A Quantitative Analysis of Board of Certification Examination Outcomes for Athletic Training Programs

A Dissertation submitted
to the Graduate School
Valdosta State University

In partial fulfillment of requirements
for the degree of

DOCTOR OF EDUCATION

In Leadership

In the Department of Curriculum, Leadership, and Technology
of the Dewar College of Education and Human Services

STACEY D. WALTERS

Masters of Arts in Teaching, University of West Alabama, 1999
Bachelor of Science in Sports Medicine, Valdosta State University, 1997

This dissertation, "A Quantitative Analysis of Board of Certification Examination Outcomes for Athletic Training Programs" by Stacey D. Walters is approved by:

Dissertation Committee Chair

Lantry L. Brockmeier, Ph.D.
Professor of Leadership, Technology, and Workforce Development

Committee Members

James Archibald, Ph.D., LPC
Associate Professor of Leadership, Technology, and Workforce Development

Michael Bochenko, Ed.D.
Assistant Professor of Leadership, Technology, and Workforce Development

Associate Provost for Graduate Studies and Research

Becky K. da Cruz, Ph.D., J.D.
Professor of Criminal Justice

Defense Date 9.30.2020

ABSTRACT

The ability to produce competent athletic trainers for the workforce, particularly in the secondary school setting, is a growing concern. Athletic training program administrators seek to create programs that graduate competent athletic training students who can pass the Board of Certification (BOC) credentialing examination. The Commission on Accreditation of Athletic Training Education (CAATE) mandates that programs meet a three-year aggregate BOC program pass rate outcome of 70% for first-time test takers. The purpose of this study was to examine whether clinical education and faculty demographic characteristic variables selected from an extensive literature review impacted BOC undergraduate and graduate program three-year aggregate pass rates. The sample for the study consisted of 136 undergraduate and 38 graduate athletic training program directors from across the United States who responded to an 18-item survey that was validated by an expert panel.

Pearson correlations found no correlation between the undergraduate three-year aggregate BOC program pass rate and any of the variables used in this study. For graduate programs, a negative correlation was found between the three-year aggregate BOC program pass rate and both the number of required minimum clinical hours per week as well as the number of dual-appointed faculty associated with the program. Using multiple regression with backward selection, the current study determined that the BOC three-year aggregate pass rate for graduate programs could be predicted using the number of required maximum clinical hours per week and the number of dual-appointed faculty associated with the program. In addition, the use of upsampled logistic regression found that compliance with the mandated 70% three-year aggregate BOC pass rate could be predicted for undergraduate programs using the average clinical preceptor-to-student ratio, the average number of years of faculty clinical experience, the average number of years faculty teaching experience, and the number of full-time faculty associated with the program. Last, a series of factorial ANOVAs found no interactions between the selected variables for undergraduate and graduate programs. In addition, there were no significant main effects for any of the selected variables across undergraduate and graduate athletic training programs.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

I would like to express my sincere thanks to my committee chair, Dr. Lantry Brockmeier, who throughout this research process, encouraged me and provided invaluable guidance to complete the study. As a teacher and mentor during this process, Dr. Brockmeier taught me more about the research process than I could ever verbalize. I would also like to thank my Dissertation Committee, Dr. James Archibald and Dr. Michael Bochenko for their guidance and expertise.

I would like to thank the people with whom I work as they provided support and encouragement along this journey. To Dr. Sheri Noviello, who has always been a bright spot in times when I needed a gentle push and a word of reassurance, thank you. Also, my sincere gratitude to Dr. LaGary Carter who consistently encouraged me during this journey. Finally, to faculty members in my department throughout the years, Lori Howard, Chuck Conner, Russ Hoff, and Mark Kasper, thank you for your endless support and your friendship.

None have been more important than my family during this academic journey. I would like to thank my parents, whose love, support, and guidance has always been evident in whatever I pursued academically. I would also like to thank my husband, Robby, and his children Addie, Lee, and Caleb for encouraging me in the final months of completing my dissertation. I am forever grateful to all of you for your faith in my ability to complete this research study.

Chapter I

INTRODUCTION

Certified athletic trainers are allied health care professionals who provide prevention, assessment, treatment, and rehabilitation of injuries and illnesses that occur in the physically active population (National Athletic Trainers' Association [NATA], 2010). Athletic trainers work with the athletic population in the secondary school, collegiate, and professional sports settings, otherwise known as "traditional" practice settings. In recent years, athletic training has grown to include other "emerging" practice settings such as the physician's office, performing arts, military, industry, hospitals, outpatient therapy clinics, and public safety. Not only do these new settings allow for growth in the profession, but future advancement in the traditional setting is also expected with the increased focus on sudden death in athletics, spikes in the number of adolescent injury rates, and concussions in the athletic population. In fact, the U.S. Bureau of Labor Statistics (2020) projects that the field of athletic training will increase by 16% by the year 2029. With this predicted increase in job growth, the demand for athletic training educators to graduate competent professionals is also mounting. Three organizations, The Commission on Accreditation of Athletic Training Education (CAATE), The Board of Certification (BOC), and The National Athletic Trainers' Association (NATA), work cohesively to outline current instructional content and program evaluation of athletic training programs.

Athletic training students must graduate from a CAATE-accredited program before becoming a candidate for the national certification examination (Board of

Certification, Inc. [BOC], 2016a). In these accredited programs, faculty must instruct students using the competencies as outlined by the NATA in the most current version of the Athletic Training Education Competencies publication (NATA, 2011). The NATA distributes these competencies to athletic training education programs upon completion of an updated BOC role delineation study. The role delineation study serves as the foundation for competency-based education, examination development, and continuing education by surveying current practicing athletic training professionals (BOC, 2010).

The CAATE is responsible for the assessment, evaluation, and development of athletic training education (Commission on Accreditation of Athletic Training Education [CAATE], 2016). Part of the CAATE mission is to maintain overall program structure and performance via published standards (CAATE, 2012). These standards include evaluation of institutional sponsorship, evaluation of program outcomes, appropriate program personnel, purposeful program delivery, maintenance of student health and safety, adequate financial resources, adequate facilities and instructional resources, operational policies and fair practices, clearly written program requirements, and maintenance of student academic records. CAATE leaders write many of these standards in a broad manner which allows athletic training program directors to create a variety of curriculum and instructional practices as well as outcome measures specific to the institution and program. Furthermore, program directors may design the didactic and clinical components that meet accreditation standards in any manner they choose. Athletic training curriculum instruction and design can vary from program to program; however, instructional competencies are the same for all programs.

The CAATE standards outline the requirement of program outcomes assessment. All athletic training programs are required to assess and report one specific outcome measure, that of the program's BOC aggregate pass rate data over three years (CAATE, 2012). Athletic training programs are mandated to maintain a three-year aggregate first-time cohort pass rate of 70% or better on the BOC examination, the national credentialing examination for athletic training. The goal of the BOC examination is to ultimately qualify athletic training professionals as competent and safe entry-level practitioners for the public (BOC, 2015). The mandate of a three-year aggregate first-time cohort pass rate of 70% or better places a great deal of importance on BOC examination student success rates as an outcomes measure. Therefore, athletic training program directors must recruit, retain, and graduate students who will pass the BOC examination to meet the CAATE mandate as well as provide the active population with safe athletic training practitioners.

Student recruitment and retention often hinge on the current first-time pass rate data for the program which is required to be published for public access (CAATE, 2012). Consequently, program directors must focus their attention on creating valuable learning experiences that produce positive student outcomes on the BOC examination. The emphasis on student outcomes requires program administrators to look at program components and admission requirements which can be modified to promote student success. Another area of focus taken from previous research in athletic training and other allied health education is that of clinical education and faculty characteristic demographics.

Athletic training programs use a blend of didactic content delivered by program faculty and clinical experiences delivered by preceptors to educate and prepare students for professional practice. Prior research finds that athletic training educators feel that the link between the academic content and clinical education experience must be robust and cohesive (Carr & Drummond, 2002). Clinical education and faculty demographic characteristics have previously been studied in athletic training education (Draper, 1989; Freesemann, 2000; Harrelson, Gallaspy, Knight, & Leaver-Dunn, 1997; Leard, Booth, & Johnson, 1991; Leone, Judd, and Colandreo, 2008; Middlemas, Manning, Gazzillo, & Young, 2001; Perkins & Judd, 2001; Perrin & Lephart, 1988; Sciera, 1981; Starkey & Henderson, 1995; Turocy, Comfort, Perrin, & Giech, 2000; Williams & Hadfield, 2003). These studies included a variety of results with clinical education and faculty characteristics being studied independently of each other.

Statement of the Problem

The field of athletic training is growing, and there is an increased need for more competent athletic training practitioners. A recent study determined that only one-third of all public secondary schools have full-time athletic trainers, a number that must increase to provide appropriate medical care to this specific patient population (NATA, 2004; Pryor, Casa, Vandermark, Stearns, Attanasio, Fontaine, & Wafer, 2015; U.S. Department of Education, 2013). Consequently, there is growing pressure placed on athletic training program faculty to produce knowledgeable and skilled athletic training students who can pass the athletic training national credentialing examination—the Board of Certification Examination.

Currently, 17% of all athletic training programs are deemed noncompliant with the three-year aggregate first-time cohort BOC pass rate mandate of 70% (CAATE, 2017). This noncompliance statistic demonstrates that there is an outcome gap that exists between athletic training education programs. Therefore, it is important to assess what variables may impact a program's compliance with the BOC pass rate mandate. It is important to investigate this outcome gap to provide program administrators with empirical evidence that may allow them to graduate successful, competent students who can pass the BOC examination on the first attempt.

Although the current first-time pass rate for the BOC is similar to that of other allied health professions, this has not always been the case (American Occupational Therapy Association, Inc. [AOTA], 2014; BOC, 2015; Federation of State Boards of Physical Therapy [FSBPT], 2016b; National Council of State Boards of Nursing [NCSBN], 2014). Several changes have occurred in athletic training education since the gap between athletic training and other allied health professional student's first-time pass rates has improved. No published studies have considered cohort outcomes on the BOC examination, and none have combined variables associated with clinical education and faculty demographic characteristics. This study will use data after the last educational changes to provide additional information to the body of knowledge that currently exists with regards to BOC examination success.

Purpose of the Study

The purpose of this study was to identify whether selected variables associated with clinical education and faculty demographic characteristics impact BOC examination success. There is an important connection between these areas in that faculty members deliver educational content, and student engagement in clinical education allows the application of knowledge and skills from coursework to patients in a real-world setting. This learning process allows students to become competent, independent practitioners.

Furthermore, prior studies have identified clinical education and program faculty demographic characteristics as areas of interest for continued athletic training education research (Freesemann, 2000; Hickman, 2010; Turocy et al., 2000; Williams & Hadfield, 2003). Specifically, this study included selected clinical education and faculty demographic characteristics from previous literature to determine whether one can predict BOC examination three-year aggregate program pass rates. The same variables were included to determine whether one can classify athletic training programs as compliant or noncompliant with the 70% mandate. This study describes the effects of selected variable levels on first-time BOC examination cohort three-year aggregate pass rates. Overall, this research study provides athletic training educators with valuable empirical evidence on cohort BOC examination success.

Research Questions

Research questions for this study are comprised of the following:

1. Are selected athletic training clinical education variables and faculty demographic characteristics significant predictors of the three-year aggregate BOC pass rate for first-time test takers?
    a. Are selected athletic training clinical education program variables (minimum required clinical hours per week, maximum clinical hours per week, number of semesters with clinical experience, average preceptor-to-student ratio, and presence of a capstone clinical experience) and faculty

demographic characteristics (number of faculty with a doctorate, average years of faculty teaching experience, average years of faculty clinical experience, the total number of full-time faculty devoted to the program, and number of dual appointed faculty) significant predictors of undergraduate athletic training program BOC three-year aggregate pass rate for first-time test takers?

  b. Are selected athletic training clinical education program variables (minimum required clinical hours per week, maximum clinical hours per week, number of semesters with clinical experience, average preceptor-to-student ratio, and presence of a capstone clinical experience) and faculty demographic characteristics (number of faculty with a doctorate, average years of faculty teaching experience, average years of faculty clinical experience, the total number of full-time faculty devoted to the program, and number of dual appointed faculty) significant predictors of graduate athletic training program BOC three-year aggregate pass rate for first-time test takers?

2. Are selected athletic training clinical education variables (minimum required clinical hours per week, maximum clinical hours per week, number of semesters with clinical experience, average preceptor-to-student ratio, and presence of a capstone clinical experience) and faculty demographic characteristics (number of faculty with a doctorate, average years of faculty teaching experience, average years of faculty clinical experience,the total number of full-time faculty devoted to the program, and number of dual appointed faculty) significant predictors in

classifying undergraduate athletic training programs as compliant or noncompliant with the standard of a 70% three-year aggregate BOC pass rate for first-time test takers?

3. Is there a significant difference between levels of selected variables on the BOC examination three-year aggregate pass rate for first-time test takers?
    a. Is there a significant difference between levels of average years of faculty clinical experience and levels of average years of faculty teaching experience on undergraduate athletic training program BOC examination three-year aggregate pass rate for first-time test takers?
    b. Is there a significant difference between the levels of clinical site preceptor-to-student ratio and levels of minimum required weekly clinical hours on undergraduate athletic training program BOC examination three-year aggregate pass rate for first-time test takers?
    c. Is there a significant difference between levels of average years of faculty clinical experience and levels of average years of faculty teaching experience on graduate athletic training program's BOC examination three-year aggregate pass rate for first-time test takers?
    d. Is there a significant difference between the levels of clinical site preceptor-to-student ratio and levels of minimum required weekly clinical hours on graduate athletic training program BOC examination three-year aggregate pass rate for first-time test takers?

Research Methodology

This nonexperimental survey research design with correlational and group comparison methods surveyed both undergraduate and graduate athletic training program directors regarding variables included in the study. The dependent variable identified for this study is the three-year aggregate BOC examination program pass rate for first-time test takers, which can range from 0% to 100%, a ratio level variable. Independent variables studied included selected variables related to clinical education and faculty demographic characteristics. Independent variables related to clinical education in this study included: (a) minimum required clinical hours per week, (b) maximum limit of clinical hours per week, (c) number of semester students are engaged in clinical experiences, (d) average preceptor-to-student ratio at clinical sites, and (e) whether a capstone clinical experience exists. Variables associated with faculty demographic characteristics included: (a) number of faculty with a doctorate, (b) average faculty years of clinical experience, (c) average faculty years of teaching experience, (d) the total number of full-time faculty devoted to the program, and (e) number of dual appointed faculty—between athletics and academics.

Currently, 361 higher education athletic training programs exist, 289 undergraduate and 72 graduate programs, each having a dedicated program director. After IRB approval (see Appendix A), a survey was administered to all program directors in an online and paper-and-pencil format. In addition, program data related to accreditation was sought through CAATE but was denied. A process of survey assessment, feedback, and editing was used to assess for survey content validity before data collection. The use of two survey formats and the use of data gathered from the individual programs and the CAATE websites were effective in garnering participation in the research study.

Descriptive statistics and inferential statistics were generated and presented for each of the research questions. Multiple regression was used to answer the first research question to determine whether one could predict a program's three-year aggregate BOC pass rate for first-time test takers using the independent variables. Undergraduate and graduate programs were analyzed separately. Separating these types of programs helped determine which variables were relevant at the undergraduate and graduate program levels for first-time test takers.

For the second research question, logistic regression was used to determine the predictive abilities of the independent variables to categorize undergraduate programs into one of two groups—compliant or noncompliant in reaching the 70% mandate for first-time BOC test takers. This research question focused on undergraduate programs since only three out of 72 graduate programs were noncompliant. Therefore, there was not a large enough group of noncompliant programs to assess the predictive abilities of independent variables on BOC examination success at the graduate level.

The third research question was answered using a series of factorial ANOVAs to determine whether selected independent variable levels were significant to the BOC pass rate for first-time test-takers. The goal was to determine whether significant differences existed between levels of faculty clinical experience, faculty teaching experience, preceptor-to-student ratio, and the minimum number of required weekly clinical hours in undergraduate and graduate programs.

Significance of the Study

This study is significant in that it was used to identify whether particular variables associated with athletic training clinical education and faculty demographic characteristics impact the three-year aggregate first-time pass rate on the BOC examination. By identifying variables that may impact the first-time pass rate for cohorts, administrators may use empirical evidence to critically assess and structure athletic training programs in a manner that creates successful test candidates. Also, program administrators may find that variables associated with program faculty and first-time cohort BOC pass rates allow them to focus on faculty development or recruit highly qualified faculty in a manner that might impact student success.

By expanding BOC examination pass rate research across the undergraduate and graduate levels of CAATE-accredited programs, an updated research study may provide valuable information in variables that impact BOC examination first-time cohort pass rates for a variety of students. It is important to study both undergraduate and graduate-level education because more students are coming to college with successful college credit course completion from high school dual-enrollment programs. Data from the 2010-2011 academic year showed that 53% of all U.S. high school administration reported that students at their institution are dually enrolled for college credit (U.S. Department of Education, 2013). Students who have gained dual-enrollment credits may be entering graduate school at an earlier age than ever before. Therefore, the students at the undergraduate level in this study could provide valuable information for future graduate athletic training programs accepting students at that particular age range.

This study also intended to provide some information about relevant variables found in programs with first-time pass rates over 70% which could be used to realign programs that fall below the metric. This realignment could have the impact of improvement in program and student outcomes. Ultimately, identifying predictor variables could impact athletic training practice at the local, district, state, and national levels by graduating competent, knowledgeable professionals. Students who pass the examination could help fill the current void in providing appropriate medical care for secondary school athletes across the United States.

Theoretical Framework

Athletic training education programs use a combination of didactic and clinical education to prepare students for entry-level employment (CAATE, 2012). CAATE leadership does not dictate a specific program structure and this results in a variety of curricular and clinical programming across the 361 athletic training programs. The process of knowledge retention consists of tasks associated with instruction and learning. Therefore, this study incorporates two theories, Gagné's theory of instruction and the constructivist theory of learning as foundational theories.

Gagné's Instructional Theory

Previously allied health education research studies in disciplines containing a clinical component included Gagné's instructional theory as a foundation (Adel, Lorch, DeAngelis, Vause-Earland, & Mollo, 2013; Gatti-Petito, Lakatos, Bradley, Cook, Haight, & Karl, 2013). The intent of clinical education is to provide students with an opportunity to augment the retention and transferability of learned information. Gatti-Petito et al. (2013) applied this theory to nursing education as they felt that the process of clinical practice supplements and enhances didactic content. One can apply this same principle to athletic training since the process of didactic and clinical education are similar to that of nursing education.

Didactic instruction and clinical education are both areas in which instruction occurs. Therefore, one theoretical basis for this study is that of Gagné's theory of instruction (Gangé & Medsker, 1996). This theory has three components: (a) structured learning outcomes, (b) learning context, and (c) an instructional strategy. According to Gagné and Medsker, learning is an internal process that is based in an environmental context and requires a practical component. Students attain transferability of knowledge through a process of practice in which the learner applies the information in a variety of settings and contexts. This particular component of Gagné's instructional theory is an important aspect of athletic training clinical education where program leadership alters context by assigning students to a variety of clinical sites, preceptors, and peer groupings.

This learning theory directly mirrors what occurs in athletic training education programs. Students are first taught and assessed on knowledge and skills in the classroom. Preceptors at clinical sites are responsible for the continued education and supervision of the student as they apply knowledge and skills to a real patient. Therefore, teachers, preceptors, and students use Gagné's instructional theory across didactic and clinical education in athletic training programs.

Constructivism Learning Theory

The constructivist theory states that learning is a process of how students use and make sense of their experiences (Merriam & Bierema, 2014). This process involves an individualized gathering of information viewed as important and relevant. Researchers in nursing education previously used the constructivist theory to build learning opportunities in either a clinical or patient-simulation setting (Kakkinen & Arwood, 2009; Rothgeb, 2008). The constructivist theory maintains that knowledge acquisition occurs through self-directed learning, group, and individual interactions, as well as self-reflection to create context. Therefore, learned information is specific to the context at the time of learning. In a classroom, the context of learning would be quite different from that in clinical education where learners are interacting with patients in real-time, across a variety of settings. Consequently, the manner in which the student makes sense of the information differs.

The theory maintains that students learn via their working relationship with supervisors, peers, and patients. Parker and Myrick (2009) noted the importance of allowing students to access information from a variety of sources, critically appraise the information gathered, and make decisions. The authors go on to state that the use of the constructivist theory to create learning scenarios assists in furthering a student's clinical and decision-making skills as well as their collaboration techniques. This process of sharing information between peers and preceptors helps the learner construct and make sense of the information. As the student maneuvers through the educational process, a reflective practice must occur in which the learner critiques and alters how information fits their context (Merriam & Bierema, 2014). Students must enhance their ability to do this to practice in a competent, independent manner. They must interact with physicians and professional peers to grow and mature professionally. Clinical education is, therefore, a critical component to student success and professional growth.

Limitations of the Study

Although this study sought to understand how clinical education and faculty demographic characteristics impact BOC examination success, there were limitations to the study. One of the greatest limitations of this study involved the return rate from the current number of graduate athletic training programs, n = 72. A low return rate from graduate program directors could have impacted the ability to garner successful data interpretation using the planned statistical procedures since there are fewer overall athletic training graduate programs. A low survey return rate could have rendered only descriptive statistics across graduate programs.

Other variables associated with clinical education could also affect study results. The volume and type of patient interaction experiences, the variety of patient injury and illness exposure, type of clinical settings in which students gained experience, and the total number of hours a student earned over the totality of time in the program could have impacted student outcomes. This study gathered variables on a group level since the focus is cohort success. Gathering cohort data on volume and type of interaction, the variety of injury and illness exposure, and the type of clinical settings in which the student gained experience would have been difficult. Students often have very different, individualized experiences across an athletic training program. For the purpose of this study, gathering data on the student's total number of clinical hours is not difficult to collect. However, it would be difficult to convert that individual-level data into group-level data.

Variables associated with program faculty which is out of the researcher's control could also affect results. This study did not consider the teaching styles of faculty members.   Again, this study included group-level data for faculty demographic characteristics and data on teaching styles would be difficult to collapse into a group level. In addition, within a three-year testing window for programs, there may be changes in faculty and program characteristics. The program director reported on current faculty associated with the program; these faculty may not have been part of the program at another point in the three-year testing window.

Definition of Terms

The following definitions are provided for terms used in this study.

Athletic training student(s). Higher education student(s) enrolled in the professional component of an athletic training program.

Athletic training program. An undergraduate or graduate program that is accredited by the Commission on the Accreditation of Athletic Training Education.

Board of Certification (BOC). The entity that provides a mechanism for national credentialing, reviews the standards for athletic training practice, and reviews continuing education requirements for athletic training professionals (BOC, 2010).

Board of Certification examination. The only national professional credentialing examination for athletic trainers. The examination assesses a candidate's knowledge in the five athletic training domains—injury/illness prevention and wellness protection, clinical evaluation and diagnosis, immediate and emergency care, treatment, rehabilitation, organizational skills, and professional health and well-being (BOC, 2013).

Certified athletic trainer. A healthcare professional who works under the supervision of and collaborates with physicians to provide injury and illness prevention, emergency care, clinical diagnosis of injuries and diseases, therapeutic interventions, and rehabilitation of injuries and illnesses to physically active patients (NATA, 2010).

Clinical capstone experience. A clinical experience, typically in a student's senior year, where the student spends time in a clinical setting for extended periods. A practicing athletic trainer supervises students at these immersive experiences.

Clinical education. A component of healthcare education conducted in a real-world setting where students provide patient care under the supervision of a preceptor (CAATE, 2012).

