, S. (1998). Predictors of student academic performance in the introductory marketing course. *Journal of Education for Business, 73*(5), 302-306.

Cariaga-Lo, L., Enarson, C., Crandall, S., Zaccaro, D., & Richards, B. (1997). Cognitive and noncognitive predictors of academic difficulty and attrition. *Academic Medicine,*

72(10 suppl), S69-S71.

Collins, J., White, G. & Kennedy, J. (1995). Entry to medical school: An audit of traditional selection requirements. *Journal of Medical Education, 29,* 22-28.

Dunlap, K., Henley, H., & Fraser, M. (1998). The relationship between admissions criteria and academic performance in an MSW program. *Journal of Social Work Education, 34*(3), 455-462.

Edwards, J., Elam, C. & Wagoner, N. (2001). An admission model for medical schools. *Academic Medicine, 76*(12), 1207-1212.

Ellsworth, J. (2000). *Surviving change: A survey of educational change models.* Syracuse, NY: ERIC Publications.

Erdmann, J. (1984). The medical college admission test and the selection of medical students. *New England Journal of Medicine, 310*(6), 386-389.

Feldhusen, J. & Jarwan, F. (1995). Predictors of academic success at state-supported residential schools for mathematics and science: A validity study. *Educational and Psychological Measurement, 55,* 505-512.

Fleming, J. & Garcia, N. (1998). Are standardized tests fair to African-Americans? Predictive validity of the SAT in black and white institutions. *Journal of Higher Education, 69*(5), 71-95.

Fleming, J. & Morning, C. (1998). Correlates of the SAT in minority engineering students: An exploratory study. *Journal of Higher Education, 69,* 89-108.

Fogelman, B. & Zwagg, R. (1981). Demographic, situational, and scholastic factors in medical school attrition. *Southern Medical Journal, 74*(5), 602-606.

Fraenkel, J. & Wallen, N. (2003). *How to design and evaluate research in education (5th*

edition). New York, NY: McGraw-Hill Higher Education.

Fullan, M. (1994). *Change forces: Probing the depths of educational reform. School development and the management of change series:* 10. (ERIC Document Reproduction Service No. ED373391).

Gall, J., Gall, M. & Borg, W. (2005). *Applying educational research: A practical guide (5th edition).* Boston, MA: Pearson Education, Inc.

Hall, F. & Bailey, B. (1992). Correlating students' undergraduate GPAs, their MCAT scores, and the academic caliber of their undergraduate colleges and their first-year academic performances across five classes at Dartmouth Medical School. *Academic Medicine, 67*(2), 121-123.

Hart, M., Payne, D & Lewis, L. (1981). Prediction of basic science learning outcomes with cognitive style and traditional admissions criteria. *Journal of Medical Education, 56,* 137-139.

Hendron, R. (1988). Predicting success and failure of medical students at risk for dismissal. *Journal of Medical Education, 63,* 596-602.

History of ACT. (2005). Retrieved February 25, 2005 from http://www.act.org/aboutact/history.html.

Hoefer, P. & Gould, J. (2000). Assessment of admission criteria for predicting students' academic performance in graduate business programs. *Journal of Education for Business,75*(4), 225-229.

Inglehart, M. & Brown, D. (1990). Professional identity and academic achievement-Considerations for the admissions process. *Academic Medicine, 65,* S3-S4.

Jones, R. & Mitchell, K. (1986, April). *Racial/ethic differences in the predictive validity of*

MCAT scores. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

Jones, R. & Thomae-Forgues, M. (1984). MCAT scores and student progress in medical school. *Journal of Medical Education, 59,* 527-531).

Julian, E. (2005). Validity of the medical college admission test for predicting medical school performance. *Academic Medicine, 80*(10), 910-917.

Keill, S. & Willer, B. (1985). Detection of psychiatrically at-risk applicants in the medical school admission process. *Journal of Medical Education, 60,* 800-802.

Klecka, W. (1975). Discriminant analysis. In Nie, N., Hull, C., Jenkins, K., Steinbrenner, K., & Bent, D. (Eds.), Statistical package for the social sciences (2^{nd} edition) (p.435). New York: McGraw-Hill.