Cohort. A group of students, similar in level, who are enrolled in a professional education program. These students take the same courses in the major simultaneously.

Commission on Accreditation of Athletic Training Education (CAATE). The organization responsible for oversight of athletic training education (CAATE, 2016).

Didactic education. An educational process that is teacher-centered, where students learn from an instructor viewed as the expert in the relationship.

Dual-appointed faculty. Faculty with a split appointment between the athletic training academic program and clinical duties with another program, athletics, or another department.

Mean Absolute Error (MAE). A measurement of the average unaltered magnitude of errors in a set of predicted values compared to the observed value.

Mean Squared Error (MSE). The mean of the squared difference between the predicted value and the observed value (Kuhn & Johnson, 2013).

National Athletic Trainers' Association. The national professional membership association for certified athletic trainers.

Noncompliant. An athletic training program whose three-year aggregate first-time BOC pass rate is below 70%.

Preceptor. A state-credentialed health care professional who is responsible for clinical education instruction, assessment, and supervision of students enrolled in an accredited athletic training education program (CAATE, 2012).

Program director. A BOC-certified athletic training faculty member with administrative oversight and supervision of the education program at an institution (CAATE, 2012).

Role delineation study. A component of practice analysis which the BOC undertakes to ensure that professional entry-level athletic trainers have the knowledge and skills necessary to practice in a competent and safe manner. The role delineation study serves as a blueprint for BOC examination development and continuing education (BOC, 2010).

Root Mean Square Error (RMSE). A measure of the difference in observed values and a regression model-predicted value (Kuhn &Johnson, 2013).

Three-year aggregate first-time pass rate. Aggregate BOC pass rate data for the most recent three test cycles (CAATE, 2012).

Organization of the Study

The findings of this research study could allow program administrators to critically assess their program and make changes to graduate students who successfully pass the BOC examination on the first attempt, thereby improving cohort pass rates. The organization of the dissertation is as follows. Chapter 2 provides a historical perspective of the organizations and people influential in the development of athletic training education programs. In addition, a timeline is provided which outlines the beginnings and advancement of the athletic training profession through education. This timeline is important because the dates help justify the need for this study. Next, a literature review provides the reader with background information about the independent variables used in this study—faculty demographic characteristics and clinical education. Information about the Board of Certification (BOC) examination and prior BOC predictor variable research are also provided for the reader.

Chapter 3 provides an overview of the research methods employed in this study. The quantitative research design is discussed along with the intended participants included in the study. Instrumentation, data collection, and data analysis are described in this chapter. Chapter 4 presents the results of data analysis. Descriptive statistics of the variables, checks of considerations and assumptions for each statistical technique, and inferential statistical results for each research question. Chapter 5 presents a summary of the study, the conclusions, implications of the study, and recommendations for further research.

Chapter II

LITERATURE REVIEW

As the field of athletic training continues to grow, athletic training program administrators are focused on the need to graduate athletic training students who can become competent entry-level practitioners. In addition, programs are mandated to meet a three-year aggregate BOC examination program pass rate of 70% or higher. Therefore, student outcomes are an important focus for athletic training program directors. In order to better understand possible factors that affect BOC first-time pass rates in athletic training education programs, this literature review focused on (a) athletic training teaching faculty; (b) clinical education; (c) background information of credentialing examination for athletic training, physical therapy, physical therapy assistant, and nursing students; and (d) variables that have previously been included in athletic training and other allied health care education research. Understanding and critically appraising studies in each of these areas were vital for the foundation of this study.

Historical Perspective of Athletic Training

Athletic training is a profession that is still considered to be in its infancy. The profession has existed for nearly 100 years, having been born in the early 20th century (Ebel, 1999). Ebel indicated that athletic training initially organized and held the first National Athletic Trainers' Association (NATA) meeting in 1950. By the next year, the organization adopted a set of bylaws and a constitution, further serving to organize the athletic training profession. Over the next six years, the association established a peer-reviewed scholarly journal, adopted a professional code of ethics, and aligned with other organizations like the National Collegiate Athletic Association (NCAA). By the mid-1960s, the organization focused on building membership, which eventually reached 1,000 members.

Historically, the NATA was founded with the purpose to "build and strengthen the profession of athletic training through the exchange of ideas, knowledge, and methods of athletic training" (O'Shea, 1980, p. 28). In 1956, the NATA Board of Directors appointed a committee to study methods by which further professionalization of athletic training could occur (Delforge & Behnke, 1999). The committee strongly felt that a national certification examination and the development of formal athletic training education were fundamental approaches to gaining stature in the medical field. The evolution of athletic training education became the immediate focus while the creation of a path to certification occurred later. In 1951, the Gaining Recognition Committee was formed to study and make recommendations regarding athletic training education (Delforge & Behnke, 1999). Four years later in 1955, the Board of Directors approved the educational recommendations made by this committee.

The profession's leaders next began to focus on an examination that would certify athletic trainers. McLean (1969) published an article that would bring the issue of national certification to the forefront of athletic training. He felt that strengthening the profession required two specific components: education programs and professional certification. McLean also felt that collegiate athletic training curriculums might also prosper as this created a logical way for students to prepare for a certification examination. In 1968, the Professional Advancement Committee explored the development of a certification examination. One year later, the committee presented their plan for the credentialing examination to the NATA Board of Directors (Grace, 1999). The first athletic training certification examination, administered in 1968, consisted of a 150-question written portion and a 5-question practical portion. The questions included three categories of information, basic science, the theory of athletic training, and the practical application of athletic training.

The committee also set forth five certification pathways to be inclusive of all practicing athletic training professionals at the time (Grace, 1999). The routes to certification included (1) athletic trainers actively engaged but not yet certified, (2) students who graduated from an approved NATA undergraduate or graduate program, (3) physical therapy degree graduates, (4) student apprentices, and (5) those by special consideration. Each route had certain requirements to become certified as an athletic trainer. Pathways to the professional certification required a combination of one or more of the following: requisite years of previous athletic training experience, two years consecutive membership with the NATA, graduation from an approved NATA program, on the job training, and a successful passing score on the certification examination.

In 1982, the Professional Education Committee conducted the first role delineation study to determine skills and knowledge that athletic trainers required in clinical practice (Delforge & Behnke, 1999). The first role delineation served as a foundation for the certification examination's content and later became necessary during discussions about the athletic training curriculum competencies. Grace (1999) stated that the first role delineation study was used to tailor certification examination questions, based upon the tasks performed by certified athletic trainers. This practice continues with the current examination. The National Commission for Health Certifying Agencies (NCHCA) granted accreditation to the Board of Certification in 1982 (Grace, 1999). The NCHCA standards for accreditation became the impetus for the creation of the first Competencies in Athletic Training document. These competencies were used to create and approve curriculum programs for athletic training.

Over the next two decades, the number of athletic training curriculum programs grew to a total of 62 undergraduate programs and nine graduate programs (Delforge, 1982). Early athletic training programs required extensive basic science programs and a secondary school teaching credential in health or physical education (Delforge & Behnke, 1999). Most athletic training majors obtained a degree in health and physical education, and also received athletic training content through additional coursework. At that time, the high school setting had the greatest need for athletic trainers, and leaders felt that the health and physical education degree made sense for the future growth of the profession. Unfortunately, the opportunities for these positions were limited and often filled with athletic coaches (Delforge & Behnke, 1999). The leaders of the athletic training profession had to look to a different path outside of the health and physical education degree. Program directors elected to make the teaching certification degree optional as programs expanded the athletic training content taught. The intent was to transition to a degree which better prepared athletic trainers.

In 1980, this evolution caused Sayers "Bud" Miller, chair of the NATA Committee on Professional Advancement, to propose the creation of a stand-alone major in athletic training (Delforge & Behnke, 1999). Miller appointed a subcommittee on curricular development to determine the current climate and future opportunities for athletic training programs in the United States (Miller, 1970). According to Delforge and Behnke (1999), the NATA approved a resolution from the Committee on Professional Advancement to require that all NATA-approved undergraduate athletic training programs offer a major in athletic training. As part of the plan, a deadline of July 1, 1990, was given for all programs to transition to this requirement. The NATA Board of Directors also created the National Athletic Trainers' Board of Certification (NATABOC), which was an independent agency responsible for the certification process via examination (Grace, 1999).

Early, the certifying body recognized five routes to certification. However, by the late 1980s, the NATABOC recognized two routes to certification, the curriculum and internship (Lindquist, Arrington, & Scheopner, 2007). The curriculum candidate was required to complete an undergraduate curriculum athletic training program and 800 hours of clinical experience with a supervising certified athletic trainer. The internship candidate was required to graduate with an undergraduate degree and complete 1800 hours supervised by a certified athletic trainer within a period of two to five years. Both candidates were required to have first aid and CPR training, proof of graduation or be in the last semester of their degree program, and evidence of endorsement by a supervising certified athletic trainer to take the certification examination.

A significant milestone for the NATA occurred in 1990 when the American Medical Association (AMA) formally recognized athletic training as an allied healthcare profession (Delforge & Behnke, 1999). This formal recognition by the AMA was a requirement for athletic training programs to become accredited by the Committee on Allied Health Education and Accreditation (CAHEA), and finally gave athletic training professionals the recognition for which they had long fought. Two years later, CAHEA disbanded and established a new independent accrediting agency, the Commission on Accreditation of Allied Health Education Programs (CAAHEP). In conjunction with CAAHEP, the Joint Review Committee on Educational Programs in Athletic Training (JRC-AT) was responsible for accrediting athletic training education programs.

In 1994, the NATA appointed the NATA Education Task Force to assess and make recommendations about certified athletic trainer preparation (Delforge & Behnke, 1999). The NATA Education Task Force recommended, and the NATA Board of Directors approved a resolution that abolished the internship route to certification, leaving only the curriculum path. The accredited curriculum path remains the only route to athletic training certification today. By 2006, the JRC-AT became independent of CAAHEP and changed its name to the Commission on Accreditation of Athletic Training Education (CAATE). CAATE is currently accountable for athletic training program accreditation (Commission on Accreditation of Athletic Training [CAATE], 2016).

The BOC also made a change in the delivery of the test. In 2007, the BOC announced that the examination would be entirely computer-based (BOC, 2014). Soon afterward, in 2011, the NATA completed a role delineation study and published a new set of competencies that accredited programs were required to incorporate into their programs by 2012 (NATA, 2011). Understanding the timeline of historical events in the athletic training profession is important because much of the published research regarding student success was done before the 2003-2012 educational and examination changes (Draper, 1989; Harrelson et al., 1997; Middlemas et al., 2001; Starkey & Henderson, 1995; Turocy et al., 2000; Williams & Hadfield, 2003).

The CAATE is the national accrediting body for athletic training education. The purpose of the CAATE is to develop, maintain, and promote minimum education standards for undergraduate and graduate entry-level athletic training programs (CAATE, 2012). CAATE's leadership sets standards related to the program director, clinical education coordinator, program faculty, medical directors, preceptors, program delivery, health and safety, financial resources, facilities, instructional resources, operational policies and fair practices, program description and requirements, student records, and distance learning sites to secure the minimum required educational standards. Components related to the program director, clinical education coordinator, faculty, and program delivery can vary from program to program (CAATE, 2012). These differences among programs may provide valuable information about which clinical structures, strategies for hiring faculty, and providing professional development to faculty might best prepare athletic training students for the certification examination.

Credentialing Examination Background

Athletic Training Credentialing Examination

CAATE serves as the accrediting body and provides athletic training education program oversight (CAATE, 2012; CAATE, 2016). An important program outcome metric the Commission on Accreditation of Athletic Training Education utilizes is a three-year aggregate BOC examination pass rate for first-time test takers, which is a 70% minimum requirement (CAATE, 2012). Athletic training program directors can utilize other program outcomes to determine program success. Typical program outcomes include retention and graduation rates, employment rates of alumni, and employer survey results. However, the BOC pass rate remains the universal benchmark outcome for program success (CAATE, 2012). The BOC examination questions and athletic training program competencies are derived from the role delineation study completed by the Board of Certification. Program faculty members instruct students on all NATA competencies which prepare students for the BOC examination (CAATE, 2012; NATA, 2011).

The BOC examination's current structure and format have evolved since its inception (BOC, 2014; Lindquist, Arrington, & Scheopner, 2007). The initial BOC examination was a paper-and-pencil format consisting of a written portion and an oral/practical component. This examination format continued until the 1985 addition of a written-simulation component (Lindquist et al., 2007). Later, the practical component became a single component which included multiple skill assessments; the written and written simulation components of the examination remained (BOC, 2014). The current computerized examination format includes multiple-choice items, stand-alone alternative items, and focused scenarios (BOC, 2016b).

Other important historical points related to the BOC examination evolution include changes to the route of candidacy, an updated role delineation study, and a new set of competencies. In 2003, the BOC leadership abolished the internship route to certification (BOC, 2014). By 2007, the BOC examination was administered in an online format. In 2011, the BOC leadership completed a new role delineation study survey and published a new set of competencies (NATA, 2011). These role delineation studies opened the BOC to examination item changes because often new competencies were included in the survey's results. CAATE also published a new set of program standards that continue to evolve as changes to athletic training education occur (CAATE, 2012).

Research studies completed before these changes cannot be used to generalize to current athletic training student populations.

Other Allied Health Credentialing Examinations

This literature review includes information for other allied health care education programs and credentialing examinations. Much of the research associated with professional credentialing examinations occur in nursing, physical therapy, and physical therapy assistants. These professions were utilized for background research because the educational process closely mirrors that of athletic training. Students in these programs take academic coursework, complete clinicals in real-world settings, and credentialing exams are used to assess entry-level practitioners. Nursing is a long-standing profession with a long history of education. In 1860 the Nightingale Training School for Nurses was founded in London, England (Potter & Perry, 2009). In 1890, a professional group founded what would later become the American Nurses Association. The National Council of State Boards of Nursing (NCSBN), established in 1979, helped create a plan for the RN examination (National Council of State Boards of Nursing [NCBSN], 2017). The plan was for all state boards to offer a single examination to nursing students for licensure. This new examination plan implemented in 1982 was administered in a paper-and-pencil format. By 1994, the National Council Licensure Examination for Registered Nurses (NCLEX-RN) examination was given in an online testing format which still currently remains.

The NCLEX-RN examination is given to provide a consistent structure of assessing nursing competencies and for public protection and safety (NCSBN, 2016). To be eligible for the examination, students must apply for licensure to their respective state boards of nursing and meet all of the eligibility requirements. Eligibility criteria may include verification of graduation from an approved nursing education program and a criminal background check. The examination focuses on four categories: (a) safe and effective care environment, (b) health promotion and maintenance, (c) psychosocial integrity, and (d) physiological integrity. The examination can include between 75 and 265 items, which includes multiple-choice, multiple responses, fill-in-the-blank calculation, ordered response, and hot spots. As candidates progress through the test, their responses determine the length of the examination. Testing ends when a candidate is determined to be either above or below the passing standard.

The American Physical Therapy Association (APTA) developed the first National Physical Therapy Examination (NPTE) around 1950 for licensure (Bach & Wadsworth, 2001). The examination contained 300 questions and was delivered in three parts. By 1991, the examination transitioned to an online format to maintain examination security and to create a standard passing score. Content areas covered by the NPTE-PT examination are: (a) physical therapy examination, (b) foundations for evaluation, (c) differential diagnosis, and prognosis, and (d) non-systems domains (Federation of State Boards of Physical Therapy [FSBPT], 2016a). Currently, the examination has a total of 250 multiple choice questions divided into five sections, each with 50 questions (American Physical Therapy Association [APTA], 2015). Of those 250 questions, only 200 are used to score the examination.

The Federation of State Boards of Physical Therapy (FSBPT) administers the NPTE-PT and the NPTE-PTA for physical therapy assistant examinations. The purpose of the NPTE-PTA is to provide examination services, to provide a consistent evaluation standard across states, and to protect the public (FSBPT, 2016b). THE NPTE-PTA examination content areas include: (a) physical therapy data collection, (b) diseases/conditions that impact effective treatment, (c) interventions, and (d) non-systems domains. The NPTE-PTA examination has 200 questions, administered in 4 sections, each with 50 questions. The passing scale score on both the NPTE-PT and NPTE-PTA examinations is a 600. At a minimum, candidates for the NPTE-PT and NPTE-PTA must have graduated from a PT or PTA program that meets the accreditation standards of the Commission on Accreditation in Physical Therapy Education (CAPTE).

Allied Health Credentialing Examination Research

Two critical components of athletic training education are didactic and clinical education. The relationship between academic content and clinical education must be cohesive and strong for student learning to occur (Carr & Drummond, 2002; Gagné & Medsker, 1996). Carr and Drummond (2002) studied whether instructors, preceptors, and students perceived or observed a difference in the cooperation and communication between preceptors and course instructors in athletic training programs. The researchers randomly selected 30 out of 75 total athletic training programs and surveyed preceptors, course instructors, and students in each program. A total of 19 programs, $n = 547$, responded and stated that the relationship between clinical preceptors, course instructors, and athletic training students have a substantial effect on overall learning. Carr and Drummond (2002) indicated that the relationship between clinical supervisors, course instructors, and athletic training students was essential to the learning process. Although they did not show a particular effect on the relationship between clinical and academic instruction on a student's learning, subjects of the study agreed that the interactions among preceptors, instructors, and students were imperative. The authors further stated that this relationship might be a key indicator of student achievement. Therefore, it would be prudent to assess whether factors associated with clinical education and the faculty of the academic program might affect BOC outcomes.

BOC examination outcomes research remains limited—there are a total of seven published research studies in peer-reviewed journals (Cavallario & Van Lunen, 2015; Draper, 1989; Harrelson et al., 1997; Middlemas et al., 2001; Starkey & Henderson, 1995; Turocy et al., 2000; Williams & Hadfield, 2003). These studies are quite outdated as compared to the timeline for changes in athletic training education—the last change having occurred in 2012 when CAATE disseminated a new set of program standards. Three variables emerged as significant BOC outcome predictors in the research: (a) grade point average, (b) clinical education, and (c) faculty demographic characteristics (Draper, 1989; Harrelson et al., 1997; Middlemas et al., 2001; Searcy, 2006; Turocy et al., 2000; Williams & Hadfield, 2003). These variables indicate that didactic and clinical experiences are important factors of BOC pass rate outcomes. It is, therefore, important to critically assess the research in the area of BOC pass rate comparison and prediction. This study will focus on variables associated with clinical education and faculty demographic characteristics.

Clinical Education

Clinical education in allied health programs most likely grew from the medical education model for training physicians, which allowed students to work in a clinical setting with patients (Seegmiller, 2003; Weidner & Henning, 2002). Clinical education provides a pathway for student learning, professional competence, and professional socialization (Weidner, 2009). It is a way that athletic training program leaders can produce competent and expert clinical practitioners. Bransford, Brown, and Cocking (2000) remind us of the importance of providing students with learning experiences that enhance their abilities in moving towards professional expertise. Experts have a keen ability to reason and critically think through problems. In fact, the authors maintain that experts are more likely to focus on meaningful patterns than are novice practitioners. In turn, this pattern recognition helps learners develop competence and confidence in the tasks and skills they perform. This learning process that merges knowledge with practice in a clinical setting continues to benefit students in multiple medical education programs (Caldwell, Tenofsky, & Nugent, 2010; Ehrenberg & Häggblom, 2007; Healey, 2008; Henderson & Scott, 2011; Levy, Sexton, Willeford, Barnum, Guyer, Gardner, & Fincher, 2009).

Clinical Education in Athletic Training

CAATE leadership sets forth standards in which athletic training clinical preceptors must provide students with patient-interaction opportunities at a clinical site (CAATE, 2012). The clinical education standards require that each student must gain experience with individual and team sports, sports requiring the use of protective equipment, a variety of patient demographic characteristics, non-sport populations, as well as a variety of conditions other than orthopedics. The various required settings allow students to interact in different environments in which they apply knowledge and skills acquired in the classroom. Clinical assignments must also occur in a manner that allows for appropriate preceptor-to-student ratios—although no clear metric is defined (CAATE, 2012).

Research concerning clinical education exists across several allied health education programs (Carr & Drummond, 2002; Erickson & Martin, 2000; Laurent & Weidner, 2002; Maring, Costello, Ulfers, & Zuber, 2013; Nemshick & Shepard, 1996; O'Connor, Cahill, & McKay, 2012). One athletic training study of interest is the Erickson and Martin (2000) study which surveyed 77 program directors whose students sat for the national credentialing examination. The authors found that program administrators felt that clinical education was a meaningful activity that prepared students for the BOC examination. More specifically, the program directors felt that students needed a quality hands-on environment to improve their clinical and decision-making skills. A key factor in creating a quality educational environment is the collaboration between faculty and preceptors (Carr & Drummond, 2002). Student respondents of a different research study indicated that more than half of their athletic training professional development came from clinical education (Laurent & Weidner, 2002). These same researchers found that athletic training students felt that clinical education with patient-centered care and hands-on experience in a variety of settings helped to improve skills associated with clinical practice, decision-making, and communication. In essence, not only does clinical education allow students to develop skills, but it also serves as an avenue for professional acclimatization.

The clinical capstone experience is a full-time, immersive clinical education experience that is internal or external to the student's campus. This type of experience often allows a student to work with one or more preceptors consistently for an extended period of time. Wallace (2016) found that students immersed in a 10-week clinical experience felt that they were able to become more competent when working with patients. Likewise, a study of nursing students involved in a 16-week internship found significant differences between nursing interns who participated in an internship program and those that did not (Blanzola, Lindeman, & King, 2004). Interns were paired and each pair was split into the control group and the test group, *n* = 18. A dependent means t-test was used to determine whether differences existed between the two groups. When assessed by peers within each group, the nurse interns in the program scored significantly higher on outcomes at a six-month interval and the end of the internship program.

Many of the standards concerning athletic training clinical education are quite broad and therefore allow for a variety of programming. The standards related to clinical education do not set forth a requirement for clinical education minimum or maximum total hours per student, a guideline for the number of maximum clinical semesters, preceptor-to-student ratio, or a clinical capstone requirement. The absence of clinical education structure consistency across programs may provide a valuable view of the type of structure that best prepares students for the BOC examination. This lack of consistent structure also lends clinical education as a variable to study with relation to program BOC first-time pass success.

Several studies included clinical education hours as a variable of study and its impact on BOC outcomes (Draper, 1989; Harrelson et al., 1997; Hickman, 2010; Middlemas et al., 2001; Turocy et al., 2000). Draper (1989) surveyed student candidates, *n* = 102, for the 1998 BOC examination to determine whether learning styles, preference for oral examinations, type of educational program (internship or curriculum), and the number of clinical hours had an impact on examination outcomes. He found no relationship existed between examination outcomes and the total quantity of clinical hours a student attained. A critical assessment of the article is that the author does not provide information on how the quantitative data were analyzed. In fact, it appears that the author provides mostly descriptive data from the students surveyed. Therefore, it is problematic in helping to determine whether it is a valuable piece of research in athletic training. However, as one of the first studies, it provides a foundation for future inclusion of clinical education as a variable.

As part of a dissertation study, Hickman (2010) studied the impact of a student's total number of clinical hours and the number of clinical rotations that consisted of more than 50 total hours on BOC examination pass rates. Using Chi-square statistics, the author found no significant relationship between the number of clinical hours and first-time pass rates on the BOC examination. However, the sample numbers—$n = 24$— and the fact that the subjects were from one university, make the findings difficult to generalize to other athletic training students and programs. In addition, the author did not present a contingency table for clinical hours and first-time BOC pass rates, making it difficult to determine whether researchers met the assumptions for the Chi-square statistical test.