Kuncel, N., Hezlett, S., & Ones, D. (2001). A comprehensive meta-analysis of the predictive validity of the graduate record examination: Implications for graduate student selection and performance. *Psychological Bulletin, 127*(1), 162-181.

Linn, R. & Hastings, C. (1984). A meta analysis of the validity of predictors of performance in law school. *Journal of Educational Measurement, 21*(3), 245-259.

Magner, L. (2005). *A history of medicine (2^{nd} edition).* Boca Raton, FL: Taylor & Francis.

McGaghie, W. (2000). Perspectives on medical school admission. *Academic Medicine, 65*(3), 136-139.

McGaghie, W. (2000). Qualitative variables in medical school admission. *Academic Medicine, 65*(3), 145-149.

McNeal, L. & Christy, W. (2001). *A discussion of change theory, system theory, and state designed standards and accountability initiatives.* Paper presented at the annual

meeting of the Southern Regional Council on Educational Administration, Jacksonville, FL.

Medical school admission requirements (MSAR): 2007-2008 (58th edition). (2007). Washington, DC: Association of American Medical Colleges.

Mitchell, K. (1987). Use of MCAT data in selecting students for admission to medical school. *Journal of Medical Education, 62,* 871-879.

Mitchell, K. (1990). Traditional predictors of performance in medical school. *Academic Medicine, 65,* 149-158.

Morrison, T. & Morrison, M. (1995). A meta-analytic assessment of the predictive validity of the quantitative and verbal components of the graduate record examination with graduate grade point average representing the criterion of graduate success. *Educational and Psychological Measurement, 52*(2), 309-316.

Neufeld, O. (1972). Predicting low academic performance of medical students. *Journal of the American Osteopathic Association, 72*(2), 175-180.

Osborne, R. (1998). *A history of the Oklahoma state university college of osteopathic medicine.* Stillwater, OK: Oklahoma State University.

Osteopathic medical college information book: 2007 entering class (2nd edition). (2007). Chevy Chase, MD: American Association of Colleges of Osteopathic Medicine.

Pedhazur, E. (1997). *Multiple regression in behavioral research: Explanation and prediction (3rd edition).* Orlando, FL: Harcourt Brace.

Powers, D. (1982). Long-term predictive and construct validity of two traditional predictors of law school performance. *Journal of Educational Psychology, 74*(4), 568-576.

Ragosta, M., Braun, H., & Kaplan, B. (1991). *Performance and persistence: A validity study*

of the SAT for students with disabilities. New York, NY: College Board.

Reid, J. & Blain, B. (1977). Identifying students who will be in academic difficulty in medical school. *Journal of Medical Education, 52,* 66-67.

Rhoads, J., Gallemore, J., Gianturco, D. & Osterhout, S. (1974). Motivation, medical school admissions and student performance. *Journal of Medical Education, 49,* 1119-1127.

Sarason, S. (1990). *The predictable failure of educational reform: Can we change course before it's too late?* San Francisco, CA: Josey-Bass.

Sarnacki, R. (1992). The predictive value of the premedical grade-point average. *Journal of Medical Education, 57,* 163-169.

Spooner, D. (1990). Help for the gatekeepers: Comment and summation on the admission process. *Academic Medicine, 65*(3), 183-187.

Tabachnick, B. & Fidell, L. (1989). Using multivariate statistics. New York: Harper & Row.

Van Loon, R. (2001). Organizational change: A case study. *Journal of Innovative Higher Education, 25*(4), 285-301.

What is ETS? (2005). Retrieved February 25, 2005 from http://www.ets.org/aboutets/visitors.html.

Wright, R., Palmer, J., & Miller, J. (1996). An examination of gender-based variations in the predictive ability of the SAT. *College Student Journal, 30,* 81-84.

Young, J. (1995). A comparison of two adjustment methods for improving the prediction of law school grades. *Educational and Psychological Measurement, 55,* 558-571.