Turocy et al. (2000) surveyed 269 students from the 1993 June and November BOC examination dates to determine whether the number of clinical hours, previous allied health or athletic training experience, and student demographics could predict BOC examination success. When focusing on students who completed 400 hours greater than their required clinical hours, Turocy et al. found that they had higher pass rates than students who did not—whether by meeting only the minimum requirements or gaining more than 400 hours over their required mark. However, the authors determined that total clinical hours could neither predict the overall BOC score nor any individual examination portion score using multiple regression.

Conversely, Middlemas et al. (2001) surveyed 270 examination candidates from a two-month administration window of the BOC examination given in 1998. Using multiple regression, they found that the interaction between a student's overall GPA and the number of clinical hours was significant in predicting the ability of students to pass the BOC examination. In this study, the authors indicate that didactic and clinical education may interact and produce improved examination outcomes. However, the researchers completed this study under the old examination and educational requirements—the use of two routes to professional certification.

Furthermore, Searcy (2006) surveyed 94 program directors in a dissertation study. The use of logistic regression indicated that students with a high GPA and more semesters of engaged clinical experience were more likely to pass the written simulation and practical portions of the BOC examination. The more semesters a student is engaged in clinical experiences, the potential higher number of clinical hours a student acquires. Since both of these studies, the BOC abolished the practical portion of the examination and now delivers the written simulation in a different format. Therefore, research into whether this trend still exists with regards to BOC examination success would be beneficial to athletic training program leadership. In athletic training education research, there remains varying information linking clinical education and examination success; therefore, more research is required (Hickman, 2010; Turocy et al., 2000).

A recent study comparing undergraduate and graduate programs provided descriptive statistics across 178 athletic training programs (Cavallario & Van Lunen, 2015). Out of the pool of 178, 15 undergraduate and 15 graduate programs were matched based on school size and program size. In this study programs outlined their total minimum and maximum clinical hours requirements. Undergraduate programs had a mean of 905.5 ± 293.4 minimum clinical hours and a mean of 1660.4 ± 527.6 maximum clinical hours across the span of their program. Graduate programs had a mean of 1067.3 ± 210.0 minimum clinical hours and a mean of 2001.0 ± 296.4 maximum clinical hours. Authors reported three-year aggregate BOC first-time pass rate percentages for undergraduate programs and graduate programs at a mean of 76.6 ± 18.3 and 91.4 ± 8.7 respectively. In both categories of clinical hours, graduate programs had a slightly higher number of clinical hour's requirements and higher BOC first-time pass rate percentages. These improved outcomes for graduate programs could be related to the fact that students are typically older or it could be that the number of clinical education hours is impactful to BOC examination success for athletic training student graduates. Including the variables of the minimum number of clinical hours and the maximum number of clinical hours a program requires of each student may provide valuable research related to clinical education structure.

Clinical Education in Other Allied Health Education Programs

Since there are only a few athletic training research articles that evaluate the impact of clinical education on credentialing examination outcomes, it is important to look across other allied health education programs. Clinical education hours have not been shown to impact outcomes on credentialing examinations (Gresham, Thompson, Luedtke-Hoffmann, & Tietze, 2015; Maring & Costello, 2009). However, some studies indicate that clinical education is an important variable to study (Barkley, Rhodes, and

Defour, 1998; Beeman & Waterhouse, 2001; Englehard & McCallum, 2015; Maring & Costello, 2009; Maring et al., 2013).

Students who excel in clinical courses perform better on credentialing examinations (Barkley et al., 1998). In a study of one university's nursing program, *n* = 81, Barkley found that students who obtained a grade of C or higher in a clinical course performed better on the NCLEX-RN examination. Chi-square statistics indicated that students who attained a grade of C or lower for each clinical were more likely to fail the NCLEX-RN examination. Likewise, a second study found that students who had fewer clinical course grades at a B or lower performed better on the NCLEX-RN examination (Beeman & Waterhouse, 2001). This study was conducted using records from 538 University of Delaware nursing students divided into two groups. The use of discriminant analysis did not indicate that clinical course grades were useful in classifying graduates based on NCLEX-RN pass or fail. These studies may be an indicator that clinical education is an important factor in positive outcomes on the NCLEX-RN credentialing examination. Clinical education should be further studied to determine whether it is a significant factor that impacts BOC examination success for first-time test takers.

Clinical education hours

At the surface, total clinical education hours in other allied health care education does not seem to impact student outcomes on the credentialing examinations. Maring et al. (2013) found that a fewer number of clinical hours combined with more laboratory contact hours resulted in improved outcomes on the NPTE-PTA. Clinical hours occur in real-life settings where patient care occurs. Laboratory settings allow peers to perform skills on each other outside of patient care. Lab hours are probably effective for improved examination outcomes since peer practice allows for repetitive skills practice. Repetitive practice in a clinical setting requires multiple patients with similar maladies. In contrast to clinical hours, laboratory contact hours most likely provide a comfortable environment where skill application can take place without the implications of incorrect skill selection and application on a patient.

However, there are some indications that clinical education may be of importance. Maring and Costello (2009) surveyed 55 program directors of physical therapy assistant programs. They found that students with more clinical education credit hours had improved NPTE-PTA pass rates for first-time test takers as well as the overall pass rates. University personnel typically base credit hours for courses on contact hours in the classroom or lab. Consequently, an increased number of clinical course credit hours may translate to more clinical education contact hours. The authors included 17 independent variables and used multiple regression. This study does not meet the required ratio of subjects to variables—the *n:k* ratio. It would be of interest to determine whether the number of semesters a student is engaged in clinical education and specific clinical education requirements impact BOC outcomes. No study in athletic training research has assessed clinical education program length and the number of hours per week a student is involved in clinical education and its impact on examination outcomes.

Time engaged in clinical education

In a study indicated earlier in this literature review, Mohr, Ingram, Hayes, & Du (2005) found that the length of the clinical education experience was not significant in determining the NPTE-PT pass rate (Mohr et al., 2005). The authors used clinical experience length, in weeks, and do not appear to drill down and include the number of hours attained per week. Some programs in the study may have had more weeks with lower total hours. Mohr et al. recommended further studies into clinical education and its impact on NPTE-PT outcomes. This study met the lower requirement for participants as compared to variables. Mertler and Vannatta (2013) recommend using the larger participant requirement, which this study did not satisfy. This study may help in determining whether the number of clinical hours per week is impactful to BOC outcomes.

Full-time clinical rotations, similar to those used in athletic training, could not be used to predict three-year pass rates or cohort first-time pass rates for the NPTE-PT examination (Gresham et al., 2015; Maring & Costello, 2009). In full-time clinical rotations, students are immersed in a full semester of clinical rotations while they are completing coursework. Although these studies did not find value in full-time clinical rotations, one study did. Englehard and McCallum (2015) used data from 204 physical therapy program students between the years of 2011 and 2013. Using descriptive statistics, they found that the best clinical education model included a mixture of part-time clinical experiences, full-time clinical experiences, and a clinical internship, similar to the clinical capstone used in this study. It accounted for an average first-time pass rate of approximately 96% of students who sat for the NPTE-PT. However, the number of programs in this study with that mixture was small, $n = 4$. Programs that utilized full-time clinical experiences and a clinical capstone, $n = 11$, accounted for about 95% of first-time pass rates on the NPTE. These full-time clinical experiences may be a factor in credentialing examination success. The authors reported only descriptive statistics with no comparative or predictive statistics used to assess these data. This study also continues to validate the length of time that students are engaged in clinical experiences as a variable for this proposed study.

Preceptor-to-student ratio

Several studies address clinical preceptor-to-student ratio models and the impact on students (DeClute & Ladyshewsky, 1993; Ladyshewsky, Barrie, & Drake, 1998; Laurent & Weidner, 2002; Nemshick & Shepard, 1996; O'Connor et al., 2012). Several of these studies found that lower preceptor-to-student ratios tend to be more beneficial in clinical education; although, most compare only the 1:1 and 1:2 preceptor-to-student ratio (DeClute & Ladyshewsky, 1993; Laurent & Weidner, 2002; O'Connor et al., 2012). Currently, the CAATE standards do not set any preceptor-to-student ratio guidelines. However, the accreditation standards indicate that students are to be directly supervised—the supervisor is to be in a position to provide auditory and visual supervision, as well as intervene on behalf of the patient—when the student is providing patient care. A qualitative study indicated that students felt the 1:2 ratio was most beneficial early in clinical education because students could work together while providing patient care (O'Connor et al., 2012). However, as students progressed through clinical experiences, they felt that a 1:1 ratio was more beneficial for developing independent practice. The only drawback to the 1:2 preceptor-to-student ratio was that it required more planning on the part of the preceptor and it may have caused a student to step back when paired with a student of different abilities.

Nemshick and Shepard (1996) felt that a 1:1 model affords appropriate supervision, but it also creates a superior-inferior role between the preceptor and student respectively. In the superior-inferior role, the student looks to the preceptor for feedback and direction. This hierarchy can carry over into professional clinical practice as new employees seek advice from someone of a higher status when employers are expecting independent practice. In a 1:1 ratio, students often receive individualized educational opportunities from their preceptors because of the reduced planning needed on the part of the clinical supervisor. Simply stated, it is easier to supervise one student versus many students during the clinical experience. It is important to note that not all students receive these individualized educational opportunities for a variety of reasons. Preceptors may not trust students to provide appropriate care, they may not trust themselves as a supervising preceptor, or there may be a strained relationship between the preceptor and student. The researchers did not attempt to discover whether the 1:2 model impacted student success.

A model of multiple preceptors-to-multiple students, also known as a cooperative or collaborative clinical education model, allows students to interact with peers and create a collaboration where students can work together clinically. Ladyshewsky et al. (1998) found that a cooperative or collaborative clinical education model was more beneficial than a 1:1 clinical education model. Students who took part in the cooperative model stated that problem-solving activities among peers and through discussions helped to improve learning outcomes. Also, the model created a casual atmosphere where students felt comfortable.

The DeClute and Ladyshewsky (1993) study indicated that students involved in a collaborative clinical education model, specifically a 1:2 model, scored significantly higher in seven out of seven areas of a clinical education evaluation. Of note, skills that involved clinical judgment—patient assessment, program planning, treatment theory and application, and professional behavior—were all significantly greater in the collaborative clinical education model students. Athletic training educators strive for these qualities and skills because it is an indicator of the student's ability for autonomous practice. Independent practice capabilities may also indicate that students can take the knowledge and skills learned in the classroom and apply it to clinical practice.

One published research article provided a systematic review of clinical education models in previous physical therapy research (Lekkas, Larsen, Kumar, Grimmer, Nyland, Chipchase, Jull, Buttrum, Carr, & Finch, 2007). The researchers presented the multiple preceptors to a single student and multiple preceptor-to-multiple student models. These models may also occur in athletic training clinical education since CAATE has no specifically required preceptor-to-student ratio outlined in the standards. One student with multiple preceptors creates an experience where team collaboration is important, and the student learns from various supervisors, thereby broadening their horizons when it comes to clinical decision-making and skill application. This model can also be disadvantageous in that students can have a disjointed experience if preceptors are not planning the student's overall clinical experience appropriately. Multiple preceptors-to-multiple students may also have advantages and disadvantages. In addition to the benefits of peer learning, this model allows for exposure to multiple preceptors. The disadvantages to this model are similar to the multiple preceptors to a single student clinical education model. Researchers found that no clinical education model is superior to another, mostly because of the lack of multiple, robust comparative studies.

In another systematic review of literature in various health care fields, Secomb (2006) found that models of cooperative or collaborative learning help the student by improving learning outcomes in content knowledge and clinical skills. However, since most of the studies included in this review gathered data via self-reporting from students at the clinical experience, it did not provide the perspective of clinical preceptors. Iwasiw and Goldenberg (1993) provided a preceptor perspective. Preceptors felt that students involved in a peer teaching project had a significant increase in outcomes when assessed across educational content and skill performance. These improved outcomes related to peer teaching could translate to improved BOC examination pass rates. The study provided a direct link to collaborative clinical education and student outcomes. Unfortunately, no research in athletic training education or other allied health care fields exists that assesses whether certain preceptor-to-student ratios impact credentialing examination results. Determining whether the preceptor-to-student ratio impacts BOC outcomes would be beneficial to program administrators.

Clinical capstone experience

In addition to the Englehard and McCallum (2015) study, nursing education research previously included the clinical capstone experience as a variable to study. Washburn (2006) surveyed 252 Michigan nurses issued licenses between April 2004 and September 2005. Washburn wanted to see whether externship programs, a type of clinical capstone experience that occurs off-campus, impacted NCLEX-RN pass rates. Nurses who participated in an externship felt that the experience had a positive impact on their ability to pass the credentialing nursing examination. Washburn also wanted to discover whether variations in the externship experience impacted NCLEX-RN first-time pass rates. The author used Chi-Square statistics and found that nurses who participated in a clinical capstone experience were more likely to pass the NCLEX-RN on the first attempt (91.1%).

Similarly, a survey of 25 Kansas and Missouri nursing program directors indicated that the presence of an internship experience had a significant moderate positive correlation, $r = .59$ with NCLEX-RN pass rates (Longabach, 2012). This correlational study utilized a very particular group of participants and therefore, may not be generalizable to nursing programs in other states. Also, because there were so few responses to the survey, the results of this study should be used cautiously. An additional study indicated slightly improved pass rates in a single program after the implementation of a clinical immersion experience (Diefenbeck, Hayes, Wade, & Herrman, 2011). The researchers compared student NCLEX-RN pass rates from five years before and five years after the clinical capstone implementation. This study resulted in descriptive statistics only. Students who took part in the clinical capstone had marginally improved average pass rates of about 3%.

In conclusion, studies selected very specific populations with regards to clinical education and credentialing examination success. This does not provide an avenue for generalizability across programs. For example, two researchers used sampling strategies that provided small samples, each at single universities. Furthermore, some researchers surveyed student participants who often do not understand the intricacies associated with clinical education and academic programming in athletic training programs. Therefore, the survey of program directors helped determine what programmatic variables might impact BOC first-time program pass rates.

Much of the published research in the area of BOC examination pass rate prediction is outdated, having used BOC testing dates before 2012. Since CAATE holds programs to the standard of a three-year aggregate cohort pass rate of 70% or better for first-time test takers, it is important to understand clinical and faculty variables that may predict this cohort pass metric. Currently, no athletic training studies exist in this area. This study will use recent BOC examination testing years of 2014-2017 to determine whether a model exists to predict program performance in this area. This study included clinical education and program faculty factors to add to the body of knowledge and provide program directors with empirical evidence as to whether these variables improved BOC first-time cohort pass rates. The goal was to improve future BOC outcomes for athletic training education programs.

Faculty

The faculty in allied health education programs serve important roles in the didactic, and often, the clinical components of their respective programs. Gagné's theory of instruction has served as the basis for allied health education and has three components, learning outcomes, learning context, and instructional strategy (Gagné & Medsker, 1996). In allied health, learning outcomes in the form of competencies are provided to programs for faculty to teach across their program (APTA, 2005; NATA, 2011; National League of Nursing [NLN], 2012). Faculty members can alter the learning context and instructional strategies to ensure student learning.

Faculty in Athletic Training Programs

Athletic training programs are composed of a program director, clinical education coordinator, and teaching faculty. The program director has administrative and supervisory authority, must be a full-time employee, must have full faculty status, must maintain current certification, and must maintain state credentials as an athletic trainer (CAATE, 2012). In addition, the program director may also serve as a teaching faculty member in the athletic training program (Perkins & Judd, 2001).

Faculty must have the knowledge and skills necessary for athletic training instruction (CAATE, 2012). The standards outline that program faculty must also maintain certification with the BOC and professional credentialing in their respective states. According to the criteria, the number of program faculty is dependent upon several factors which include the ability to provide sufficient student advisement and mentorship, meet program outcomes, offer courses regularly, and maintain adequate student-to-instructor ratios. One faculty member of the program must also serve as the clinical education coordinator (CAATE, 2012). CAATE does not outline a specific degree, years of teaching experience, or years of clinical experience requirements for program directors or faculty members. Therefore, these factors vary across programs.

Athletic training education research regarding program directors and teaching faculty results in mostly demographic characteristic information (Leard et al., 1991; Leone et al., 2008; Perkins & Judd, 2001; Perrin & Lephart, 1988; Sciera, 1981). Two studies are the exception and evaluate the impact of particular faculty demographic characteristics on the BOC pass rate which are discussed later (Freesemann, 2000; Williams & Hadfield, 2003). Previous professional experience is a major component in faculty demographic characteristics. Three studies included student and program director input and found that program directors should have at least three to five years of clinical experience (Leard et al., 1991; Leone et al., 2008; Sciera, 1981). This previous clinical experience affords them practical experience from which to draw examples when teaching and a level of professional credibility with students. Therefore, previous clinical experience is deemed an important factor in athletic training education and lends itself as a variable that may impact student success.

Program directors are responsible for teaching, scholarly work, and service work as part of tenure and promotion, as well as for annual faculty evaluations (Perkins & Judd, 2001; Perrin & Lephart, 1988; Starkey & Ingersoll, 2001). Perkins and Judd (2001) surveyed 83 athletic training education program directors and compared that to findings from a previous study. They found that 96% of respondent athletic training program directors were responsible for teaching athletic training courses and 80% reported being active in clinical education through an appointment with athletics. In this role, athletic trainers provide patient care as well as athletic training student clinical education and supervision.

Staurowsky and Scriber (1998) felt that athletic training faculty members working in both the academic and athletic realms opened themselves up to role conflict and gaps in performance evaluations. Specifically, when faculty members are dual-appointed—having academic and athletic training clinical duties— the weight of performance evaluations from the athletic director is not weighted as heavily as evaluations from department chairs and deans. This gap often impacts athletic training educators on their annual faculty review. Furthermore, program directors who are dually appointed have a more difficult time producing scholarly work which can also impact annual faculty reviews (Starkey & Ingersoll, 2001). Starkey and Ingersoll found that as the percentage of academic appointments increased, so did the mean scholarly productivity index.

Athletic training educators, like program directors, are expected to work towards tenure and promotion at their respective universities. Staurowsky and Scriber (1998) reported that most athletic training educators' duties included teaching, academic advising, service to the athletic department, and athletic training student supervision at clinical education sites. Instruction and academic advising composed about 40% of an educator’s workload, while service to the athletic department and student supervision composed about 30% of the workload. Staurowsky and Scriber (1998) also determined that 93% of athletic training educator participants in their study work 51 to 55 hours on average per week; 16% of participants stated they worked more than 60 hours per week. From this study, a recommendation emerged that athletic training educators should examine current workloads and responsibilities to reduce burnout. Another study by Freesemann (2000) found that 51% of full-time academic, athletic training faculty members also have clinical appointments within the athletic program. Furthermore, 78% of athletic trainers appointed to an athletics position also teach in an athletic training program. Both of these positions are considered dual-appointment.

To focus on academic duties, program directors and faculty members often relinquished their athletic responsibilities (Leard et al., 1991; Mathies, Denegar, & Arnhold, 1995; Perkins & Judd, 2001; Perrin and Lephart, 1988; Starkey & Ingersoll, 2001). Perrin and Lephart (1988) found that program directors felt that faculty who were still clinically active were a benefit to students. Clinical responsibilities for faculty members, such as in a dual-appointed position, lent credibility to faculty members because students could see their professors in practice. However, it is difficult for faculty members to maintain teaching, scholarly work, and service work when their professional duties coincide with patient care responsibilities and athletic training student supervision. CAATE leadership requires programs to have one full-time faculty member, in addition to the program director, who is responsible for teaching in the athletic training program. Before this standard, programs used dual-appointment faculty that provided athletic training student education and patient care (Freesemann, 2000). These dual appointment positions still exist in some programs as the standards only require one full-time faculty member appointed by academics (CAATE, 2012). However, faculty members within athletic training programs are taking part in the growing trend to abolish split appointments between athletics and academics.

Two athletic training studies focused on faculty members in athletic training education programs and their impact on BOC examination results. Williams and Hadfield (2003) wanted to determine which program characteristics and structure led to improved BOC examination outcomes. They surveyed 54 program directors, which constituted 64% of the total number of program directors. Using backward stepwise multiple linear regression, they found that programs with a variety of clinical education sites and faculty terminal degrees had a significant impact on improved BOC examination outcomes. In contrast, when the program had dual-appointment faculty and faculty with previous P-12 work experience, students tended to be less successful on the examination. Other factors noted as critical to BOC outcomes were the variety of separate academic and clinical faculty and clinical rotation experiences offered. However, the variety of clinical rotation experiences offered and faculty terminal degree variables were not included in the final prediction equation as they did not impact the prediction modeling.

The statistical procedure used in this study, multiple linear regression, requires an n:k ratio of at least 15:1for multiple linear regression (Mertler & Vannatta, 2013). The ratio for this research study was about 5:1. The small n to k ratio for this study may indicate a potential error in the model's prediction abilities. Furthermore, Mertler and Vannatta provide two equations that help to determine the response quantity needed to result in a model that cross validates with little loss of prediction ability. The response number used in this study did not meet either requirement. Therefore, one should use the results of this study cautiously. The authors did not address other statistical techniques to adjust for $n < k$ in the study. Another critique of the research study is that it is outdated. It is important to note that it is challenging to determine exactly which BOC year examinee pool the researchers used in this study. The authors mention CAAHEP accreditation in the article; because of this, one can assume that the research was completed before 2006 when program accreditation was taken over by CAATE (CAATE, 2014). Since the study occurred before 2006, this indicates that test format changes, a new set of educational competencies, and new CAATE standards all occurred after study completion. Due to the number of participants combined with the statistical technique and the timing of the study, it would be prudent to see if these predictive abilities exist in a wider and more current participant pool.

Freesemann (2000) also discovered a link between faculty demographics and BOC examination success. Freesemann surveyed 52 program directors to determine whether specific variables impacted program accreditation and student performance on the BOC examination. The study focused on management structure, organizational culture, the number and status of participating faculty, faculty roles and responsibilities, and the relationships between teaching faculty and athletic department personnel. Of interest in this study were the faculty demographic characteristics and their impact on BOC outcomes. The researchers found that the total number of full-time faculty teaching in the athletic training program, whether dual-appointed or not, had a weak positive correlation with students who passed the practical component of the BOC examination for two testing years, 1997 and 1998. Multiple linear regression indicated that combining variables could not improve the prediction of BOC examination results over single variables.

Freesemann (2000) used 13 variables when assessing BOC examination outcomes. Like the Williams and Hadfield study, the researchers did not meet the required number of respondents to independent variables. Consequently, this could have impacted the use of the research results. Expanding this research to reach the required ratio or employing other statistical procedures to adjust for $n > k$ would help to determine whether these variables are impactful to BOC examination results. Also, since this was done using the 1997 and 1998 BOC examination results, identifying whether a link existed between the number of full-time faculty members and BOC examination success would be of interest in the current study. An updated study was important to assist in determining whether dual faculty appointments are of value in BOC examination pass rate improvement. Therefore, this would be an essential variable for inclusion in this dissertation study.

These faculty demographic characteristics sought to provide empirical evidence as to what faculty structures resulted in program success and compliance with the three-year aggregate pass rate for the BOC examination. The studies outlined help lend degree level, years of clinical experience, and years of experience as variables to study across all teaching faculty. Research in other allied health education programs helps to further specify how these variables should be included in further research.

Faculty in Other Allied Health Education Programs

Other allied health education researchers—such as nursing, physical therapy, and physical therapy assistant programs—included faculty demographic characteristics and their impact on credentialing examinations (Kuss, 2014; Maring et al., 2013; Mohr et al., 2005; Novak, Brown-Cross, & Echternach, 2011; Stevens, 1996; Turner, 2005). These studies included variables similar to those to be used in this study: (a) faculty degree level, (b) years of teaching experience, (c) years of clinical experience, (d) number of full-time faculty, and (e) number of part-time faculty. In athletic training programs, there is typically a mixture of full-time faculty and dual-appointed faculty. Dual-appointed faculty members spend part of their time engaged in clinical practice and part of their time teaching in an academic capacity.

Faculty degree level

Research related to faculty degree level provides split results across allied health education programs. Two studies found that degree level as a stand-alone variable was not impactful to pass rates on the National Physical Therapy Examination for Physical Therapy Assistants (NPTE-PTA) and the National Council Licensure Examination for Registered Nurses (NCLEX-RN) examinations (Novak, 2009; Turner, 2005).

Novak used data from the Commission on Accreditation in Physical Therapy Education (CAPTE) annual accreditation reports of 190 physical therapy assistant programs. Novak wanted to determine whether educational degree, employment status (full-time, part-time, adjunct, or core faculty), and years as an educator had an impact on NPTE-PTA outcomes. Backward stepwise multiple regression was used to determine which variables were significant in predicting BOC examination outcomes. Although Novak found that degree level alone was not impactful to examination results, when combined with the total number of full-time and part-time program faculty, it was significant in predicting first-time pass rate. However, it only accounted for 6.5% of the variance for NPTE-PTA first-time test takers. This study used five independent variables and met the $n > k$ metric that Mertler and Vannatta (2013) outlined.

Turner (2005) used student data from 19 undergraduate nursing programs in West Virginia. Student and program data from the West Virginia Board of Examiners for Registered Nurses were collected from nursing annual program reports from 1991 to 2000, $n = 187$. They wanted to determine whether degree, years of teaching experience, years of nursing service (clinical experience), and the percentage of part-time faculty had a significant impact on NCLEX-RN examination pass rates. The researcher did not find that degree level affected student examination results.

In another study, Kuss (2014) surveyed program administrators of 80 associate degree nursing programs in Florida. The purpose of the research study was to determine whether faculty characteristics influenced NCLEX-RN pass rates for students. Ultimately, 40 program administrators responded to the survey. Correlation and multiple regression statistical techniques were used to assess these data. In contrast to the Novak study (2009), Kuss (2014) found a moderate positive correlation, $r = .64$, between faculty with a doctorate and at least nine credits of graduate education coursework and NCLEX-RN pass rates. These findings suggested that faculty who hold a doctorate with foundational education courses may impact outcomes on the NCLEX-RN examination. Therefore, these different findings lent the degree level and academics employment status (full-time, part-time, or dual-appointed) as variables of inclusion for this proposed study.

Other studies indicated that the number of doctoral-prepared faculty members may have an impact on first-time pass rates for the NPTE-PT and NCLEX-RN examinations (Mohr et al., 2005; Stevens, 1996). Mohr et al. (2005) sought to determine whether program characteristics, including 21 variables, could be used to predict NPTE-PT pass rates. Specific variables of the study that are related to the current study include faculty degree level and the number of full-time faculty members. The researchers surveyed program directors from 175 programs and received 132 responses. Multiple regression was used to determine whether a predictive model existed. The researchers found that when combining the number of doctoral faculty, accreditation status, and years of student coursework, it accounted for 30.2% of the variance for students taking the NPTE. The number of doctoral faculty members and the accreditation status accounted for 27% of the variance and accreditation status alone accounted for 18.2% of the pass rate variance. Adding the degree to the prediction model improved the variance statistic by almost 9%. It is important to note that this research violates the $n > k$ requirement. Based on Mertler and Vannatta's (2013) recommendations, the researchers should have gathered 218 responses, which this study did not garner. Another criticism is the lack of validity and reliability checks detailed in the article. It is difficult to determine whether any validity or reliability checks took place. Therefore, one should use the results of the study cautiously.

Stevens (1996) looked at whether program attributes and faculty qualifications had an impact on NCLEX-RN outcomes. Participants were students of West Virginia nursing programs who sat for the NCLEX-RN examination between 1985 and 1994, n = 161. Stevens found a weak to moderate negative correlation between the percentage of faculty with a doctorate and student pass rate percentage on the NCLEX-RN examination. In fact, upon utilizing multiple regression to predict NCLEX-RN pass rates, faculty degree was used as a variable for inclusion in the final model.

Although three studies found no significant link between faculty degree level and credentialing examination outcomes, one study found a weak to moderate negative correlation between the two variables (Kuss, 2014; Novak, 2009; Stevens, 1996; Turner, 2005). Mohr et al. (2005) found a weak to moderate negative correlation focused on the percentage of doctoral-prepared faculty and its impact on NPTE-PT examination results. The percentage of faculty with a doctorate was found to be important in the final prediction model. The current study included the number of program faculty with doctorate degrees and its impact on BOC pass examination rates.

Faculty teaching and clinical experience

Varying evidence exists that used years of teaching experience and its impact on credentialing examinations for other allied health care students (Kuss, 2014; Maring et al., 2013; Novak, 2009; Turner, 2005). Maring et al. (2013) used data from 178 physical therapy assistant program CAPTE annual reports. Logistic regression indicated that the number of years teaching experience for faculty and program directors was not significant in predicting the NPTE-PTA examination outcomes. Other studies did find a link between years of teaching experience and credentialing examination pass rate (Kuss, 2014; Novak, 2009; Turner, 2005). Novak (2009) concluded that years of teaching experience and the number of full-time faculty with a terminal degree were significant predictors for the NPTE-PTA examination outcomes. In fact, physical therapy programs with a 100% pass rate status had an average of 9.2 years of teaching experience for full-time faculty. Therefore, faculty with more years of teaching experience may better know how to present educational content and skills to improve student outcomes. Kuss (2014) found a positive weak to moderate correlation between teaching experience and NCLEX-RN pass rates. Furthermore, teaching experience and faculty completion of graduate courses were components of the final predictive model used to predict NCLEX-RN pass rates.

In contrast, a study by Turner (2005) found a weak negative correlation between faculty with more than 30 years of teaching experience and the NCLEX-RN examination pass rate. This may suggest that during their academic career, teaching faculty reach a point where teaching effectiveness weakens. A loss in teaching effectiveness may have an effect on pass rates for students enrolled in courses with these faculty. Turner's study also included the impact of faculty clinical experience on students taking the NCLEX-RN credentialing examination. Nursing faculty with 10-19 years of clinical experience had a weak positive correlation with NCLEX-RN pass rates and was useful in predicting NCLEX-RN pass rate. Faculty with previous clinical experience that ranged from 0-6 years and 0-9 years had weak negative correlations with NCLEX-RN pass rates but also predicted NCLEX-RN pass rates. Faculty members who have previous nursing clinical experience may be stronger teachers and this could translate to higher pass rates. Seeing if these same patterns occurred for athletic training faculty and students taking the BOC examination was of interest in the current study.

Number of faculty

Previous studies have included the number of faculty as a variable and determined its impact on credentialing examination pass rates (Kuss, 2014; Novak, 2009; Stevens, 1996). One research study reports that across nursing programs, the total number of faculty involved in the program had no impact on student NCLEX-RN examination outcomes (Kuss, 2014). However, a study by Stevens (1996) found that programs with a higher percentage of full-time nursing faculty had higher NCLEX-RN pass rates.

Novak (2009) found that physical therapy assistant programs with a greater number of clinically-specialized part-time faculty were significant as a predictor variable for a student's NPTE-PTA first-time pass rate. Because there were a variety of results and only one study included variables of the total number of faculty, the number of full-time faculty members, and the number of part-time faculty members, it was important to incorporate these variables into the current study. This athletic training research study sought to delineate between full-time faculty devoted to the athletic training program and those who are dual-appointed, having both academic and clinical responsibilities.

Summary

This literature review of selected studies created a foundation for including the proposed variables for this study. Presented is a historical timeline of athletic training as a profession and its evolution. The timeline is important because much of the research occurred before the numerous changes in athletic training education and testing. It not only justified the need for new studies, but it also identified a gap in the literature with regards to BOC outcomes. The review presented studies about teaching faculty, program directors, and clinical education structure across allied health care professional education. Although few studies exist in athletic training education programs on credentialing examination outcomes, there are studies in other allied health education programs that included clinical education and faculty demographic characteristic variables. Research related to clinical education included the number of clinical education hours, time engaged in clinical education, preceptor-to-student ratio, and the clinical capstone experience. The last variables presented were faculty degree level, teaching experience, clinical experience, the number of faculty members—full-time, part-time, and dual-appointed as they related to faculty demographic characteristics.

Chapter III

METHODOLOGY

This chapter presents the research methodology. First, the research design and a justification for the chosen design are provided. Information about the population and participant selection is presented. Next, the process of survey instrument creation and testing procedures to establish validity and reliability are discussed. The process and timeline of data collection are also explained. Finally, the process of data analysis, statistical procedures, statistical considerations, and statistical assumptions are outlined for each research question in the study.

Research Design

Nonexperimental survey research design with correlational and group comparison methods was used to answer the research questions in this study. Multiple regression and logistic regression were the correlational methods used to determine whether variables predict Board of Certification (BOC) outcomes. The group comparison method used was the factorial ANOVA to determine whether selected levels of independent variables—the average years of faculty teaching experience, the average years of faculty clinical experience, preceptor-to-student ratio, and the minimum required weekly clinical hours— impacted the dependent variable, program three-year aggregate BOC program pass rate.

Independent variables included in the study relate to clinical education and faculty demographic characteristics within athletic training programs. Independent variables associated with clinical education in this study included (a) minimum required clinical hours per week, (b) maximum limit of clinical hours per week, (c) number of semesters students are engaged in clinical experiences, (d) average preceptor-to-student ratio at clinical sites, and (e) whether a capstone clinical experience exists in the curriculum. Variables associated with faculty demographic characteristics included (a) number of faculty with a doctorate degree, (b) faculty average years of clinical experience, (c) faculty average years of teaching experience, (d) the total number of full-time faculty devoted to the program, and (e) number of dual appointed faculty—between athletics and academics. All independent variables were at the interval or ratio measurement level except for one categorical variable—clinical capstone.

The dependent variable for the study was the three-year aggregate program BOC pass rate for first-time test takers. Athletic training programs must maintain a three-year aggregate BOC examination program pass rate of 70% or better for first-time test takers to be deemed as compliant with Standard 11 (CAATE, 2012). For this study, the three-year aggregate BOC pass rate score was used for multiple regression as well as the factorial ANOVA statistical procedures. For logistic regression, the dependent variable was coded as either 0 for noncompliant programs who fell below the 70% mandated pass rate or 1 for compliant when programs reached or exceeded the 70% mandate.

Participants

In this study, the target population included undergraduate and graduate athletic training program directors. Program directors provided these data for their respective programs as each has an intimate knowledge of clinical education structure and faculty demographic characteristics within their respective programs. Access to each athletic training education program director's contact information is readily available on the Commission on Accreditation of Athletic Training Education (CAATE) website. The CAATE website lists all athletic training programs along with program outcomes as it relates to the mandated standard of a three-year aggregate 70% cohort pass rate (CAATE, 2016). Furthermore, the website includes program directors and their contact information. Individual university athletic training program websites were used to access updated program director information. The intent was to survey the entire population of undergraduate and graduate athletic training program directors. Currently a total of 289 undergraduate and 79 graduate athletic training programs exist in the United States. A total of 136 of the 289 (47.1%) undergraduate program directors responded to the survey. Out of the 72 graduate program directors, 39 (54.2%) responded to the survey.

Instrumentation

This study used data collected from a combination of published BOC three-year aggregate pass rates and athletic training program directors. BOC pass rate data and program type—undergraduate or graduate— are published on the CAATE website annually and is publicly accessible. The researcher sought data directly from CAATE, but the request for data was denied. Therefore, the remaining data were collected using the program director survey.

BOC Examination Structure

The Board of Certification examination currently contains 175 scored and experimental questions (BOC, 2016a). Questions for the BOC examination are developed by athletic trainers using a set of published guidelines (BOC, 2017). These guidelines give strict directives for creating an examination item. Examination items are then submitted to a six-member BOC Examination Development Committee to determine item validity (BOC, 2016b).

BOC Examination Validity

Examination items are written by athletic trainers from a variety of practice settings to ensure that examination questions cover the entire spectrum of entry-level athletic training practice. It is impossible to include each written item in the exam, therefore the BOC Examination Development Committee strives to create content validity for the examination. Each examination item submitted to the BOC Examination Development Committee is evaluated. Evaluation of each item includes using selected references to establish item inclusion (BOC, 2016b). Examination questions must be referenced in two resources or at least once in a seminal reference (BOC, 2017). The Board of Certification defines a seminal reference as a resource that is older than five years, has withstood the test of time, and is used in most athletic training programs.

Content validity is also established by determining which questions should be included on the BOC exam annually. This process is established using the BOC Role Delineation Study, which is conducted every five years. Through this study, BOC leadership compiles information on athletic training job and task analysis from Certified Athletic Trainers. Content areas gathered from the study are then collapsed into knowledge and skills, then into tasks, and finally into general topic areas called domains. There are currently five domains: (a) injury/illness prevention and wellness protection, (b) clinical evaluation and diagnosis, (c) immediate and emergency care, (d) treatment and rehabilitation, and (e) organizational and professional health, and well-being. National Athletic Trainers' Association (NATA) leadership uses this role delineation study to create a working document of competencies for athletic training education programs. Likewise, the BOC Examination Development Committee uses these domains, tasks, knowledge, and skills to select questions for the BOC exam. Each examination item is classified by the BOC Examination Development Committee according to its domain and tasks for exam purposes to ensure that selected items cover the gamut of tasks required to practice as an athletic trainer.

Last, the BOC examination is used to determine whether a candidate is deemed competent for entry-level practice. This requires that the BOC examination scoring be accurately able to determine the pass/fail status of a candidate. In 2011, a panel of 10 athletic trainers who were practicing clinically, gathered to establish the criteria for candidate performance standard. The panel participated in three rounds of data collection using the modified Angoff model (BOC, 2016c). The examinations given after 2011 use common-item non-equivalent groups design because there is no requirement that candidates taking a new examination be equal in their ability to the candidates taking a prior version of an exam. Within the exam, there is a group of common items that span across multiple versions of the exam. This serves as the common subset of items used to determine which candidates have greater abilities and whether the new examination format is easier or harder than the previous exam. Based on increased or decreased examination difficulty, the scale score is adjusted to ensure that the same passing standard can be applied to all formats of the examination.

BOC Examination Reliability

Reliability for the BOC examination was assessed using Cronbach's alpha for examination reliability, Brennan-Kane for pass/fail decision reliability, and the standard error of measurement for examination precision (BOC, 2016, "Examination Report"). The BOC leadership stated that the BOC examination is consistent with reporting requirements established by the National Commission for Certifying Agencies (NCCA) accrediting body. Furthermore, the BOC leadership stated that reliability and equivalence across the examination are strong and that candidate performance across examinations was consistent.

For the 2017 reporting year, three BOC examination forms were administered to candidates—Exam 32, Exam PA701, and Exam PA702—with each having a cut-point of 500 to determine examination pass/fail (BOC, 2018). For the three exams, means were 586.36 (*SD* = 61.89), 510.87 (*SD* = 68.44), and 504.29 (*SD* = 65.22), respectively. It should be noted that Exam 32 was based on the 6^{th} edition of the role delineation study, and exams PA701 and PA702 were based on the 7^{th} edition of the role delineation study.

Cronbach's alpha was used to determine examination reliability. Some authors suggest that Cronbach's alpha, an indicator of consistency across exam items, greater than 0.70 indicates good reliability for exams like the BOC which is a pass-fail exam (Field, Miles, and Field, 2012). Cronbach's alpha for the three examination forms was 0.82, 0.84, and 0.83 respectively, which are acceptable. Brennan-Kane for pass/fail decision reliability was measured at 0.78, 0.81, and 0.79 respectively, indicating consistent pass/fail decisions across the three exams administered during the 2017 testing window. The standard error of measurement (SEM) is a function of the examination score standard deviation and examination reliability. The SEM test statistic measures the consistency across individual performances on the examination and was reported at 3.80, 4.09, and 4.10. When looking at the cut-point of 500 for pass/fail decisions on the exam, the relatively small window of ±1-2 SEM around the cut-point is acceptable.

Survey

A paper-and-pencil survey with follow-up online surveys was used to collect data from program directors of CAATE-accredited athletic training programs. Instrument items were constructed based on a review of the literature and previous surveys used in studies across selected allied health care education programs (Cavallario & Van Lunen, 2015; DeClute & Ladyshewsky, 1993; Draper, 1989; Engelhard & McCallum, 2015; Freesemann, 2000; Harrelson et al., 1997; Iwasiw & Goldenberg, 1993; Kuss, 2014; Maring & Costello, 2009; Maring et al., 2013; Middlemas et al., 2001; Mohr et al., 2005; Novak et al., 2011; Searcy, 2006; Stevens, 1996; Turner, 2005; Turocy et al., 2000; Williams & Hadfield, 2003). In addition, CAATE educational standards were used to construct some of the instrument items (CAATE, 2012). The instrument included 18 items and consisted of mostly open-ended questions in the form of fill-in or completion items. It also included some close-ended items where the participant selected a preselected response. The choice to utilize open-ended responses for the majority of the instrument centered around several reasons: (a) there may have been a variety of responses to each question, (b) it decreased the chance that a participant will have to choose a grouped response that might not fit with their actual response, and (c) it provided raw data which could be collapsed into groups during the statistical analysis.

Survey Validity

An expert review panel of four athletic training program directors from a variety of undergraduate and graduate programs as well as one researcher with a background in instrument development assessed the instrument. The expert review panel members were provided with the instructions for completing the instrument assessment survey (see Appendix B). These professionals were asked to provide feedback regarding instruction and item clarity, the ability of each item to collect needed data, the length of the survey, ease of use, the appropriateness of the types of items used, and the grammatical correctness of instructions and survey items. In addition, expert panel members were asked whether additional items might improve the instrument.

A paper-and-pencil survey was utilized to collect feedback about the instrument, and instructions were provided in a cover letter. The expert panel's comments and survey items were examined to retain, edit, or discard instrument items. Several survey questions were edited through this process and additional clarification was provided on the instrument. In addition, one open-ended question was added to help provide a specific explanation to one of the close-ended questions. This process helped create the final instrument as well as the content validity for the instrument employed in the research study.

Survey Reliability

The reliability of the survey instrument relied heavily on the program director's ability to provide accurate data. A large majority of the requested data for this study can be pulled from annual program reports that are submitted to CAATE. The CAATE Review Committee serves as the accreditation gatekeeper for athletic training programs (CAATE, 2016). They provide initial and ongoing accreditation through a variety of mechanisms.

In order to receive initial accreditation, program administrators must apply for accreditation, pay a fee, and submit a comprehensive self-study (CAATE, 2016). Upon self-study submission, a site visit team is selected by the CAATE Site Visit Committee and the names are provided to program administrators to ensure that no conflicts of interest exist between the parties involved. After reviewing the self-study against CAATE program standards, the site visit team schedules a three-day visit with the program's administrator. During the site visit, the team meets with program faculty, preceptors, administration to ensure that the program operates as described in the self-study and meets all the CAATE standards. After the site visit, the team submits a report to the CAATE Review Committee. The committee creates and distributes a final report to program administrators who then have 90 days to submit a response to the site visit team's findings. Once responses are received, the program information goes before the CAATE Board to determine accreditation status. Initial accreditation status can be granted for up to five years.

Continuing accreditation occurs via annual reporting and by site visits. Program administrators must submit a program annual report to CAATE (CAATE, 2016). The annual report serves as a mechanism to ensure that athletic training programs have continuing compliance with CAATE standards. The Review Committee ensures that information provided meets the standards and a recommendation is passed onto the CAATE Board to determine final continuing accreditation status. The Review Committee may request additional information for areas of non-compliance or areas of concern in the form of a rejoinder. Failure to submit a rejoinder may render a program's accreditation status to that of “probation”. In addition, CAATE may conduct a special evaluation site visit to investigate areas of noncompliance or areas of other concern.

Continuing accreditation may be awarded for a maximum of 10 years. At the end of a program’s accreditation period, program administrators must again submit a self-study and have an on-site review to maintain accreditation. Much like the initial accreditation, the site visit team submits a report to the Review Committee and the final report is provided to program administrators for a response. Once all responses are received, the CAATE Board votes to determine whether continued accreditations status is awarded.

Currently, CAATE leadership has the mechanisms in place to determine whether programs are compliant with the standards. They are also able to determine whether red flags exist in the provided data, and can follow up with program administrators. This provides a means of data checking to ensure data accuracy. This process created a means of data reliability, and program directors can pull these data from the annual report for the current study’s survey to maintain data accuracy. In addition, much of the information provided by program directors for this study can be verified through published program documents, program websites, and faculty vita.

Data Collection

Once the Institutional Review Board (IRB) granted approval, a request for research data was submitted to the Commission on Accreditation of Athletic Training Education (CAATE). CAATE collected data on several of the variables that were used in this study as well as institutional characteristics. Variables associated with academic year type, program degree type, average preceptor-to-student ratio, BOC three-year aggregate results for the first attempt, the number of full-time (core) faculty, the number of dual-appointed (associated) faculty, and the number of part-time (adjunct) faculty were gathered by CAATE. Unfortunately, CAATE leadership denied the request for data.

Since the CAATE administration did not approve the request for data, the program director survey and the CAATE website were used to gather all of these data for this study. The names of the undergraduate and graduate programs, program directors, mailing addresses, and email addresses were obtained from the CAATE website. Upon the Institutional Review Board (IRB) approval, a cover letter with instructions and the instrument were disseminated to accredited athletic training program directors (see Appendix C) with the 18-item survey (see Appendix D).

The survey was provided in both a paper-and-pencil and an online format using Qualtrics software to 361 program directors in early September 2018. The cover letter included a description of the study's purpose, a request for participant cooperation, a description of protection afforded to the participant, and a promise of participant privacy. In addition, the cover letter included a deadline for return, which was two weeks from receipt of the survey packet. Program directors utilizing the online survey were provided the informed consent letter at the beginning of the survey. The paper-and-pencil survey packet included the survey and a self-addressed stamped envelope for return.

Several strategies were used to increase the survey response rate. Four email follow-up requests were sent to undergraduate program directors. Five email follow-up requests were sent to graduate program directors due to the small number of graduate programs. Email reminders were sent at two-week intervals for all program directors. Follow-up phone calls were made to graduate program directors at varying times to improve response rates. A report of program director survey completion was obtained from Qualtrics software after each round of email reminders. This was compared to the paper-and-pencil survey respondents to ensure that program directors who responded via mail were not receiving follow-up emails for the online survey. Data for the study was collected in September and October of 2018. The return of a completed questionnaire was accepted as consent to participate in the study. Data collected included the 2014-2017 BOC examination testing years and was placed into an Excel spreadsheet.

Data Analysis

Data analysis was conducted using the R statistical software package. Initial analysis included an assessment of the distribution of responses to the survey items. Measures of central tendency, variance, and frequency statistics were summarized using descriptive statistic techniques. Measures of central tendency assessed included the mean, median, and mode. Measures of variance assessed included the minimum value, maximum value, range, and standard deviation. In addition, z-scores were used to assess measures of relative position and potential outliers in these data. For the categorical independent variable—the presence of a clinical capstone experience—frequency and percentages were evaluated. Pearson r was utilized to assess measures of the relationship between variables. Finally, inferential statistics to address the research questions employed multiple regression, logistic regression, and a series of factorial ANOVAs.