Zeleznik, C., Veloski, J., Conly, S & Hojat, M. (1980). The relationship between MCAT science subtest scores and performance in medical school-The impact of the undergraduate institution. *Association of American Medical Colleges, 19,* 257-62.

Appendix A

IRB Approval

Oklahoma State University Institutional Review Board

Date:	Wednesday, October 17, 2007
IRB Application No	ED0793
Proposal Title:	Admissions Criteria as Predictors of Academic Success in First- and Second-Year Osteopathic Medical Students
Reviewed and Processed as:	Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 10/16/2008

Principal Investigator(s)

Emily A. Brown
4230 E. 83rd Place
Tulsa, OK 74137

Adrienne Hyle
325 Willard
Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☒ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Beth McTernan in 219 Cordell North (phone: 405-744-5700, beth.mcternan@okstate.edu).

Sincerely,

Sue C. Jacobs, Chair
Institutional Review Board

APPENDIX B

Excel Spreadsheet Sample Data

MCAT	SCIENCE GPA	OVERALL GPA	PART I COMLEX	DIFFICULTY	COMMENTS
10.00	3.31	3.39	Pass	No	
8.67	3.92	3.90	Pass	No	
9.00	3.33	3.51	Pass	No	
8.00	3.49	3.52	Pass	No	
8.67	3.38	3.56	Pass	No	
7.67	3.54	3.67	Pass	No	
7.67	3.00	3.24	Pass	No	
6.67	3.05	3.31	Pass	No	
9.33	2.89	3.02	N/A	Yes	W/D not in good standing
7.00	4.00	4.00	Pass	No	
7.33	3.79	3.86	Pass	No	
7.33	3.55	3.60	Pass	Yes	Graduated 2001 - made Ds in first two years
8.67	3.74	3.77	N/A	Yes	W/D not in good standing
7.67	3.69	3.37	Pass	No	
8.00	3.85	3.76	Pass	No	
7.67	3.41	3.60	Pass	No	
10.00	3.51	3.10	Pass	No	
8.33	3.92	3.89	Pass	No	
8.00	3.18	3.24	Fail	Yes	Repeated 1st year - graduated in 2000
9.00	3.12	3.31	Pass	Yes	Course remediation
7.00	3.31	3.50	Pass	No	
8.67	3.18	2.99	Pass	No	
9.67	2.95	3.16	Pass	No	
10.33	3.18	3.09	Pass	No	
10.00	2.94	3.07	Pass	No	
6.67	3.44	3.69	Pass	No	
8.33	4.00	4.00	Pass	No	
AACOMAS not in file - original misplaced			Pass	Yes	Repeated 1st year - graduated in 2000
8.33	3.18	3.29	Pass	No	
9.67	3.35	3.18	Pass	No	
8.00	3.26	3.14	Pass	No	
8.33	3.17	3.29	Pass	No	
7.70	2.88	2.87	Pass	No	
8.67	3.31	3.41	Pass	No	
10.33	2.93	3.20	Pass	No	
8.00	3.51	3.52	Pass	No	