Statistical Considerations and Assumptions

Before performing inferential statistical analysis, several statistical assumptions and considerations must be met. One of the statistical considerations for all inferential statistics is missing data. There were 39 surveys completed, one case had no data provided and was removed from the data set. The remaining data from the graduate survey was complete and there were no missing data. The undergraduate data had some missing data across four of the independent variables and the dependent variable. No more than 1.5% of these data were missing for any single variable. Three cases in the undergraduate data set had 16.7% of missing data. To minimize the loss of cases, missing data were imputed using a bagged tree technique that provides missing values for multiple variables at once. This statistical technique uses multiple bagged models to predict values missing in the data set, which are then averaged to impute the missing data (Kuhn & Johnson, 2013).

A second statistical consideration is the presence of outliers in these data. The raw data were converted to z-scores and assessed for extreme outliers beyond the cut-off value of ±3.0 standard deviations from the mean. The graduate and undergraduate data had outliers across several variables. These outliers were also verified using boxplots. First, these data were checked for correctness and no errors were found. Outliers in both data sets were adjusted to three standard deviations from the mean due to the responses. A reassessment of z-scores after outlier adjustments found that no outliers were present in these data.

A third statistical consideration is the normal distribution of these data. Variables assessed for normality must be interval or ratio level data. Univariate normality was assessed using histograms, Shapiro-Wilk test, Kolmogorov-Smirnov test, Lilliefors test, and Jarque-Bera test. George and Mallery (2010) suggested that skewness and kurtosis values of greater than ±2.0 may be cause for concern. These data were also examined for multivariate outliers using Mahalanobis distance. Data transformations were utilized to reduce skewness and kurtosis, as well as bring these data into a more normal distribution. Box-Cox data transformation was completed and transformed variables were used in the inferential analyses.

After transformation, some variables did not fall into a normal distribution. These variables included the number of maximum required clinical hours per week, the number of terms a student is engaged in clinical and the number of dual appointed faculty in the undergraduate data set, as well as the number of dual appointed faculty in the graduate data set. No single transformation of the variable's data seemed to bring them into a normal distribution, however, it did improve the normality of these data. Other specific statistical assumptions related to each inferential analysis is discussed within the results chapter.

Research Question 1

Multiple regression was used to determine which independent variables were significant in predicting the dependent variable, the program's three-year aggregate pass rate percentage for first-time BOC test takers. The number of program director respondents for undergraduate and graduate determined which technique was required. The use of multiple regression requires a substantial number of participants as compared to the number of predictor variables, $n > k$. Mertler and Vannatta (2013) set forth two equations for determining the respondent requirement. The authors recommended that the higher number of two equations be used to determine the needed number of participant responses, $n \geq 104 + k$ or $n \geq 50 + 8k$. In the current research study, the higher equation product estimates that 130 responses were needed for the research question. That requirement was met for the undergraduate data, but not for the graduate data. Therefore, forward selection, backward selection, ridge regression, and lasso were used for the graduate data to find the best regression model. In addition, cross-validation—k-fold, leave-one-out— was utilized to determine the accuracy of the model. The undergraduate program director respondents met the required number of needed responses to simply employ the use of multiple regression to answer the research question should the remaining statistical assumptions be met.

Research Question 2

For the second research question, logistic regression was used to determine whether the independent variables were useful in predicting the classification of the dependent variable. The dependent variable is a two-level categorical variable which makes logistic regression appropriate for use. The dependent variable was coded as either 0 for "*noncompliant"* or 1 for "*compliant*." Noncompliant meant the program fell below the mandated three-year aggregate pass rate of 70% for first-time test takers. Programs meeting or exceeding the 70% mandate were compliant. Only three of the graduate programs were non-compliant. Therefore, research question 2 included only undergraduate programs.

Logistic regression was chosen over discriminant analysis due to the types of variables being used. The discriminant analysis statistical procedure utilizes continuous variables to predict or classify dependent variables. Logistic regression can use both continuous and categorical variables, which are included in this study. In addition, logistic regression is much more flexible with statistical assumption violations. The independent variables do not require a normal distribution, a linear relationship, or have equal variances within groups.

Discriminant analysis also requires a higher number of responses. For discriminant analysis, 20 responses per variable used in the study are required (Mertler & Vannatta, 2013). There were 10 independent variables used in this study which indicated the need for 200 responses to utilize discriminant analysis as a statistical tool. This response requirement would have required 54% of all undergraduate program directors to respond to the survey. Last, logistic regression requires no less than five responses per variable (Mertler & Vannatta, 2013). Therefore, a minimum of at least 50 undergraduate program director participants was required. The response requirement for logistic regression was met.

Research Question 3

Research question 3 used a series of factorial ANOVAs to determine whether levels of selected independent variables—average years of faculty clinical experience, average years of faculty teaching experience, preceptor-to-student ratio, and minimum required weekly clinical hours—had a significant effect on first-time pass rate for undergraduate and graduate athletic training program cohorts. Variables were binned by quartiles to create groups for comparison. The undergraduate and graduate data were collapsed for each independent variable into two levels for comparison due to sample size. Statistical assumptions and inferential results are presented in the results chapter. The ANOVA F test was used to compare groups. The Tukey HSD post hoc comparison test was also evaluated.

Summary

This chapter presented the research design and methodology used to study independent variables associated with clinical education (number of required minimum and maximum clinical hours per week, the number of semesters students are engaged in clinical education, the average preceptor-to-student ratio at clinical sites, and whether a required clinical capstone experience exists in the program) and faculty demographic characteristics (number of doctoral faculty, the average number years of faculty clinical and teaching experience, the number of full-time faculty devoted to the program, and the number of dual-appointed faculty associated with the program) and their impact on program three-year aggregate BOC pass rate for first-time test takers. Survey instrument validity was established using an expert review panel that assessed the instrument. The reliability of the survey instrument was established with data checks using program publications and program faculty surveys. Board of Certification examination validity and reliability were presented as well. The population was identified using the CAATE director. Data collection procedures were discussed with regards to the use of paper-and-pencil surveys, online surveys, and telephone surveys.

A nonexperimental research design that included correlational group comparison methods was appropriate to investigate the impact on the three-year aggregate BOC examination program pass rate. Data analysis, as well as the assessment of statistical considerations, and statistical assumptions were discussed. Missing data were imputed and data outliers were adjusted. These data were subsequently transformed to improve univariate normality. Multiple regression was employed to determine whether the independent variables predicted the program's three-year aggregate pass rate for both undergraduate and graduate programs. Logistic regression was used to determine whether undergraduate programs could be classified as compliant or noncompliant based on the independent variables selected for the study. Last, a series of factorial ANOVAs were chosen to determine whether the minimum number of required clinical hours per week and preceptor-to-student ratio, as well as, the average number of years faculty teaching and clinical experience impacted program three-year aggregate outcomes. Specific requirements and methods used for this study were identified and discussed.

Chapter IV

RESULTS

The purpose of this study was to identify whether selected variables associated with clinical education (minimum required clinical hours per week, maximum clinical hours per week, number of semesters with clinical experience, average preceptor-to-student ratio, and presence of a capstone clinical experience) and faculty demographic characteristics (number of faculty with a doctorate, faculty years of teaching experience, faculty years of clinical experience, the total number of full-time faculty devoted to the program, and number of dual appointed faculty) affect a program's BOC examination success. The research was designed to answer the following research questions:

1. Are selected athletic training clinical education variables and faculty demographic characteristics significant predictors of the three-year aggregate BOC pass rate for first-time test takers?
   a. Are selected athletic training clinical education program variables (minimum clinical hours required per week, maximum clinical hours required per week, number of semesters student engaged in clinical experience, average preceptor-to-student ratio, and presence of a capstone clinical experience in the program) and faculty demographic characteristics (number of faculty with a doctorate, number of years faculty teaching experience, number of years faculty clinical experience, the total number of full-time faculty devoted to the program, and number

of dual-appointed faculty) significant predictors of undergraduate athletic training program BOC three-year aggregate pass rate for first-time test takers?

b. Are selected athletic training clinical education program variables (minimum clinical hours required per week, maximum clinical hours required per week, number of semesters student engaged in clinical experience, average preceptor-to-student ratio, and presence of a capstone clinical experience in the program) and faculty demographic characteristics (number of faculty with a doctorate, number of years faculty teaching experience, number of years faculty clinical experience, the total number of full-time faculty devoted to the program, and number of dual-appointed faculty) significant predictors of graduate athletic training program BOC three-year aggregate pass rate for first-time test takers?

2. Are selected athletic training clinical education variables (minimum clinical hours required per week, maximum clinical hours required per week, number of semesters student engaged in clinical experience, average preceptor-to-student ratio, and presence of a capstone clinical experience in the program) and faculty demographic characteristics (number of faculty with a doctorate, number of years faculty teaching experience, number of years faculty clinical experience, the total number of full-time faculty devoted to the program, and number of dual-appointed faculty) significant predictors in classifying undergraduate athletic

training programs as compliant or noncompliant with the standard of a 70% three-year aggregate BOC pass rate for first-time test takers?

3. Is there a significant difference between levels of selected variables on the BOC examination three-year aggregate pass rate for first-time test takers?
    a. Is there a significant difference between levels of faculty clinical experience and levels of faculty teaching experience on undergraduate athletic training program BOC examination three-year aggregate pass rate for first-time test takers?
    b. Is there a significant difference between the levels of clinical site preceptor-to-student ratio and levels of minimum required weekly clinical hours on undergraduate athletic training program BOC examination three-year aggregate pass rate for first-time test takers?
    c. Is there a significant difference between levels of faculty clinical experience and levels of faculty teaching experience on graduate athletic training program's BOC examination three-year aggregate pass rate for first-time test takers?
    d. Is there a significant difference between the levels of clinical site preceptor-to-student ratio and levels of minimum required weekly clinical hours on graduate athletic training program BOC examination three-year aggregate pass rate for first-time test takers?

This chapter presents the data analysis and results for each research question. The first section describes the demographic characteristics of the population. The second section presents the descriptive statistics of the untransformed data and Pearson's correlation coefficients. Data transformations are described as well as the descriptive statistics for transformed data. Last, the statistical considerations and assumptions are discussed, as well as the statistical analysis for each inferential statistical technique.

Demographic Characteristics

According to the Commission on Accreditation of Athletic Training Education (CAATE), at the time of data collection, there were 289 undergraduate and 79 graduate programs (CAATE, 2017). A total of 136 of 289 (47.1%) undergraduate and 39 of 72 (54.2%) graduate program directors responded to the survey. All 136 of the undergraduate program directors survey responses were used for the data analysis. One of the 39 graduate program director responses was unable to be used for the data analysis because only two out of the 18 questions were completed on the survey.

Descriptive Statistics and Correlations

Items on the survey instrument were divided into three categories: program clinical education, program faculty, and program characteristics. Items related to program clinical education included items about the minimum number of required clinical education hours per week, the maximum number of required clinical education hours per week, the number of academic terms students are engaged in clinical education experiences, the average preceptor-to-student ratio, and whether the program requires a stand-alone clinical capstone experience. Items related to faculty characteristics included items about the number of faculty with a doctoral degree, the average years of clinical experience, the average years of teaching experience, the number of full-time (core) faculty, and the number of dual-appointed (associated) faculty. The independent variables used in this study are mostly interval or ratio level measurements, except for the presence of a clinical capstone course which is a nominal-level measurement. One of the dependent variables in this study was the program three-year aggregate Board of Certification (BOC) pass rate percentage, whereas the other dependent variable was a nominal-level pass or fail variable.

Overall undergraduate programs averaged 81.84% (*SD* = 13.63) on the three-year aggregate BOC examination program pass rate. Program clinical education characteristics were measured using five survey items and program faculty characteristics were measured using six survey items. Out of the 136 undergraduate programs, 18 (13.24%) programs included a clinical capstone course where, in the last term of their program, students are immersed in a clinical setting. Undergraduate programs with a clinical capstone course in the program had a three-year aggregate BOC examination pass rate of 79.44% and those without a clinical capstone course had an average of 82.21%. Table 1 presents the descriptive statistics for undergraduate programs survey items. Students in undergraduate programs averaged 5.32 (*SD* = 1.16) semesters of clinical experiences and required an average of between 11.67 (*SD* = 4.35) and 23.49 (*SD* = 6.14) clinical hours per week. Undergraduate athletic training programs averaged a 1.12 (*SD* = 1.13) preceptor-to-student ratio, with at least one program having eight preceptors per student.

There was an average of 2.77 (*SD* = 2.24) doctoral faculty across undergraduate programs. Faculty averaged 12.53 (*SD* = 6.22) years of clinical experience and 12.19 (*SD* = 5.61) years of teaching experience. There is a wide variety in the years of clinical and teaching experience across undergraduate programs. Program faculty ranged from a minimum of two years teaching and clinical experience and approximately 32 years of teaching and clinical experience. Historically undergraduate athletic training education programs faculty split their time between academics and patient care. Surprisingly, undergraduate programs averaged 2.76 (*SD* = 1.2) full-time faculty and averaged 1.03 (*SD* = 1.78) dual-appointed faculty who teach and provide clinical care to patients.

Table 1

Descriptive Statistics for Undergraduate Athletic Training Programs before Data Transformation

Variable	Min	Max	*Mdn*	*M*	*SD*	Skewness	Kurtosis
MINCH	0.00	20.00	11.00	11.67	4.35	-0.08	-0.16
MAXCH	10.00	44.58	20.00	23.49	6.14	1.16	2.15
Clinical terms	2.00	8.87	6.00	5.32	1.16	-0.73	1.80
PSR	0.13	5.00	0.50	1.12	1.13	1.53	1.49
Doctoral faculty	0.00	9.25	2.00	2.77	2.24	1.06	0.60
FYCE	2.00	32.00	12.00	12.53	6.22	0.83	0.56
FYTE	2.00	33.29	12.00	12.19	5.61	0.76	0.74
Number FTF	1.00	6.69	2.00	2.76	1.20	1.41	1.88
Number DAF	0.00	6.85	0.00	1.03	1.78	1.80	2.36
BOC3YR	43.00	100.00	83.00	81.84	13.63	-0.70	-0.23

Note. *n* = 136. MINCH = required minimum clinical hours per week. MAXCH = required maximum clinical hours per week. PSR = preceptor-to-student ratio. FYCE = average years of faculty clinical experience. FYTE = average years of faculty teaching experience. FTF = full-time (core) faculty. DAF = dual-appointed (associated) faculty. BOC3YR = Board of Certification three-year aggregate pass rate.

Graduate programs averaged 91.89% (*SD* = 8.70) on the three-year aggregate BOC examination program pass rate. Out of the 38 responding program directors, 22 (57.89%) program directors reported a required clinical capstone course where students are immersed in a clinical setting in their last academic term. Graduate programs with a clinical capstone course in the program had a three-year aggregate BOC examination pass rate of 92.07% and those without a clinical capstone course had an average of 90.86%.

Descriptive statistics for the graduate program survey items were assessed (see Table 2). Students in graduate athletic training programs averaged 4.68 (*SD* = 0.93) clinical terms. Students averaged 17.57 (*SD* = 6.43) minimum clinical hours per week and 33.28 (*SD* = 11.16) maximum number of clinical hours per week. The average preceptor-to-student ratio was 0.94 (*SD* = 0.57). Gradate athletic training programs averaged 4.53 (*SD* = 1.87) doctoral faculty. The average number of years of faculty clinical experience ranged from 1.2 to 35 years and averaged 13.43 (*SD* = 6.42) years. The number of years of faculty teaching experience ranged from 5 to 32 years and averaged 12.98 (*SD* = 5.10) years.

Table 2

Descriptive Statistics for Graduate Athletic Training Programs before Data Transformation

Variable	Min	Max	*Mdn*	*M*	*SD*	Skewness	Kurtosis
MINCH	6.25	40.00	15.50	17.57	6.43	1.10	2.08
MAXCH	20.00	60.00	30.00	33.28	11.16	0.89	0.14
Clinical terms	2.50	8.00	5.00	4.68	0.93	1.01	2.71
PSR	0.20	2.00	1.00	0.94	0.57	0.87	-0.53
Doctoral faculty	1.00	11.00	4.00	4.53	1.87	1.07	1.97
FYCE	1.20	35.00	13.50	13.43	6.42	0.85	1.55
FYTE	5.00	32.00	12.00	12.98	5.10	1.50	3.45
Number FTF	2.00	9.00	3.50	3.71	1.58	1.07	1.43
Number DAF	0.00	3.00	0.00	0.47	0.92	1.79	1.90
BOC3YR	59.00	100.00	93.50	91.89	8.70	-1.69	3.31

Note. *n* = 38. MINCH = required minimum clinical hours per week. MAXCH = required maximum clinical hours per week. PSR = preceptor-to-student ratio. FYCE = average years of faculty clinical experience. FYTE = average years of faculty teaching experience. FTF = full-time (core) faculty. DAF = dual-appointed (associated) faculty. BOC = Board of Certification three-year aggregate pass rate.

A correlation matrix was generated to examine the correlation between the variables for undergraduate programs (see Table 3). The relationships between variables were evaluated using the Pearson product-moment correlation coefficient. The analysis of variables revealed two weak to moderate correlations. The average number of years of faculty teaching experience had a weak to moderate, positive correlation with the average number of years of faculty clinical experience, $r(133) = 0.36$, $p < .001$, indicating that as the average years of faculty teaching experience increased, the average years of faculty clinical experienced also increased. There was also a weak to moderate, positive correlation between the number of full-time faculty and the number of faculty with doctoral degrees, $r(135) = .47$, $p < .001$. This indicates that as the number of full-time faculty associated with the program increased, so did the number of faculty with doctoral degrees. A weak, positive correlation exists between the average years of faculty clinical experience and the presence of a clinical capstone course, $r(133) = .18$, $p = .04$, indicating that as the average faculty years of clinical experience increases so does the likelihood that a clinical capstone course exists in the program. There was also a weak, positive correlation between the number of dual-appointed faculty and the number of full-time faculty associated with the program, $r(135) = 0.20$, $p = .02$, indicating that as the number of full-time faculty increases so does the number of dual-appointed faculty. No correlations were found between the independent variables and the dependent variable, program three-year aggregate BOC pass rate.

Table 3

Undergraduate Athletic Training Program Pearson Correlations before Data Transformation

Variable	1	2	3	4	5	6	7	8	9	10	11
1. MINCH	1.00										
2. MAXCH	.15	1.00									
3. Clinical terms	-.12	.04	1.00								
4. PSR	-.02	.00	-.10	1.00							
5. Clinical capstone	.01	.11	-.03	-.10	1.00						
6. Doctoral faculty	-.04	-.07	-.09	.06	-.14	1.00					
7. FYCE	-.07	-.12	-.07	.04	.18*	-.11	1.00				
8. FYTE	.17	.04	.08	.14	-.01	.08	.36**	1.00			
9. Number FTF	.03	-.01	-.04	.09	-.12	.47**	.02	.09	1.00		
10. Number DAF	-.01	-.05	-.16	.12	.06	.01	.01	.05	.20*	1.00	
11. BOC3YR	-.04	.10	.04	-.06	-.06	.16	-.14	.07	.16	.11	1.00

Note. $n = 136$. $*p < .05$, $**p < .001$. MINCH = required minimum clinical hours per week. MAXCH = required maximum clinical hours per week. PSR = preceptor-to-student ratio. FYCE = average years faculty clinical experience. FYTE = average years faculty teaching experience. FTF = full-time (core) faculty. DAF = dual-appointed (associated) faculty. BOC3YR = Board of Certification three-year aggregate first-time pass rate.

Correlations among variables in the graduate data were assessed (see Table 4). There was a weak, positive correlation between the number of dual-appointed faculty and the dependent variable, the program three-year aggregate BOC examination pass rate, $r(38) = .33$, $p = .04$. This suggests that as the number of dual-appointed faculty increases so does the three-year aggregate BOC pass rate for graduate programs. Two independent variables showed a moderate correlation, the number of full-time faculty and number of faculty with a doctorate, $r(38) = .65$, $p < .001$, indicating that as the number of full-time faculty increases so does the number of faculty with a doctoral degree. There was a weak to moderate, positive correlation between the required minimum and maximum clinical hours per week, $r(38) = .52$, $p < .001$, suggesting that as the number of required minimum hours per week increased so did the number of maximum clinical hours per week. Last, there was also a weak to moderate, positive correlation between average years of faculty teaching and average years of clinical experience, $r(38) = .40$, $p = .01$. This indicates that as the average years of faculty of teaching experience increased so did the average years of faculty clinical experience.

Table 4

Graduate Athletic Training Program Pearson Correlations before Data Transformation

Variable	1	2	3	4	5	6	7	8	9	10	11
1. MINCH	1.00										
2. MAXCH	.52**	1.00									
3. Clinical terms	-.19	-.15	1.00								
4. PSR	.02	-.09	.28	1.00							
5. Clinical capstone	.16	.23	-.24	-.01	1.00						
6. Doctoral faculty	.02	.02	-.11	.03	.21	1.00					
7. FYCE	-.01	.19	.02	-.30	.28	-.14	1.00				
8. FYTE	-.14	-.04	-.08	.10	.12	-.11	.40*	1.00			
9. Number FTF	-.14	.15	.05	.14	-.06	.65**	-.11	-.13	1.00		
10. Number DAF	.14	-.29	-.20	-.02	.09	.06	-.11	.07	-.29	1.00	
11. BOC3YR	.30	.16	-.07	.07	-.14	-.11	-.05	-.04	-.23	.33*	1.00

Note. $n = 38$. $*p < .05$, $**p < .001$. MINCH = required minimum clinical hours per week. MAXCH = required maximum clinical hours per week. PSR = preceptor-to-student ratio. FYCE = average years faculty clinical experience. FYTE = average years faculty teaching experience. FTF = full-time (core) faculty. DAF = dual-appointed (associated) faculty. BOC3YR = Board of Certification three-year aggregate first-time pass rate.

Statistical Considerations and Assumptions

Prior to the use of inferential statistics, there were several statistical considerations and assumptions that needed to be met. One of those statistical considerations was missing data. The graduate survey data had 39 responses and one case with incomplete data. The case had no data provided and was removed from the data set. The undergraduate data had eight single data points missing which accounted for less than 5% of the data set. In order to minimize the loss of cases, missing data in the undergraduate data set were imputed using a bagged tree technique that provides missing values for multiple variables at once. In addition, this statistical technique uses multiple bagged models to predict values missing in the data set, which are then averaged to impute the missing data (Kuhn & Johnson, 2013).

A second statistical consideration is the presence of outliers in these data. Each variable was assessed for univariate outliers using boxplots and *z*-scores with a cut-off value of ±3. Upon assessing both the undergraduate and graduate data using *z*-scores, outliers were found across several variables which were verified with the use of boxplots. In addition, multivariate outliers were assessed using Mahalanobis distance and Cook's distance. Mahalanobis distance measures the distance from the centroid, while Cook's distance measures the effect of removing a single data point. In the undergraduate data, no multivariate outliers were found using the cutoff of 34.53, although one was very close at 31.07. In the graduate data, no single Mahalanobis distance was found to be greater than the cutoff of 32.91 and p-value < .001. Cook's distance identified several cases in both the undergraduate and graduate data that might cause undue influence.

Due to the presence of outliers and influential cases that might impact the outcomes of statistical procedures, outliers in these data were adjusted to three standard deviations from the mean. A reassessment of boxplots and z-scores after outlier adjustments found no univariate outliers present in these data using the same cut-off value in both the undergraduate and graduate data. After a reassessment of multivariate outliers for the undergraduate and graduate data, the potentially influential cases were no longer a concern.

Prior to any data transformations, these data were assessed for univariate normality using histograms, Shapiro-Wilk test, Lilliefors test, and Jarque-Bera test. Assessments of univariate normality completed before data imputation utilized Shapiro-Wilk and Lilliefors tests since they can be used when data is missing, such as in the undergraduate data set. In the undergraduate data set, all variables were found to lack normal distribution. All variables in the graduate data violated the normality assumption except one, average years of faculty clinical experience, $W(38) = 0.95$, $p = 0.07$.

Multivariate normality was assessed before data transformations using the Mardia and Henze-Zirkler tests. The undergraduate data set did not have multivariate normality, $HZ(135) = 1.50$, $p < .001$ and $H(135) = 495.53$, $p < .001$. In the graduate data set, the Mardia test found multivariate normality with skewness and kurtosis present. Likewise, the Henze-Zirkler test found multivariate normality in the graduate data set, $HZ(38) = 0.99$, $p = .06$. The multivariate normality assumption was met for the graduate data set. Due to the lack of multivariate normality in the undergraduate data set and the lack of univariate normality in the graduate data set, data transformations were performed.

Data transformation was utilized to reduce skewness and kurtosis, as well as to bring these data into a more normal distribution. The Box-Cox data transformation anchored at one was used and although it did not bring all variables into a normal distribution, it did improve the univariate normality of these data in both the undergraduate and graduate data sets. After data imputation, outlier adjustments, and data transformations were performed, univariate normality was rechecked using the Shapiro-Wilk test, Lilliefors test, and Jarque-Bera tests, as well as histogram visualization. The Jarque-Bera test uses skewness and kurtosis to determine data normality and has a lower Type I error rate than the Shapiro-Wilks test (Oztuna, Elhan, & Tuccar, 2006).

Using the Jarque-Bera test, all variables in the undergraduate data set had a normal distribution with the exception of the number of maximum clinical hours per week, number of clinical terms, and the number of dual-appointed faculty. In the graduate data, the number of dual-appointed faculty were found to have non-normal distribution, $JB\ X^2(2) = 60.01$, $p < .001$. Multivariate normality was reassessed after data transformations. The outlier adjustments and data transformations did improve multivariate normality in the undergraduate data by lowering test statistics, $HZ(135) = 1.38$, $p < .001$ and $H(135) = 440.61$, $p < .001$. However, multivariate normality was not achieved in the undergraduate data set after data transformation.

Descriptive Statistics and Correlations after Data Transformation

Descriptive statistics were reassessed for the transformed undergraduate data set (see Table 5). After data transformations, there were still some variables that lacked univariate normality in both the undergraduate and graduate data sets. The assumption related to multivariate normality was not met for the undergraduate data set. The assumption was met for the graduate data set. However, it is important to note that the statistics for univariate and multivariate normality did improve with the transformation of both data sets.

Descriptive statistics for undergraduate programs indicated the average three-year aggregate pass rate after data transformation was 6.49 ($SD = 6.10$). The number of clinical terms students are engaged in clinical experiences ranged from 0 to 4.63 with a mean of 2.67 ($SD = 0.73$). Programs required between 0 and 16.10 minimum clinical hours per week with a mean of 7.09 (*SD* = 3.53). The required maximum clinical hours per week ranged between 0 and 11.89 with a mean of 6.43 (*SD* = 2.04). The total number of doctoral faculty ranged from 0 to 2.62 with a mean of 1.26 (*SD* = 0.68). Programs had a mean of 0.18 (*SD* = 0.25) of dual-appointed faculty ranging from 0 to 0.60. The average number of years of faculty teaching experience ranged from 0 to 8.59 with a mean of 4.47 (*SD* = 1.69).

Table 5

Descriptive Statistics for Undergraduate Athletic Training Programs after Outlier Adjustments and Data Transformation

Variable	Min	Max	*Mdn*	*M*	*SD*	Skewness	Kurtosis
MINCH	0.00	16.10	7.71	7.09	3.53	-0.07	-0.15
MAXCH	0.00	11.89	5.36	6.43	2.04	0.20	1.38
Clinical terms	0.00	4.63	2.26	2.67	0.73	0.26	2.28
PSR	0.00	0.65	0.25	0.33	0.18	0.34	-1.17
Doctoral faculty	0.00	2.62	1.16	1.26	0.68	-0.06	-0.54
FYCE	0.00	8.99	4.63	4.53	1.85	0.04	-0.11
FYTE	0.00	8.59	4.63	4.47	1.69	-0.04	-0.27
Number FTF	0.00	1.55	0.65	0.84	0.32	-0.05	0.46
Number DAF	0.00	0.60	0.00	0.18	0.25	0.71	-1.41
BOC3YR	0.00	13.23	6.49	6.10	3.32	-0.08	-0.69

Note. *n* = 136. MINCH = required minimum clinical hours per week. MAXCH = required maximum clinical hours per week. PSR = preceptor-to-student ratio. FYCE = average years of faculty clinical experience. FYTE = average years of faculty teaching experience. FTF = full-time (core) faculty. DAF = dual-appointed (associated) faculty. BOC = Board of Certification three-year aggregate first-time pass rate.

Descriptive statistics were generated for graduate programs after these data were transformed, (see Table 6). The program three-year aggregate BOC examination program pass rate after outlier adjustments and data transformations ranged from 0 to 5.19 and the mean was 2.22 (*SD* = 1.47). The number of terms a student spent in clinical experiences ranged from 0 to 3.20 with a mean of 1.63 (*SD* = 0.55). Programs required between 0 and 11.57 minimum clinical hours per week with a mean of 5.59 (SD = 2.29). The required maximum clinical hours per week ranged between 0 and 8.54 with a mean of 4.12 (*SD* = 2.48). The total number of doctoral faculty ranged from 0 to 4.37 with a mean of 2.16 (*SD* = 0.84). The number of full-time faculty associated with the program ranged from 0 to 2.22 with a mean of 0.88 (*SD* = 0.64). Programs had a mean of 0.11 (*SD* = 0.19) dual-appointed faculty.

Table 6

Descriptive Statistics for Graduate Athletic Training Programs after Data Transformation

Item	Min	Max	*Mdn*	*M*	SD	Skewness	Kurtosis
MINCH	0.00	11.57	5.07	5.59	2.29	0.06	0.46
MAXCH	0.00	8.54	4.02	4.12	2.48	-0.16	-0.76
Clinical terms	0.00	3.20	1.87	1.63	0.55	0.11	1.35
PSR	0.00	0.67	0.46	0.38	0.19	0.11	-1.08
Doctoral faculty	0.00	4.37	2.11	2.16	0.84	0.11	0.41
FYCE	1.20	32.69	13.50	13.37	6.22	0.65	0.81
FYTE	0.00	6.45	3.24	3.28	1.29	-0.06	0.39
Number FTF	0.00	2.22	0.94	0.88	0.64	-0.07	-1.10
Number DAF	0.00	0.47	0.00	0.11	0.19	1.08	-0.79
BOC3YR	0.00	5.19	2.48	2.22	1.47	-0.04	-0.97

Note. $n = 38$. MINCH = required minimum clinical hours per week. MAXCH = required maximum clinical hours per week. PSR = preceptor-to-student ratio. FYCE = average years of faculty clinical experience. FYTE = average years of faculty teaching experience. FTF = full-time (core) faculty. DAF = dual-appointed (associated) faculty. BOC = Board of Certification three-year aggregate first-time pass rate.

The relationships between variables of the study in both data sets were reassessed using the Pearson product-moment correlation coefficient. There were several variables with weak to moderate correlations in the undergraduate data (see Table 7). A weak, positive correlation exists between required minimum and maximum clinical hours per week, $r(135) = .23$, $p = .01$, indicating that as required minimum clinical hours per week increased, so did the required maximum number of clinical hours per week. There was also a weak to moderate positive correlation between the number of full-time (core) faculty and the number of faculty with a doctorate, $r(135) = .43$, $p < .001$, indicating that as the number of doctoral faculty associated with programs increased so did the number of full-time faculty teaching in the program. There was a weak to moderate, positive correlation between the average number of years faculty teaching and clinical experience, $r(135) = .48$, $p < .001$, Therefore, as the average years of faculty teaching experience increased so did the average years of faculty clinical experience. There was no correlation between the three-year aggregate BOC pass rate and any transformed variable in the undergraduate data set.

Table 7

Undergraduate Athletic Training Program Pearson Correlations after Data Transformation

Variable	1	2	3	4	5	6	7	8	9	10	11
1. MINCH	1.00										
2. MAXCH	.23*	1.00									
3. Clinical terms	-.06	.05	1.00								
4. PSR	-.01	.10	-.12	1.00							
5. Clinical capstone	.01	.11	-.07	-.12	1.00						
6. Doctoral faculty	.02	-.01	.00	.11	-.11	1.00					
7. FYCE	-.02	-.11	.11	-.01	.09	-.09	1.00				
8. FYTE	.10	.00	.16	.08	-.02	.15	.48**	1.00			
9. Number FTF	.05	.04	-.09	.15	-.14	.43**	.02	.07	1.00		
10. Number DAF	-.04	-.09	.04	-.01	.15	-.07	.06	.08	-.15	1.00	
11. BOC3YR	-.04	.11	-.03	.07	-.05	.16	-.13	.08	.12	.00	1.00

Note. $n = 136$. $*p \leq .05$, $**p < .001$. MINCH = required minimum clinical hours per week. MAXCH = required maximum clinical hours per week. PS = preceptor-to-student. FYCE = average years faculty clinical experience. FYTE = average years faculty teaching experience. FTF = full-time (core) faculty. DAF = dual-appointed (associated) faculty. BOC = Board of Certification three-year aggregate first-time pass rate.

Pearson product-moment correlation coefficients for graduate athletic training programs were generated after data transformation (see Table 8). Two variables had a weak to moderate, negative correlation with program three-year aggregate pass rate, the number of required minimum clinical hours per week, and the number of dual-appointed faculty. In the graduate data, as the program three-year aggregate BOC pass rate increased, the number of required minimum clinical hours per week decreased, $r(38) = -.34$, $p = .04$. In addition, as the program three-year aggregate BOC pass rate increased, the number of dual-appointed faculty decreased, $r(38) = -.46$, $p < .001$.

There was a weak to moderate, positive correlation between the number of required minimum and maximum clinical hours per week, $r(38) = .52$, $p < .001$, indicating that as the required number of minimum clinical hours in the program increased, so did the required number of maximum clinical hours per week. There was a weak, negative correlation between the number of dual-appointed faculty and the number of required maximum clinical hours per week, $r(38) = -.32$, $p = .05$, indicating that as the number of dual-appointed faculty increases, the number of required maximum clinical hours per week decreases. There was a weak to moderate, positive correlation between the number of full-time faculty and the number of faculty with doctoral degrees, $r(38) = .55$, $p < .001$. Therefore, as the number of full-time faculty increases, so does the number of faculty with doctorates. There was a weak, positive correlation between the average years of faculty teaching and clinical experience, $r(38) = .34$, $p = .04$. This suggests that as the average years of faculty teaching experience increases so does the average years of faculty clinical experience. Last, there was a weak, negative correlation between the number of dual-appointed faculty and the number of full-time faculty, $r(38) = -.38$, $p = .02$. Therefore, as the number of full-time (core) faculty increases, the number of dual-appointed (associated) faculty decreases.

Table 8

Graduate Athletic Training Program Pearson Correlations after Data Transformation

Variable	1	2	3	4	5	6	7	8	9	10	11
1. MINCH	1.00										
2. MAXCH	.52**	1.00									
3. Clinical terms	-.19	-.23	1.00								
4. PSR	-.10	.04	.16	1.00							
5. Clinical capstone	.16	.21	-.23	.05	1.00						
6. Doctoral faculty	.05	.05	-.14	.13	-.10	1.00					
7. FYCE	-.06	.14	.01	-.24	-.19	-.07	1.00				
8. FYTE	-.09	.01	-.02	-.04	-.10	-.07	.34*	1.00			
9. Number FTF	-.11	.25	-.02	.23	-.09	.55**	-.19	-.12	1.00		
10. Number DAF	.21	-.32*	-.18	.09	-.10	-.01	-.07	.08	-.38*	1.00	
11. BOC3YR	-.34*	-.09	.04	.06	.11	-.10	.11	.07	.24	-.46**	1.00

Note. $n = 38$. $*p < .05$, $**p < .001$. MINCH = required minimum clinical hours per week. MAXCH = required maximum clinical hours per week. PSR = preceptor-to-student ratio. FYCE = average years faculty clinical experience. FYTE = average years faculty teaching experience. FTF = full-time (core) faculty. DAF = dual-appointed (associated) faculty. BOC = Board of Certification three-year aggregate first-time pass rate.

Upon comparing the untransformed and transformed variable correlations, there were new significant correlations. In the undergraduate data, the correlation between the required number of minimum clinical hours per week and the required number of maximum clinical hours per week became a significant correlation in the transformed variables, $r(135) = .23$, $p = .01$. This indicates that as the required minimum clinical hours per week increased, so did the required maximum clinical hours. The transformation of the undergraduate data did not reveal any significant relationship between any of the independent variables with the dependent variable. Transformation of the graduate data found two additional independent variables that had a significant correlation with the dependent variable, program three-year aggregate BOC pass rate. The number of required minimum clinical hours per week had a weak, negative correlation with pass rate, *r*(38) = -.34, *p* = .04, suggesting that as the program three-year aggregate BOC pass rate increased, the required number of minimum clinical hours decreased. There was also an additional weak, negative correlation between the number of dual-appointed faculty and the number of required maximum clinical hours per week, *r*(38) = -.32, *p* = .05, suggesting that as the number of required maximum clinical hours per week for students increased, the number of dual-appointed faculty associated with the program decreased.

Research Question 1

RQ1: Are selected athletic training clinical education variables and faculty demographic characteristics significant predictors of the three-year aggregate BOC pass rate for first-time test takers?

Variables in the study were chosen by examining previous research in various areas of medical education that closely resemble the structure of athletic training education programs. Multiple regression was used to answer the research question for undergraduate (RQ1A) and graduate (RQ1B) programs. The variables used in this study were evaluated using the three-year aggregate BOC program pass rate percentages after data transformation.

Undergraduate Athletic Training Program Data

RQ1A: Are selected athletic training clinical education program variables (minimum clinical hours required per week, maximum clinical hours required per week, number of semesters student engaged in clinical experience, average preceptor-to-student ratio, and presence of a capstone clinical experience in the program) and faculty demographic characteristics (number of faculty with a doctorate, the average number of years of faculty teaching experience, the average number of years of faculty clinical experience, the total number of full-time faculty devoted to the program, and number of dual-appointed faculty) significant predictors of undergraduate athletic training program BOC three-year aggregate pass rate for first-time test takers?

Response rates are an important consideration when using multiple regression techniques. Mertler and Vannatta (2013) set forth two equations for determining this response requirement. The authors suggest that the larger value of the two equations be used which means that the use of multiple regression in this study would require 130 respondents. There was enough data collected from undergraduate athletic training programs, $n = 135$, to use a linear multiple regression technique. Multiple regression was used on the untransformed and transformed undergraduate data to ensure that data transformation improved the model. However, neither of the multiple regression models proved to be a significant predictor of program three-year aggregate program pass rate on the BOC examination. The transformed data [$R^2 = .07$, $R^2_{adj} = .002$, $F(10, 124) = 1.03$, $p = .42$] performed no better than the model with untransformed data [$R^2 = .09$, $R^2_{adj} = .02$, $F(10, 124) = 1.28$, $p = .25$]. The transformed model was reported since multiple regression requires a normal distribution of scores. Although not all variables were found to have a normal distribution, the transformation of the data set brought these data into a more normal distribution. It should also be noted that neither of the models identified variables that were significant in predicting three-year aggregate pass rates for undergraduate athletic training programs. The effect size for the model using transformed data was small to medium, $R^2 = .09$, indicating that the model accounts for only 9% of the variance in the BOC three-year aggregate pass rate for athletic training programs.

Statistical assumptions about the raw score variables included fixed independent variables, no measurement errors, a linear relationship between the independent and dependent variables, multicollinearity, and singularity of the independent variables. Assumptions were assessed on the transformed undergraduate data. In this study, raw scores for the independent and dependent variables are fixed. Data for the study was provided by athletic training program directors, therefore it is assumed to be without measurement error. Multicollinearity was assessed using the variance inflation factor (VIF). VIF statistics ranged between 1.07 and 1.44 with an average of 1.20, which is acceptable and below the cutoff of 5 to 10 (Field et al., 2012).

Residual assumptions for multiple regression include a mean of zero for errors of each observation, independence of errors, errors do not correlate with the independent variables, homogeneity of variance, and the normality of the errors. A residual scatterplot (see Figure 1) was used to assess for a zero mean of errors, error correlation with independent variables, and homogeneity of variance. These assumptions were met.

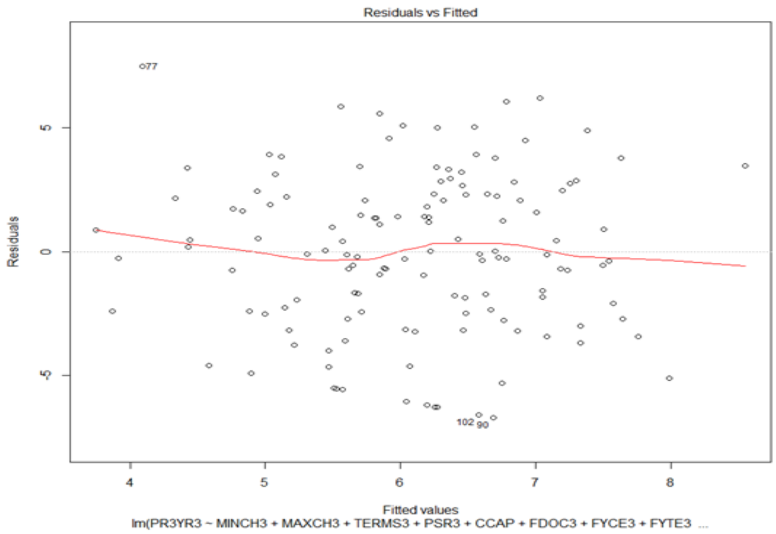

Figure 1. Residuals plot of standardized residuals versus fitted (predicted) values for undergraduate athletic training programs.

The normal distribution of errors assumption was assessed using a Q-Q plot (see Figure 2). The linear dispersion of errors indicates a normal distribution (Fields et al., 2012). There was still some deviation in the upper and lower limits that held close to the line. In addition, the residuals cluster along a horizontal line of zero in a rectangular pattern when assessed with the residual scatterplot, indicating normality (See Figure 1). The assumption of the residual independence of errors was assessed using the Durbin-Watson test and the assumption was met, $DW = 1.88$, $p = .23$. Field et al. (2012) suggest that a Durbin-Watson test statistic between one and three is sufficient to meet the assumption. All statistical considerations and assumptions for multiple regression were met in the undergraduate data set.

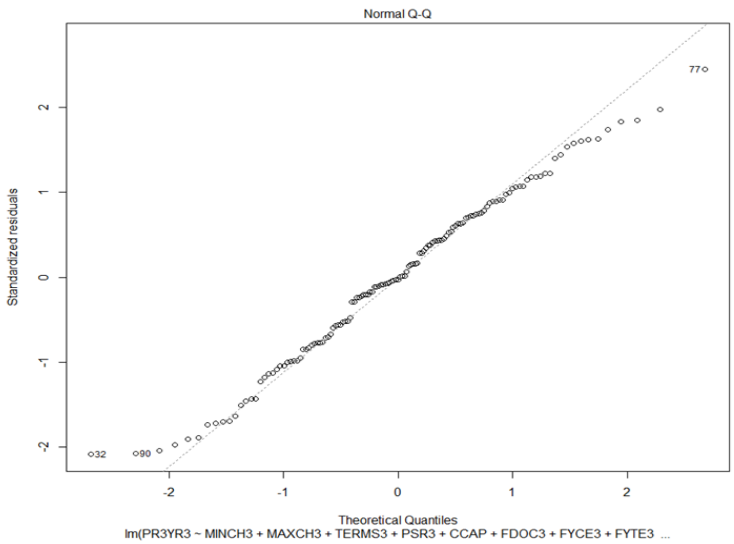

Figure 2. Residuals normality plot of standardized residuals versus predicted values for undergraduate athletic training programs.

Graduate Athletic Training Program Data

RQ1B: Are selected athletic training clinical education program variables (minimum clinical hours required per week, maximum clinical hours required per week, number of semesters student engaged in clinical experience, average preceptor-to-student ratio, and presence of a capstone clinical experience in the program) and faculty demographic characteristics (number of faculty with a doctorate, average number of years of faculty teaching experience, the average number of years of faculty clinical experience, the total number of full-time faculty devoted to the program, and number of dual-appointed faculty) significant predictors of graduate athletic training program BOC three-year aggregate pass rate for first-time test takers?

The graduate data did not meet the needed minimum number of 130 respondents to utilize linear multiple regression (Mertler & Vannatta, 2013). There are currently only 79 accredited graduate programs and 39 of those program directors responded to the survey. After the removal of one case for lack of data, 38 cases remained. In addition to running these data using multiple regression, forward and backward selection techniques, ridge regression, and lasso regression were used to determine the best model. Linear multiple regression was utilized to determine whether the forward, backward, ridge, and lasso regression techniques improved the models. Ridge and lasso regressions were employed to assist in shrinking the coefficients, which reduces variance in the model and improves model prediction. In addition, lasso and ridge regression reduce the likelihood of overfitting the model. Overfitting of the model is likely since there were 10 independent variables used with a low number of respondents, $n = 38$. Leave-one-out and k-fold cross-validation techniques were also used to assist in variance reduction. Table 9 presents the results for the backward and forward regression techniques on the untransformed and transformed data.

Table 9

Comparison of Regression Results for Graduate Data

Item	R^2	R^2_{adj}	*RSE*	*F*	*df*	*p*
Untransformed Data						
Backward selection	0.28	0.22	7.12	4.44	3, 34	.010
Forward selection	0.34	0.09	7.69	1.36	10, 27	.249
Transformed Data						
Backward selection	0.35	0.29	1.24	6.00	3, 34	.002
Forward selection	0.39	0.17	1.34	1.74	10, 27	.123

Note. $n = 38$.

The models using backward selection were significant across untransformed and transformed data. The backward selection on the transformed data model [$R^2 = .35$, $R^2_{adj} = .29$, $F(3, 34) = 1.24$, $p = .002$] performed similarly to the model with untransformed data using backward selection [$R^2 = .28$, $R^2_{adj} = .22$, $F(3, 34) = 4.44$, $p = .01$]. Backward selection using the transformed data was selected as the model with the best fit and had a low residual standard error, 1.24. In addition, the Akaike information criteria (AIC) was much lower in the model using backward selection with transformed data [$AIC = 20.08$] than when compared to the backward selection model with untransformed data [$AIC = 153$].

In the backward selection model with transformed data, variables identified as contributing to the model were the number of required weekly maximum clinical hours (MAXCH), the presence of a clinical capstone course (CCAP), and the number of dual-appointed faculty (DAF). Of note, these variables were identified as significant in both backward selection models, whether these data were transformed or not. Inspection of the beta weights and *p*-values in the backward selection model with transformed data specified that the number of required weekly maximum clinical hours and the number of dual-appointed faculty should be included in the model (see Table 10). The greatest predictor of program three-year aggregate BOC pass rate (PR3YR) was the number of dual-appointed faculty, $\beta = -4.32$, $t(3, 34) = -4.32$, $p = .001$. If both selected independent variables are used in this model, a regression equation of PR3YR = 3.04 - 0.2(MAXCH) – 4.32(DAF) is obtained. The effect size was large, $R^2 = .35$ in the backward selection model with transformed data, indicating that the model accounts for 35% of the variance in the BOC three-year aggregate pass rate for athletic training programs.