MCAT	SCIENCE GPA	OVERALL GPA	PART I COMLEX	DIFFICULTY	COMMENTS
7.67	3.46	3.33	Pass	No	
7.00	3.95	3.98	Pass	No	
7.67	3.66	3.64	Pass	No	
8.67	3.57	3.38	Pass	Yes	Course remediation
9.00	2.92	3.18	Pass	No	
8.00	3.41	3.48	Pass	No	
9.33	2.95	3.22	Pass	No	
8.00	3.06	3.02	Pass	No	
7.00	3.47	3.47	Pass	No	
8.67	3.37	3.39	Pass	No	
7.67	2.90	3.22	Pass	No	
7.67	3.76	3.27	Pass	No	
8.00	3.50	3.49	Pass	No	
10.33	3.02	2.67	Pass	Yes	Course remediation
8.33	3.23	3.11	Pass	No	
9.67	3.94	3.98	Pass	No	
8.33	3.16	3.29	Pass	No	
8.17	3.21	3.46	Pass	No	
8.67	3.28	3.40	Pass	No	
7.67	2.97	3.20	Pass	No	
9.00	3.06	3.24	Pass	No	
7.33	2.18	2.58	Pass	Yes	Course remediation
8.00	3.81	3.88	Pass	No	
7.00	3.16	3.60	Fail	Yes	Course remediation
8.00	3.77	3.50	Pass	No	
8.33	3.29	3.32	Pass	No	
8.67	2.90	3.01	Pass	No	
6.33	2.51	2.85	Pass	No	
8.00	3.23	3.49	Pass	No	
7.67	3.86	3.89	Pass	No	
7.67	3.75	3.21	Pass	No	
9.67	3.30	3.48	Pass	No	
9.00	3.30	3.59	Pass	No	
10.00	2.94	3.04	N/A	Yes	Course remediation
9.00	2.96	3.18	Pass	No	
5.00	2.78	2.97	Pass	Yes	Course remediation
8.33	2.70	3.02	Fail	Yes	Course remediation
7.33	2.90	3.23	Pass	No	
8.00	3.03	3.84	Pass	No	
10.00	3.55	3.59	Pass	No	
8.00	3.67	3.55	Pass	No	
8.00	2.89	3.11	Pass	No	
6.33	3.45	3.15	Pass	No	
8.33	3.35	3.52	Pass	No	
7.67	3.42	3.69	Pass	No	
8.00	3.46	3.49	Pass	No	
8.67	3.11	3.28	Pass	No	

MCAT	SCIENCE GPA	OVERALL GPA	PART I COMLEX	DIFFICULTY	COMMENTS
8.33	3.20	3.25	N/A	Yes	W/D not in good standing
9.67	3.44	3.48	Pass	No	
8.00	3.52	3.58	Pass	No	
8.33	3.74	3.46	Pass	No	
6.33	2.76	2.83	Pass	No	
8.67	3.11	3.48	Pass	No	

APPENDIX C

SPSS Sample Data

V 1	MCAT
V 2	Science GPA
V 3	Overall GPA
V 4	Difficulty

	V 1	V 2	V 3	GROUP
1	10.00	3.31	3.39	0
2	8.67	3.92	3.90	0
3	9.00	3.33	3.51	0
4	8.00	3.49	3.52	0
5	8.67	3.38	3.56	0
6	7.67	3.54	3.67	0
7	7.67	3.00	3.24	0
8	6.67	3.05	3.31	0
9	9.33	2.89	3.02	1
10	7.00	4.00	4.00	0
11	7.33	3.79	3.86	0
12	7.33	3.55	3.60	1
13	8.67	3.74	3.77	1
14	7.67	3.69	3.37	0
15	8.00	3.85	3.76	0
16	7.67	3.41	3.60	0
17	10.00	3.51	3.10	0
18	8.33	3.92	3.89	0
19	8.00	3.18	3.24	1
20	9.00	3.12	3.31	1
21	7.00	3.31	3.50	0
22	8.67	3.18	2.99	0
23	9.67	2.95	3.16	0
24	10.33	3.18	3.09	0
25	10.00	2.94	3.07	0
26	6.67	3.44	3.69	0
27	8.33	4.00	4.00	0
28	8.33	3.18	3.29	0
29	9.67	3.35	3.18	0
30	8.00	3.26	3.14	0
31	8.33	3.17	3.29	0
32	7.70	2.88	2.87	0
33	8.67	3.31	3.41	0
34	10.33	2.93	3.20	0
35	8.00	3.51	3.52	0
36	7.67	3.46	3.33	0

	V 1	V 2	V 3	GROUP
37	7.00	3.95	3.98	0
38	7.67	3.66	3.64	0
39	8.67	3.57	3.38	0
40	9.00	2.92	3.18	1
41	8.00	3.41	3.48	0
42	9.33	2.95	3.22	0
43	8.00	3.06	3.02	0
44	7.00	3.47	3.47	0
45	8.67	3.37	3.39	0
46	7.67	2.90	3.22	0
47	7.67	3.76	3.27	0
48	8.00	3.50	3.49	0
49	10.33	3.02	2.67	0
50	8.33	3.23	3.11	0
51	9.67	3.94	3.98	1
52	8.33	3.16	3.29	0
53	8.17	3.21	3.46	0
54	8.67	3.28	3.40	0
55	7.67	2.97	3.20	0
56	9.00	3.06	3.24	0
57	7.33	2.18	2.58	0
58	8.00	3.81	3.88	0
59	7.00	3.16	3.60	1
60	8.00	3.77	3.50	0
61	8.33	3.29	3.32	1
62	8.67	2.90	3.01	0
63	6.33	2.51	2.85	0
64	8.00	3.23	3.49	0
65	7.67	3.86	3.89	0
66	7.67	3.75	3.21	0
67	9.67	3.30	3.48	0
68	9.00	3.30	3.59	0
69	10.00	2.94	3.04	0
70	9.00	2.96	3.18	0
71	5.00	2.78	2.97	1
72	8.33	2.70	3.02	0
73	7.33	2.90	3.23	1
74	8.00	3.03	3.84	1
75	10.00	3.55	3.59	0
76	8.00	3.67	3.55	0
77	8.00	2.89	3.11	0
78	6.33	3.45	3.15	0
79	8.33	3.35	3.52	0
80	7.67	3.42	3.69	0
81	8.00	3.46	3.49	0
82	8.67	3.11	3.28	0
83	8.33	3.20	3.25	0

	V 1	V 2	V 3	GROUP
84	9.67	3.44	3.48	0
85	8.00	3.52	3.58	1
86	8.33	3.74	3.46	0
87	6.33	2.76	2.83	0
88	8.67	3.11	3.48	0

Office of Academic Affairs

CENTER FOR HEALTH SCIENCES

1111 West 17th Street
Tulsa, Oklahoma 74107-1898
918-561-1181
918-561-1278 (fax)

Appendix D

OSU-CHS Approval

RESEARCH PROPOSAL

Admissions Criteria as Predictors of Academic Success in 1st and 2nd Year Osteopathic Medical Students at Oklahoma State University Center for Health Sciences, College of Osteopathic Medicine

Emily A. Brown

Bachelor of Science
University of Texas Medical Branch
1997

Master of Science
Oklahoma State University
2000

In partial fulfillment of the requirements for the degree of
Doctor of Education
Oklahoma State University

Introduction

Overall undergraduate grade-point average (GPA), Science GPA, and MCAT scores (Medical College Admission Test) are nationally used as the leading criteria for medical school recruitment and admission, and therefore treated as the primary predictors of academic success in medical schools. The Association of American Medical Colleges (AAMC) reports that 10% of medical students fail one or more courses in their first year. Medical students that meet or exceed admissions criteria are still experiencing academic difficulties within their first-and second-year of studies and/or fail to pass Part I of Board examinations on the first attempt. Research literature also indicates that these traditional criteria are becoming increasingly less accurate in predicting future academic performance and medical student success, although still utilized as primary factors for admission to medical school; an accurate relationship may not be represented. The purpose of this study is to test the variables of overall GPA, Science GPA, and MCAT score as to whether or not these criteria accurately predict which students will experience academic difficulty in either their 1st or 2nd year of coursework or Part 1 of their licensing examination, for future planning and utilization by OSU-CHS, and to serve as an example for other osteopathic schools nationwide to develop independent, statistical self-examinations.

Method

The study sample will consist of 10 years of admission data, approximately 880 OSU-CHS osteopathic medical students, matriculating from the years 1995 through 2004. Preadmission data will be collected from students' medical school application documents including overall undergraduate GPA, Science GPA, and MCAT score. Unofficial transcript records will be examined for the students' first 2 academic years to identify students who experienced academic difficulty (course failure). Additionally, initial Pass/Fail results on the Part I Board examination (first attempt) will also be examined. Dummy coding will be the method utilized for this study for appropriate student anonymity as well as ease of statistical calculation of the data. For each student, "0" will represent that the student did NOT experience either type of failure (academic or Board failure) and "1" will represent that the student DID experience at least one type of failure. Multiple regression analysis will then be performed using SPSS (Statistical Package for the Social Sciences) to determine correlation and predictive qualities among the variables. Results will be recorded and discussed in my doctoral dissertation, to be completed in the Spring of 2008.