Table 10

Backward Selection Regression Statistics for Graduate Athletic Training Programs

								Confidence Intervals	
Item	R^2	R^2_{adj}	B	SE B	β	t	p	Lower	Upper
	0.35	0.29							
Intercept			3.04	0.49		6.20	<.001	.05	4.04
MAXCH			-0.20	0.09	0.33	-2.20	.034	.38	-0.05
CCAP			0.80	0.42	0.27	1.92	.064	-0.05	1.64
Number DAF			-4.32	1.15	0.55	3.76	.001	6.65	-1.98

Note. $n = 38$. MAXCH = required maximum clinical hours per week. CCAP = Clinical capstone course. DAF = dual-appointed (associated) faculty.

Ridge and lasso regressions utilized a training and test data set. The results were compared to the backward selection model using the transformed data. Ridge regression performed the poorest of the three models. This model did not select any significant variables and had the highest mean squared error, $MSE = 2.03$. Lasso regression performed slightly better than the ridge regression, $MSE = 1.82$, and identified one transformed variable as important to the model, the number of dual-appointed faculty. Of note, this was the variable that also contributed to the backward selection model with transformed data. However, when comparing the ridge and lasso regression model's mean squared error, the backward selection multiple regression model using transformed data [$MSE = 1.54$] outperformed the ridge regression and lasso regression models.

Cross-validation techniques, k-fold and leave one out were utilized to reduce variance error due to the small sample size. Both cross-validation techniques revealed the number of required maximum clinical hours per week, the presence of a clinical capstone course, and the number of dual-appointed faculty as variables that were significant to the model. The leave one out cross-validation technique reduced Root Mean Squared Error

(*RMSE*) and Mean Absolute Error (*MAE*) when moving from a two-variable [*RMSE* = 1.48 and *MAE* = 1.21] model to a three-variable model [*RMSE* = 1.37 and *MAE* = 1.14]. The three-variable model with leave one out cross-validation accounts for 15% of the variance in program three-year aggregate BOC pass rates. K-fold cross-validation technique reduced the RMSE and MAE when moving from a two-variable [*RMSE* = 1.45 and *MAE* = 1.08] to a three-variable model [*RMSE* = 1.32 and *MAE* = 1.08]. There was no further improvement with a four-variable model in either the leave one out or k-fold cross-validation. The k-fold cross-validation technique improved the R^2 value from the two-variable model [R^2 = .15] to a three-variable model [R^2 = .26]. The k-fold cross-validation technique accounted for a test error variance of 26%. However, neither of these techniques outperformed multiple regression using the variables identified by backward selection on the transformed data set, R^2 = 0.35.

Statistical assumptions about the raw score variables include fixed independent variables, no measurement errors, a linear relationship between the independent and dependent variables, multicollinearity, and singularity of the independent variables. Assumptions were assessed on the transformed graduate data. In this study, raw scores for the independent and dependent variables are fixed. Data for the study was provided by athletic training program directors, therefore it is assumed to be without measurement error. Multicollinearity was assessed using the variance inflation factor (VIF). VIF statistics range between 1.04 and 1.17, with an average of 1.11, which is acceptable and below the cutoff of 5 to10 (Field et al., 2012).

Residual assumptions for multiple regression include a mean of zero for errors of each observation, independence of errors, errors do not correlate with the independent variables, homogeneity of variance, and error normality. A residual scatterplot (see Figure 3) was used to assess for a zero mean of errors, error correlation with independent variables, and homogeneity of variance. These assumptions were met since these data points cluster around zero. The normal distribution of errors assumption was assessed with the Shapiro-Wilk normality test statistic [$W(38) = 0.97$, $p = .76$] and the correlation between observed residuals and expected residuals [98.9%] was used. The normality of the distribution of errors was met. The assumption of residual independence of errors was assessed using the Durbin-Watson test and the assumption was met, $DW = 2.69$, $p = .99$. Field et al. (2012) suggest that Durbin-Watson values of less than 1 or greater than 3 are cause for concern. Therefore, all statistical considerations and assumptions for multiple regression were met.

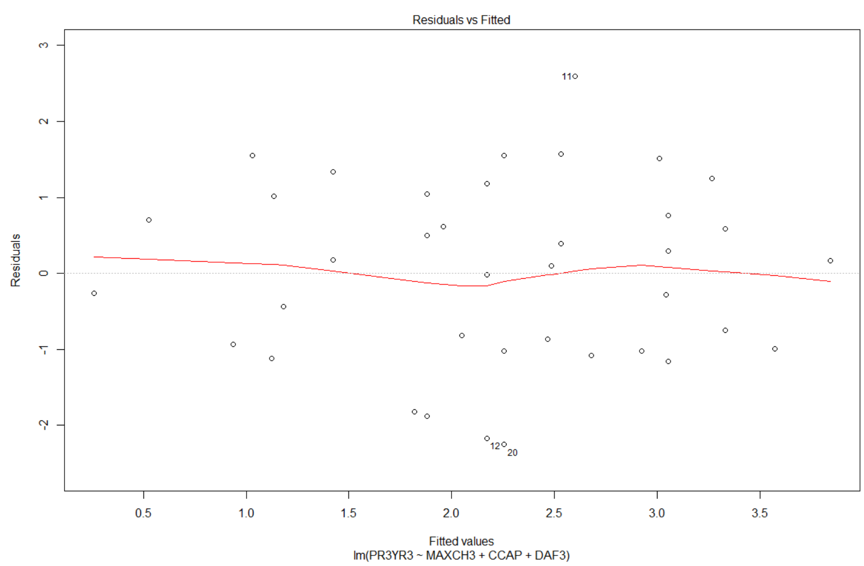

Figure 3. Residuals plot of standardized residuals versus fitted (predicted) values for graduate athletic training programs.

Research Question 2

RQ2: Are selected athletic training clinical education variables (minimum clinical hours required per week, maximum clinical hours required per week, number of semesters student engaged in clinical experience, average preceptor-to-student ratio, and presence of a capstone clinical experience in the program) and faculty demographic characteristics (number of faculty with a doctorate, the average number of years of faculty teaching experience, the average number of years of faculty clinical experience, the total number of full-time faculty devoted to the program, and number of dual-appointed faculty) significant predictors in classifying undergraduate athletic training programs as compliant or noncompliant with the standard of a 70% three-year aggregate BOC examination pass rate for first-time test takers?

Research question 2 was constructed to determine whether selected variables related to athletic training clinical education and faculty demographic characteristics are significant predictors in classifying undergraduate athletic training programs as compliant or noncompliant with the accreditation standard of a 70% three-year aggregate BOC pass rate for first-time test-takers. Logistic regression requires the use of a categorical dependent variable. Therefore, the dependent variable, program three-year aggregate pass rate, was coded as either 0 for "*noncompliant"* or 1 for "*compliant*." Noncompliant means the program fell below the mandated three-year aggregate pass rate of 70% for first-time test takers. Programs meeting or exceeding the 70% mandate are identified as compliant. The logistic regression statistical analysis was only completed using the undergraduate program data. There were too few non-compliant programs in the graduate data set, n = 3, for a similar research question.

Logistic regression was selected over discriminant analysis due to the required number of responses and the types of variables being used. Discriminant analysis utilizes continuous variables to predict or classify dependent variables and requires a larger sample of 200 (Mertler & Vannatta, 2013). Logistic regression can use both continuous and categorical variables, both of which are included in this study. In addition, logistic regression is much more accommodating with statistical assumption violations. The independent variables do not have to meet the assumptions of a normal distribution, a linear relationship, or have equal variances within groups.

First, logistic regression techniques with untransformed and transformed data sets were completed to determine whether the use of transformed data did improve the model. In addition, logistic regression techniques with upsampling and downsampling across training and test data sets were employed to determine whether the model was further improved. The use of transformed data and test data sets did improve the model. In delineating the training and test data sets, 70% of these data were used for data training and 30% of these data were used to test the model. Upsampling and downsampling is a standard practice used to reduce class imbalance by creating training and test data sets that are approximately equal in proportion. In the data set, there were only 24 of the 135 cases in undergraduate programs that were noncompliant with the 70% minimum three-year aggregate BOC pass rate. Without the use of upsampling and downsampling, the comparison would be between 24 noncompliant programs and 111 compliant programs.

This research question centers around whether programs can be classified as compliant or noncompliant. The ability to identify noncompliant programs, by way of a high specificity percentage, would allow programs to assess and make changes to their program based on specific independent variables used in the study. Therefore, the model with high levels of both sensitivity and specificity was selected, with specificity being very important to the model. In addition, Cohen's Kappa value, balanced accuracy, and the area under the Receiver Operating Characteristic (AUROC) were used to assess the model's ability to accurately discriminate between compliant and noncompliant classifications (see Table 11).

In further assisting with model selection, the AIC score, Hosmer and Lemeshow goodness of fit test, and Nagelkerke's R^2 were evaluated. The model using downsampled test data was selected as the best model. The Hosmer and Lemeshow goodness of fit test, $HL = X^2(9) = -2.76$, $p = 1$, indicates that the downsampled test data model is a good fit. This same model had an $AIC = 54.46$, which was the lowest AIC of all the logistic regression models using the transformed test data sets. In addition, the $R^2_{Nagelkerke} = .47$, indicating that 47% of the variation is accounted for by the selected independent variables of the downsampled model on the test data set. The selected model predicted compliant and noncompliant programs correctly in 66.67% and 71.43% of the cases with a balanced accuracy of 69.05%. The AUROC for this model was 64.94% with an optimal probability cutoff score of 0.43 as the decision threshold.

Table 11

Downsampled and Upsampled Logistic Regression on Transformed Data Results

Model	Sensitivity	Specificity	Balanced Accuracy	F1	Kappa	AUROC
Training Data						
Downsample	66.67%	79.17%	72.92%	71.11%	0.46	74.57%
Upsample	68.47%	72.97%	70.72%	70.05%	0.41	75.94%
Test Data						
Downsample	66.67%	71.43%	69.05%	77.19%	0.25	64.94%
Upsample	69.70%	28.57%	49.13%	75.41%	-0.01	64.07%

Note. AUROC = area under the receiver operating characteristics curve.

The model using downsampling of the test data identified no significant variables that would classify programs as compliant with the 70% three-year aggregate BOC pass rate. Table 12 presents the logistic regression model using downsampling of the transformed test data.

Table 12

Model Statistics for Downsampled Logistic Regression on Transformed Test Data for Undergraduate Athletic Training Programs

Variable	*β*	*SE*	*Wald*	*p*	Odds Ratio	Confidence Intervals 2.5%	97.5%
Intercept	-3.85	3.22	-1.20	.232	< .001	< .001	10.48
MINCH	-0.04	0.14	-0.26	.796	0.96	0.72	1.28
MAXCH	0.22	0.25	0.87	.386	1.24	0.77	2.15
Clinical terms	-0.10	0.52	-0.20	.845	0.90	0.30	2.48
PSR	-3.65	4.00	-0.91	.362	0.03	< .001	37.50
Clinical Capstone	-18.67	2793.18	-0.01	.995	< .001	NA	1.05×10^{77}
Doctoral Faculty	0.63	0.86	0.74	.460	1.88	0.35	11.25
FYCE	-0.18	0.56	-0.33	.745	0.83	0.26	2.59
FYTE	0.74	0.65	1.15	.252	2.10	0.64	9.30
Number FTF	2.30	1.71	1.35	.177	10.00	0.48	620.80
Number DAF	-1.59	1.96	-0.81	.419	0.20	0.03	8.61

Note. $n = 135$. MINCH = required minimum clinical hours per week. MAXCH = required maximum clinical hours per week. PSR = preceptor-to-student ratio. FYCE = average years of faculty clinical experience. FYTE = average years of faculty teaching experience. FTF = number of full-time (core) faculty. DAF = number of dual-appointed (associated) faculty.

Upon comparison of the downsampled and upsampled logistic regression models using the test data set, the logistic regression model using upsampling [*AIC* = 184.87] had slightly better results when classifying programs as compliant (69.70%). Several components of the confusion matrix performed well, such as the precision score and the F1 score. The F1 score (75.41%) is a combination of precision (ability to predict compliant program correctly) and recall (the ability to predict all compliant programs correctly). Furthermore, the upsampling of the test data [*AUCROC* = 64.07%] performed only slightly worse than the downsampling of the test data [*AUCROC* = 64.94%] with overall model performance. However, the confusion matrix showed that the model did not perform well in other areas. One area of importance is the ability to classify programs as noncompliant which dropped significantly from the test data model using downsampling (71.43%) to the model using upsampling (28.57%). Last, the Hosmer and Lemeshow goodness of fit test, $HL = X^2(9) = -1.14$, $p = 1$, indicated that the upsampled test data model is a good fit. However, the inability to consistently and correctly identify noncompliant programs in terms of specificity is a cause for concern. Last, the $R^2_{Nagelkerke} = .40$, indicated that 40% of the variance is accounted for by the upsampled test data model.

The upsampled logistic regression of the transformed test data set identified four significant variables to the model—the preceptor-to-student ratio (PSR), the average number of years of faculty clinical experience (FYCE), the average number of years of faculty teaching experience (FYTE), and the number of full-time faculty (FTF) associated with the program (see Table 13). If the upsampled logistic regression model on the test data set were used, an equation of Compliant (1) = -0.31 – 4.30(PSR) - 0.60(FYCE) + 0.72(FYTE) + 2.54 (FTF) could be used to determine compliance with the mandated three-year aggregate BOC pass rate percentage of 70%. The optimal cutoff value is 0.74 which is used as the decision threshold.

Upon assessing the odds ratio for the selected significant variables in the upsampled test data model, it was found that the number of full-time faculty associated with the program had the greatest impact on three-year aggregate BOC program pass rates. When the number of full-time faculty increased by one, odds of meeting the mandated 70% three-year aggregate BOC program pass rate increases by 12.66 times.

The average number of years of faculty teaching experience had the second greatest impact on three-year aggregate BOC program pass rate compliance but to a much lesser degree. As the average number of years of faculty teaching experience increases by one year, odds of compliance with the three-year aggregate BOC program pass rate increased by 2.06 times. The average years of faculty clinical experience was also a significant predictor. As the average years of faculty clinical experience increased by one, the odds of compliance with the three-year aggregate BOC program pass rate decreased by 0.55 times. Last, the preceptor-to-student ratio had the least amount of impact on the BOC pass rate for athletic training programs. As the preceptor-to-student ratio decreased by one, the odds of compliance with the three-year aggregate BOC program pass of 70% or higher increased by 0.01 times.

Table 13

Model Statistics for Upsampled Logistic Regression on Transformed Test Data for Undergraduate Athletic Training Programs

Variable	*β*	*SE*	*Wald*	*p*	Odds Ratio	Confidence Intervals 2.5%	97.5%
Intercept	0.31	1.16	-0.27	.788	0.73	0.74	7.37
MINCH	.01	0.06	0.24	.810	1.01	0.90	1.14
MAXCH	.18	0.11	1.65	.100	1.20	0.97	1.51
Clinical terms	0.28	0.27	-1.03	.302	0.75	0.43	1.27
PSR	4.30	1.31	-3.29	.001	0.01	0.001	0.16
Clinical Capstone	1.10	0.64	-1.70	.089	0.33	0.09	1.13
Doctoral Faculty	0.58	0.37	-1.59	.112	0.56	0.26	1.13
FYCE	0.60	0.17	-3.62	< .001	0.55	0.39	0.74
FYTE	.72	0.19	3.77	< .001	2.06	1.45	79.29
Number FTF	2.54	0.88	2.89	.004	12.66	2.44	79.29
Number DAF	0.16	0.93	-0.17	.864	0.85	0.14	5.46

Note. $n = 135$. MINCH = required minimum clinical hours per week. MAXCH = required maximum clinical hours per week. PSR = preceptor-to-student ratio. FYCE = average years of faculty clinical experience. FYTE = average years of faculty teaching experience. FTF = number of full-time (core) faculty. DAF = number of dual-appointed (associated) faculty.

Statistical Considerations and Assumptions

Logistic regression requires a statistical assumption check of independent variables that are measured without error, independence of errors, linearity of the independent variable, and the logit of the dependent variable, outliers, and multicollinearity. The independence of observations assumption was met since each program director reported these data for their respective program only. Furthermore, the Durbin Watson test, $DW = 1.73$, $p = .11$, indicated that the independence of errors assumption was met. Field et al. (2012) state that a Durbin Watson value of less than 1 or greater than 3 is cause for concern. The linearity of the independent variable on the logit of the dependent variable was assessed using plots and the assumption was met in all variables except the preceptor-to-student ratio (PSR3). A plot of the standardized residuals showed no outliers in these data. Multicollinearity was assessed using the variance inflation factor (VIF) and Pearson *r* correlation statistics. The multicollinearity assumption was met as all VIF statistics ranged between 1.06 and 1.80, which held well below the cut-off of 5 to10 (Field et al., 2012). No independent variables were highly correlated. The variables with the greatest correlation were the number of full-time faculty and the number of faculty with a doctorate with a weak to moderate, positive correlation, $r(135) = .55$, $p < .001$. In addition, the number of required maximum clinical hours and the number of required minimum clinical hours also had a weak to moderate, positive correlation, $r(135) = .52$, $p < .001$. Therefore, all assumptions for the use of logistic regression were met.

Research Question 3

RQ3: Is there a significant difference between levels of selected variables on the BOC examination three-year aggregate pass rate for first-time test takers?

Research question 3 used a series of factorial ANOVAs to determine whether levels of selected independent variables—average years of faculty clinical experience, average years of faculty teaching experience, preceptor-to-student ratio, and minimum required weekly clinical hours—had a significant effect on three-year aggregate first-time pass rate for undergraduate and graduate athletic training program cohorts. Data were collapsed into 2x4, 2x3, and 2x2 designs to determine which design provided the cell counts needed for data group comparison. The 2x2 design met the cell-count requirements for comparison in all four subquestions across undergraduate and graduate data.

Undergraduate Athletic Training Program Data

RQ3A: Is there a significant difference between levels of faculty clinical experience and levels of faculty teaching experience on undergraduate athletic training program BOC examination three-year aggregate pass rate for first-time test takers?

A two-way factorial ANOVA was conducted to determine whether three-year aggregate pass rates differed between the levels of average years of faculty clinical experience (FYCE) and average years of faculty teaching experience (FYTE) impacted undergraduate program three-year aggregate BOC pass rates. These data were divided into two levels of average years of faculty clinical experience, 0-12 years and 13-32 years. In addition, there were two levels of average years of faculty teaching experience, 0-12 years and 13-30 years. The 2x2 factorial ANOVA design created four groups: a low FYCE-low FYTE, a low FYCE-high FYTE, a high FYCE-low FYTE, and a high FYCE-high FYTE group. Group-level descriptive statistics for the program three-year aggregate BOC examination pass rate after the dependent variable transformation was assessed (see Table 14). Overall program three-year aggregate scores after data transformation averaged 6.10 (SD = 3.32).

Table 14

Descriptive Statistics for Factorial ANOVA of Average Years of Faculty Clinical Experience and Average Years of Faculty Teaching Experience on Undergraduate Program BOC Pass Rates

	n	*M*	*SD*	Minimum	Maximum	Skewness	Kurtosis
Low FYCE-Low FYTE	58	6.26	3.42	0.00	13.23	0.11	-1.00
Low FYCE-High FYTE	20	5.68	2.80	0.00	11.42	-0.20	-0.54
High FYCE-Low FYTE	20	6.80	3.27	0.00	12.00	-0.43	-0.33
High FYTE-High FYTE	37	5.71	3.49	0.00	12.28	-0.17	-0.88

Note. FYCE = average years of faculty clinical experience. FYTE = average years of faculty teaching experience.

Results of the factorial ANOVA indicate that there was no significant interaction between the average years of faculty clinical and teaching experience, $F(1, 131) = 0.16$, $p = .69$, $\eta^2 = .001$, $\omega^2 = -.006$. There was no significant main effect for the average years of faculty teaching experience [$F(1, 131) = 1.68$, $p = .20$, $\eta^2 = .01$, $\omega^2 = .005$] or for the average years of faculty clinical experience [$F(1, 131) = 0.23$, $p = .63$, $\eta^2 = .001$, $\omega^2 = -.006$]. Effect sizes were small indicating that almost no portion of the three-year aggregate program BOC pass rate was accounted for the average years of faculty clinical and teaching experience.

Statistical considerations for factorial ANOVA include outliers and missing data. Bagged tree imputation was utilized for missing data and *z*-score assessment found no outliers in these data. The statistical assumptions for factorial ANOVA include interval or ratio-level dependent variables, independence of observations, dependent variable normality, and homogeneity of variance. Program directors were responsible for completing surveys about their respective programs; therefore, the independence of observations assumption will be met. The dependent variable used is a ratio-level measurement. Dependent variable normality was assessed using skewness and kurtosis values, histograms, Q-Q plots, as well as the Jarque-Bera test statistic. The dependent variable was transformed and found to be normal with the Jarque-Bera test, $JB\ X^2(2) = 1.64$, $p = .44$. Homogeneity of variance was evaluated and the assumption was met whether centered on the median for Levene's test [$F(3, 131) = 0.71$, $p = .55$] or on the mean [$F(3, 131) = 0.72$, $p = .54$]. In addition, Bartlett's test of homogeneity of variance was used and the assumption was met, $\chi^2(3) = 1.26$, p = .74. All statistical assumptions for the use of the two-way factorial ANOVA on the undergraduate data were met.

RQ3B: Is there a significant difference between the levels of clinical site preceptor-to-student ratio and levels of minimum required weekly clinical hours on undergraduate athletic training program BOC examination three-year aggregate pass rate for first-time test takers?

A two-way factorial ANOVA was used to assess whether levels of the required number of minimum clinical hours per week (MINCH) and levels of the clinical preceptor-to-student ratio (PSR) impacted undergraduate program three-year aggregate BOC pass rates. These data were divided into two levels of required minimum clinical hours per week, 0-11 hours and 12-20 hours. In addition, there were two levels of the average preceptor-to-student ratio, 0-0.5 and 0.6-5. The 2x2 factorial ANOVA design created four groups: a low MINCH-low PSR, a low MINCH-high PSR, a high MINCH-low PSR, and a high MINCH-high PSR group. Group-level descriptive statistics for the program three-year aggregate BOC pass rate after the dependent variable transformation was assessed (see Table 15). Overall program three-year aggregate scores after data transformation averaged 6.10 (*SD* = 3.32).

Table 15

Descriptive Statistics for Factorial ANOVA of Minimum Required Clinical Hours per Week and Average Preceptor-to-Student Ratio on Undergraduate Program BOC Pass Rates

	n	*M*	*SD*	Minimum	Maximum	Skewness	Kurtosis
Low MINCH-Low PSR	43	6.68	3.25	0.00	13.23	-0.14	-0.56
Low MINCH-High PSR	23	5.95	3.34	0.00	12.00	-0.19	-0.63
High MINCH-Low PSR	38	5.87	3.04	0.00	12.83	0.20	-0.52
High MINCH-High PSR	29	5.88	3.82	0.00	11.42	-0.17	-1.35

Note. MINCH = required minimum clinical hours per week. PSR = preceptor-to-student ratio.

There was no significant interaction between the required number of minimum clinical hours per week and the preceptor-to-student ratio, $F(1, 129) = 0.38$, $p = .54$, $\eta^2 = .003$, $\omega^2 = -.004$. The results of the factorial ANOVA also indicated no significant main effects for either required number of minimum clinical hours per week [$F(1, 129) = 0.81$, $p = .37$, $\eta^2 = .006$, $\omega^2 = -.001$] or for preceptor-to-student ratio [$F(1, 129) = 0.33$, $p = .57$, $\eta^2 = .003$, $\omega^2 = -.005$]. Effect sizes indicated that almost no portion of the three-year aggregate program BOC pass rate was accounted for by the required number of minimum clinical hours per week or the preceptor-to-student ratio in the undergraduate data.