Data Collection

IRB (Institutional Review Board) approval will be gained from Oklahoma State University (Stillwater) during data collection in the Spring/Summer of 2007. Documentation of approval will be provided to OSU-CHS prior to receiving compiled data. Data from the matriculating class of 2004 has already been obtained and recorded from an informal, pilot study. Therefore, data from matriculating classes of 1995 through 2003 are needed (9 years). Data required can be recorded from student admission files including student name, entering MCAT score, entering overall GPA, and entering Science GPA. COMLEX Part I Board results can also be obtained from student files; although multiple attempts and copies of scores may be present, the initial "Pass/Fail" exam results are needed for this study. The student names and data can then be transferred to the Registrar's office to examine from unofficial transcript records whether or not the student experienced any academic difficulty (course failure) during their 1st or 2nd year of study. After data is compiled, student names can be removed for anonymity and can be grouped by number and class.

Data collection will be financed by myself at an appropriate amount and completed by a student worker, employee, or special employee, as deemed appropriate by the Vice President for Academic Affairs and Senior Associate Dean, in coordination with the Dean of Students. The date for completion of data collection would be ~~July 31~~ (October 31), 2007. If a confidentially agreement could be agreed upon, I would be more than happy to assist in data collection at a reduced rate.

Thank you...

Gary L. Slick, D.O.
Vice President for Academic Affairs and
Senior Associate Dean
OSU-CHS

Emily A. Brown
4/23/07
Date

VITA

Emily Alissa Brown-Hendershott

Candidate for the Degree of

Doctor of Education

Thesis: ADMISSIONS CRITERIA AS PREDICTORS OF ACADEMIC SUCCESS IN FIRST- AND SECOND- YEAR OSTEOPATHIC MEDICAL STUDENTS

Major Field: Higher Education

Education: Bachelor of Sciences, Health Care Administration
University of Texas Medical Branch, Galveston, TX (1997)

Master of Science, Higher Education Administration
Oklahoma State University, Stillwater, OK (2000)

Completed the Requirements for the Doctor of Education degree at Oklahoma State University in December, 2008.

Professional: Oklahoma State University Center for Health Sciences, College of Osteopathic Medicine, Tulsa, OK
September 1997 – May 2007

Director of Academic Affairs and Accreditation

Administrative Director – OMECO (Osteopathic Medical Education Consortium of OK)

Assistant Director of Clinical Education

University of Texas Medical Branch, Galveston, TX
April 1994 – September 1997

Name: Emily A. Brown-Hendershott Date of Degree: December, 2008

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: ADMISSIONS CRITERIA AS PREDICTORS OF ACADEMIC SUCCESS IN FIRST- AND SECOND- YEAR OSTEOPATHIC MEDICAL STUDENTS

Pages in Study: 84 Candidate for the Degree of Doctor of Education

Major Field: Higher Education

Scope and Method of Study: Overall undergraduate grade point average (GPA), Science GPA, and MCAT scores (Medical College Admission Test) are nationally used as the leading criteria for medical school recruitment and admission, and therefore treated as the primary predictors of academic success in medical schools. The model and practice of using statistical analysis to determine the justifiable use of certain admission criteria to predict academic performance in medical school has been researched but also recommends localized study. Using discriminant analysis (DA) theory as the analytical lens in this study, data from nine years of medical classes were collected for the participants, once upon matriculation into medical school and then collected again, after their second year of coursework, allowing for implications in the predictive value of the admissions criteria on student academic success or failure.

Findings and Conclusions: This study found that 15 percent of the total group met the definition of academic difficulty. Science GPA seemed to best indicate students who would most likely experience academic difficulty within their first two years of medical school, with overall undergraduate GPA next and MCAT score correlating the least. As a criterion set, the between group variability accounted for by the discriminant function was significant but small at (4.4 percent). The correct classification was achieved in 84.8 percent of the cases reflecting a fairly high practical value of analysis. However, implications regarding restriction of criterion variables should be considered.

ADVISOR'S APPROVAL: Dr. Adrienne Hyle