Statistical considerations for factorial ANOVA include outliers and missing data. Bagged tree imputation was utilized for missing data and *z*-scores found no outliers in these data. The statistical assumptions for factorial ANOVA include interval or ratio-level dependent variables, independence of observations, dependent variable normality, and homogeneity of variance. Each program director was responsible for completing surveys about their respective program; therefore, the independence of observations assumption will be met. The dependent variable used is a ratio-level measurement. Dependent variable normality was assessed using skewness and kurtosis values, histograms, Q-Q plots, as well as the Jarque-Bera test statistic. The dependent variable was transformed and found to be normal with the Jarque-Bera test, $JB\ X^2(2) = 1.64$, $p = .44$. Homogeneity of variance was evaluated for the required number of minimum clinical hours per week and the preceptor-to-student ratio. Levene's test indicated homogeneity of variance with similar test statistics, whether centered on the median [$F(3, 129) = 1.01$, $p = .39$] or the mean [$F(3, 129) = 1.04$, $p = .38$]. Also, Bartlett's test of homogeneity of variance was used and the assumption was met, $\chi^2(3) = 1.74$, p = .63. All statistical assumptions for the use of the two-way factorial ANOVA on the undergraduate data were met.

Graduate Athletic Training Program Data

RQ3C: Is there a significant difference between levels of faculty clinical experience and levels of faculty teaching experience on graduate athletic training program's BOC examination three-year aggregate pass rate for first-time test takers?

A two-way factorial ANOVA was conducted to determine whether program three-year aggregate pass rates differed between levels of average years of faculty clinical (FYCE) and average years of faculty teaching experience (FYTE). These data were divided into two levels of average years of faculty clinical experience, 0-13.5 years and 13.6-33 years. In addition, there were two levels of average years of faculty teaching experience, 0-12 years and 13-29 years. The 2x2 factorial ANOVA design created four groups: a low FYCE-low FYTE, a low FYCE-high FYTE, a high FYCE-low FYTE, and a high FYCE-high FYTE group. Overall program three-year aggregate BOC pass rates after data transformation averaged 2.22 (*SD* = 1.47). Table 16 provides group descriptive statistics for graduate program three-year aggregate BOC pass rate after the dependent variable was transformed.

Table 16

Descriptive Statistics for Factorial ANOVA of Average Years of Faculty Clinical Experience and Average Years of Faculty Teaching Experience on Graduate Program BOC Pass Rates

	n	*M*	*SD*	Minimum	Maximum	Skewness	Kurtosis
Low FYCE-Low FYTE	12	2.41	1.57	0.00	5.19	0.04	-0.93
Low FYCE-High FYTE	7	1.67	1.32	0.00	4.01	0.50	-1.13
High FYCE-Low FYTE	8	1.91	1.38	0.00	3.81	-0.24	-1.57
High FYCE-High FYTE	11	2.61	1.55	0.00	3.81	-0.51	-1.18

Note. FYCE = average years of faculty clinical experience. FYTE = average years of faculty teaching experience.

Results of the factorial ANOVA indicate that there was no significant interaction between the average years of faculty clinical and teaching experience, $F(1, 34) = 2.12$, $p = .15$, $\eta^2 = .06$, $\omega^2 = .03$. There were no significant main effects for years of faculty clinical experience [$F(1, 34) = 0.13$, $p = .72$, $\eta^2 = .003$, $\omega^2 = -.02$] and years of faculty teaching experience [$F(1, 34) = 0.0001$, $p = .99$, $\eta^2 < .0001$, $\omega^2 = -.02$]. Effect sizes were small for both main effects, indicating that almost no portion of the three-year aggregate BOC pass rate was accounted for by the average number of years of faculty clinical and teaching experience.

The statistical assumptions for factorial ANOVA include interval or ratio-level dependent variables, independence of observations, dependent variable normality, and homogeneity of variance. Program directors were responsible for completing surveys about their programs. Therefore. the independence of observations assumption was met. The dependent variable used is a ratio-level measurement. Dependent variable normality was assessed using skewness and kurtosis values, histograms, Q-Q plots, as well as

Jarque-Bera test statistics and Kolmogorov-Smirnov test statistics. The dependent variable was transformed and found to be normal with Jarque-Bera test [$JB\ X^2(2) = 0.69$, $p = .71$] and Kolmogorov-Smirnov test [$D(38) = 0.12$, $p = .19$]. All plots also verified the normal distribution of the dependent variable. Homogeneity of variance was evaluated and met using Levene's test and Bartlett's test and statistics for the graduate data. For the average number of years of faculty teaching and the average number of years of faculty clinical experience, the homogeneity of variance assumption was met whether centered on the median [$F(3, 34) = 0.14$, $p = .93$] or the mean [$F(3, 34) = 0.12$, $p = .95$] for Levene's test. In addition, the Bartlett test was used, and the homogeneity of variance assumption was met, $\chi^2(3) = 0.33$, p = .95. All statistical assumptions for the use of the two-way factorial ANOVA on the graduate data were met.

RQ3D: Is there a significant difference between the levels of clinical site preceptor-to-student ratio and levels of minimum required weekly clinical hours on graduate athletic training program BOC examination three-year aggregate pass rate for first-time test takers?

A two-way factorial ANOVA was conducted to determine whether three-year aggregate graduate program pass rates differed between levels of minimum required clinical hours per week and the preceptor-to-student ratio at clinical sites. These data were divided into two levels of required minimum clinical hours per week, 0-15.5 hours and 15.6-37 hours. In addition, there were two levels of the average preceptor-to-student ratio, 0-1 and 1.1-2. The 2x2 factorial ANOVA design created four groups: a low MINCH-low PSR, a low MINCH-high PSR, a high MINCH-low PSR, and a high MINCH-high PSR group. Overall program three-year aggregate BOC pass rates after data transformation averaged 2.22 (SD = 1.47). Table 17 provides group descriptive statistics for program three-year aggregate BOC graduate program pass rate after the dependent variable was transformed.

Table 17

Descriptive Statistics for Factorial ANOVA of Minimum Required Clinical Hours per Week and Average Preceptor-to-Student Ratio on Graduate Program BOC Pass Rates

	n	*M*	*SD*	Minimum	Maximum	Skewness	Kurtosis
Low MINCH-Low PSR	15	2.51	1.63	0.00	4.52	-0.34	-1.38
Low MINCH-High PSR	4	2.64	1.14	1.23	4.01	-0.05	-1.88
High MINCH-Low PSR	16	1.98	1.48	0.00	5.19	0.16	-0.69
High MINCH-High PSR	3	1.52	0.95	0.74	2.58	0.28	-2.33

Note. MINCH = required minimum clinical hours per week. PSR = preceptor-to-student ratio.

There was no significant interaction between the levels of required number of minimum clinical hours per week and the preceptor-to-student ratio, $F(1, 34) = 0.23$, $p = .63$, $\eta^2 = .006$, $\omega^2 = -.02$. There was no significant main effect for preceptor-to-student ratio [$F(1, 34) = 0.05$, $p = .83$, $\eta^2 = .001$, $\omega^2 = -.02$] or for the required minimum clinical hours per week [$F(1, 34) = 1.73$, $p = .20$, $\eta^2 = .05$, $\omega^2 = .02$]. The effect size was 2%, indicating that almost no portion of the three-year aggregate program BOC pass rate was accounted for by the preceptor-to-student ratio or the required minimum clinical hours per week.

Statistical assumptions for factorial ANOVA include interval or ratio-level dependent variables, independence of observations, dependent variable normality, and homogeneity of variance. Each program director was responsible for completing surveys about their program, therefore the independence of observations assumption was met. The dependent variable used was a ratio-level measurement. Dependent variable normality was assessed using skewness and kurtosis values, histograms, Q-Q plots, as well as Jarque-Bera and Kolmogorov-Smirnov test statistics. The dependent variable was transformed and found to be normal with Jarque-Bera test [$JB\ X^2(2) = 0.69$, $p = .71$] and Kolmogorov-Smirnov test [$D(38) = 0.12$, $p = .19$]. All plots also verified the normal distribution of the dependent variable. Homogeneity of variance was evaluated for the required number of minimum clinical hours per week and the preceptor-to-student ratio. Levene's test indicated homogeneity of variance with similar test statistics, whether centered on the median [$F(3, 34) = 0.82$, $p = .49$] or mean [$F(3, 34) = 0.81$, $p = .49$]. In addition, Bartlett's test of homogeneity of variance was used and the assumption was met, $\chi^2(3) = 1.09$, p = .78. All statistical assumptions for the use of the two-way factorial ANOVA on the graduate data were met.

Summary

This chapter provided a summary of the demographic characteristics and quantitative data analysis across three research questions. The undergraduate and graduate data set consisted of 136 and 38 athletic training program directors, respectively. Both data sets were assessed for missing data and outliers. There were no missing data in the graduate data set and imputation was used for the undergraduate data set. In both data sets, outliers were replaced with values of three standard deviations from the mean. In addition, data transformations were utilized to bring these data into a more normal distribution before the use of inferential statistics. Descriptive statistics before and after data transformation were presented for both sets of data.

RQ1 was answered using regression techniques across both the undergraduate and graduate data sets. In the undergraduate data set, the number of required respondents was met, which allowed the use of multiple regression with no additional selection techniques required. The graduate data set did not meet the respondent requirement and therefore, backward and forward selection, lasso, as well as ridge regression techniques were utilized. For undergraduate programs, there was no significant predictor for the three-year aggregate BOC program pass rate.

For the graduate data, the backward selection of the transformed data model [R^2 = .35, R^2_{adj} = .29, F(3, 34) = 1.24, p = .002] was found to outperform forward selection, lasso regression, and ridge regression. A regression equation was constructed for graduate programs which included the required number of maximum clinical hours per week and the number of dual-appointed faculty, PR3YR = 3.04 - 0.2(MAXCH) – 4.32(DAF). The backward selection of the transformed data had the lowest residual standard error (1.24) and the lowest AIC (20.08) of any other model. The effect size was large as the backward selection of the transformed data model accounted for 35% of the variance in program three-year aggregate BOC pass rate. The graduate data met all required statistical considerations and assumptions for the use of multiple regression.

In RQ2, only the undergraduate program data set was utilized due to the low number of programs that fell below the 70% mandated three-year aggregate BOC pass rate for first-time test-takers. Logistic regression techniques with upsampling and downsampling of the trained and test data sets were used to answer this question. The logistic regression model using downsampling of the test data had the best fit when assessing Hosmer and Lemeshow goodness of fit. Unfortunately, the selected model did not indicate any significant variables in determining program classification as compliant or noncompliant with the three-year aggregate BOC program pass rate.

In comparing the next best model, logistic regression with upsampling of the test data, it performed similarly in determining compliance with the three-year aggregate pass rate standard. This model also performed well with the Hosmer and Lemeshow goodness of fit test [$HL = X^2(9) = -1.14, p = 1$] indicating that the model is a good fit. In addition, Nagelkerke R^2 indicated that 40% of the variance was accounted for by the upsampled test data model. The upsampled test data model correctly classified programs as compliant 69.70% of the time, which was better than the downsampled test model (66.67%). This upsampled model did not perform well when predicting noncompliance (28.57%) and it had a lower AUROC (64.07%) than the downsampled logistic regression of the test data (64.94%). The upsampled logistic regression of the test data identified four significant variables—the preceptor-to-student ratio (PSR), the average number of years of faculty clinical experience (FYCE), the average number of years of faculty teaching experience (FYTE), and the number of full-time faculty (FTF) associated with the program. If the logistic regression model using upsampled test data were used to determine compliance, an equation of Compliant(1) = -0.31 – 4.30(PSR) - 0.60(FYCE) + 0.72(FYTE) + 2.54 (FTF) could be employed. The undergraduate data met all statistical considerations and assumptions for the use of logistic regression.

RQ3 used a series of 2x2 factorial ANOVAs to determine whether levels of selected independent variables—average years of faculty clinical experience and average years of faculty teaching experience, as well as the preceptor-to-student ratio and required minimum clinical hours per week—impacted three-year aggregate BOC pass rates for undergraduate and graduate programs. The 2x2 factorial ANOVA was selected as it provided equal groups for comparison across all research subquestions. There were no significant interactions between any variable across both types of programs. There were also no significant main effects for any single variable across undergraduate and graduate programs. Statistical considerations and assumptions for all factorial ANOVAs were met.

Chapter V

SUMMARY AND DISCUSSION

The primary purpose of this study was to identify whether selected variables associated with clinical education (minimum required clinical hours per week, maximum required clinical hours per week, number of semesters engaged in a clinical experience, average preceptor-to-student ratio, and the presence of a capstone clinical experience in the program) and faculty demographic characteristics (number of faculty with a doctorate, the average number of faculty years of teaching experience, the average number of faculty years of clinical experience, the total number of full-time faculty devoted to the program, and the number of dual-appointed faculty) impacted program three-year aggregate Board of Certification (BOC) pass rates. The findings of this study may assist program administrators in creating a program where BOC candidates are successful on the exam which translates to improved three-year aggregate program BOC pass rates. It may also help identify areas in a program that contribute to compliance with the Commission on Accreditation of Athletic Training Education (CAATE) Standard 11, which mandates a three-year aggregate BOC examination pass rate of 70% or higher for athletic training education programs.

This chapter includes a discussion of major findings from the literature on national credentialing examinations across a variety of healthcare programs, including those from athletic training programs, which is the focus of this study. Also presented is a brief review of the methodology used in this study. Next, a discussion of the results and findings of the research is presented. The chapter concludes with a discussion of the limitations of the study, recommendations for future research, and a summary of the research.

Related Literature

This research study focused on program outcomes associated with the BOC credentialing examination for athletic trainers. There is a great deal of research associated with credentialing examination outcomes across other allied healthcare professionals, but published athletic training studies related to BOC outcomes remain very limited. There are currently seven published studies in peer-reviewed journals, most of which are outdated with the exception of a 2015 research study (Cavallario & Van Lunen, 2015; Draper, 1989; Harrelson et al., 1997; Middlemas et al., 2001; Starkey & Henderson, 1995; Turocy et al., 2000; Williams & Hadfield, 2003). In prior research, three factors emerged as important to BOC pass outcomes—student grade point average, clinical education, and faculty demographic characteristics. Since this study focuses on program outcomes, clinical education and faculty demographic characteristics were selected as areas of focus. A comprehensive literature review was provided in Chapter 2 on each of the variables included in this study as they relate to clinical education and faculty demographic characteristics.

Clinical Education

Across a literature review of clinical education in healthcare education programs, several factors were found to impact credentialing examination outcomes. Throughout the majority of athletic training education research, the number of total clinical hours did not appear to impact BOC pass rate outcomes (Draper, 1989; Hickman, 2010; Turocy et al., 2000). However, one study by Middlemas et al. (2001) found that the total number of clinical hours was significant in predicting BOC outcomes. A more recent study across undergraduate and graduate programs indicated that students enrolled in graduate athletic training programs have a higher number of required minimum clinical hours, maximum required clinical hours, and higher BOC first-time pass rate percentages (Cavallario & Van Lunen, 2015). Maring and Costello (2009) reported that physical therapy assistant students with more clinical education credit hours, which translated to increased clinical education experience hours, was found to improved National Physical Therapy Examination for Physical Therapy Assistants (NPTE-PTA) pass rate outcomes.

Since some studies indicate that the number of hours may be important, then the number of terms a student is engaged in clinical education may also be of importance. In fact, Searcy (2006) found that the more semesters a student is engaged in clinical education, the more likely they are to pass the BOC examination. However, Mohr et al. (2005) did not find a link between the length of clinical education experiences and the NPTE-PT pass rates for physical therapy programs. When delineating clinical experiences as part-time or full-time, such as in a clinical capstone experience, two studies found that full-time experiences were not beneficial in predicting first-time pass rates for the NPTE-PT examination (Gresham et al., 2015; Maring & Costello, 2009). However, several studies across nursing programs found that students in a clinical capstone experience had improved NCLEX-RN examination results (Diefenbeck et al., 2011; Longabach, 2012; Washburn, 2006).

Several studies addressed preceptor-to-student ratios in clinical experiences and their impact on student outcomes. Most studies indicated that lower preceptor-to-student ratios—a 1:1 or 1:2 ratio—resulted in improved learning outcomes (DeClute & Ladyshewsky, 1993; Laurent & Weidner, 2002; O'Connor et al., 2012). One study found that a cooperative clinical education model where there are fewer preceptors and more students improved skill-based learning outcomes (Ladyshewsky et al., 1998). However, the authors did not delineate the preceptor-to-student ratio utilized in this study.

Faculty

A literature review across athletic training, physical therapy, physical therapy assistant, and nursing research, deemed several variables linked to program faculty as important for inclusion in this study. The number of faculty with terminal degrees was found to improve credentialing examination outcomes in nursing, physical therapy, and athletic training education (Kuss, 2014; Mohr et al., 2005; Williams & Hadfield, 2003). In fact, Williams and Hadfield (2003) found that when the number of faculty with a terminal degree was combined with a variety of clinical education sites, there was a significant impact on BOC outcomes. Two studies found no significant relationship between the number of doctoral faculty and exam outcomes in physical therapy and physical therapy assistant education programs (Novak, 2009; Turner, 2005). Last, one research study found that when there was an increase in the number of doctoral faculty, exam outcomes in nursing education decreased (Stevens, 1996).

Several studies looked at the years of faculty teaching and the years of clinical experience and their impact on national credentialing examination outcomes. The number of years of faculty teaching experience had mixed findings across various healthcare education programs. Novak (2009) found the number of years teaching experience to be a significant predictor of examination outcomes in physical therapy programs. In contrast, a study of nursing education found that program instructors with more than 30 years of teaching experience negatively impacted NCLEX-RN examination pass rates (Turner, 2005). In addition, the Turner study found that nursing faculty with 10-19 years of previous clinical experience had a weak, positive correlation with nursing credentialing examination pass rates and was significant in predicting exam pass rates. Maring et al. (2013) reported that the number of years of faculty teaching experience was not significant in predicting physical therapy credentialing examination results.

Faculty in athletic training programs are typically either full-time with solely academic responsibilities or they are dual-appointed where they split time between academics and clinical responsibilities. One athletic training study indicated that the number of dual-appointed faculty negatively impacted (Williams & Hadfield, 2003). Kuss (2014) found that the number of full-time faculty in nursing programs had no impact on NCLEX-RN examination outcomes. However, two studies in nursing and physical therapy assistant programs found that programs with a higher percentage of full-time faculty had higher credentialing examination pass rates (Novak, 2009; Stevens, 1996).

Methodology

Data were collected using a survey that included variables related to clinical education and faculty demographic characteristics. The study explored the impact of these variables on undergraduate and graduate athletic training education program three-year aggregate BOC pass rates for first-time test-takers. In order to examine these relationships, a nonexperimental survey research design with group comparison methods was used to answer the research questions in this study. Statistical techniques utilized included multiple regression, logistic regression, and a series of factorial ANOVAs.

Participants

The target population included undergraduate and graduate athletic training education program directors. At the time of this study, there were 289 undergraduate and 72 graduate programs. Of the 289 undergraduate program directors, 136 responded to the invitation to participate, yielding a response rate of 47.1%. Across graduate program directors, 39 of the 72 program directors responded, yielding a response rate of 54.2%. One of the 39 graduate program director responses was removed from data analysis because only two survey questions were completed on the survey.

Instrumentation

An 18-item survey was constructed using variables from an extensive literature review. In order to ensure clarity and the ability to gather these data, an expert review panel of athletic training program directors from a variety of undergraduate and graduate programs, as well as one researcher with a background in instrument development assessed the survey items. Feedback and comments from the expert panel resulted in the final instrument used for the research study. Instrument reliability relied heavily on the program director's ability to provide accurate data. CAATE administration has mechanisms in place to determine areas of concern through the use of program annual reports. Item responses were checked against program publications and websites. The reliability of the BOC examination was measured using Cronbach's alpha across three examination forms and reported at 0.82, 0.84, and 0.83, which are acceptable. Field et al. (2012) suggest that for ability tests such as the BOC exam, a cutoff of .7 is appropriate.

The validity of the BOC examination is another important factor to consider. The examinations' content validity is established through a process of item-review by the BOC Examination Development Committee. In addition, examination items must be referenced in two resources or at least once in a seminal reference (BOC, 2017).

Data Collection and Analysis

Upon IRB approval, the survey was provided to undergraduate and graduate athletic training program directors in paper-and-pencil and an online format. Results from the data collection were entered into an Excel spreadsheet. Descriptive and inferential statistical procedures were completed using the R statistical package. Data transformations were performed and statistical considerations and assumptions were assessed to determine whether the requirements for each statistical procedure were met.

Summary of Findings

This study included several research questions across undergraduate and graduate athletic training education programs. The results of this study are intended to be used by program administration to structure programs in such a manner that might improve BOC pass rate outcomes for students in their respective programs. This improvement in individual BOC pass rates for students translates to improved three-year aggregate BOC pass rate percentages for their respective athletic training education program, which was the focus of this study. Three overarching research questions were utilized to determine whether outcomes could be predicted, whether the categorization of a program as compliant or noncompliant with the 70% three-year aggregate pass rate, and whether levels of selected variables significantly impacted the three year-aggregate pass rate outcomes for programs.

Data collected from 136 undergraduate and 38 graduate program directors were assessed across three research questions. In undergraduate programs, Pearson's correlation completed after data transformation found no correlation between any independent variable and the dependent variable, program three-year aggregate BOC pass rate outcomes. There was a weak, positive correlation between the minimum and maximum required weekly clinical hours. There were also weak to moderate, positive correlations between the number of full-time (core) faculty and the number of faculty with a doctorate, as well as between the average number of years of faculty teaching experience and the average number of years of faculty clinical experience.

In graduate programs one variable, the number of dual-appointed faculty had significant, weak, negative correlations with two other independent variables, the maximum number of clinical hours required per week and the number of full-time faculty. A weak, positive correlation existed between the average number of years of faculty teaching experience and the average number of years of faculty clinical experience. In addition, there were weak to moderate, positive correlations between the minimum and maximum required clinical hours per week, as well as the number of full-time faculty and the number of faculty with a doctorate. There were two weak to moderate, negative correlations with the dependent variable—three-year aggregate BOC examination program pass rate—the number of required minimum clinical hours per week and the number of dual-appointed faculty associated with the program.

Research Question 1

This research question sought to determine whether program three-year aggregate BOC pass rates could be predicted using variables associated with clinical education and faculty demographic characteristics. In the undergraduate data, no model predicted program three-year aggregate BOC pass rate outcomes. However, the graduate data indicated that three variables could be used to predict program three-year aggregate BOC pass rate outcomes. The number of required maximum clinical hours per week, the presence of a clinical capstone course, and the number of dual appointed faculty were identified as predictors of a program's BOC pass rate outcomes. However, upon inspection of the *p*-values, only two of those variables were significant in predicting three-year aggregate BOC pass rates (PR3YR)—maximum required clinical hours per week (MAXCH) and the number of dual appointed faculty (DAF) associated with the program. A model using a backward selection of transformed data was used to create a regression equation of PR3YR = 3.04 - 0.2(MAXCH) – 4.32(DAF).

Research Question 2

RQ2 focused on whether programs could be categorized as compliant or noncompliant with CAATE Standard 11 (CAATE, 2012). This standard mandates a three-year aggregate first-time BOC pass rate of 70% or greater for both undergraduate and graduate programs. This research study focused on undergraduate programs because there were too few graduate programs that were noncompliant with Standard 11. The selected logistic regression model using downsampling of the test data was found to be the best model with regards to predictions. However, that model did not identify any significant variables in predicting classification as either compliant or noncompliant.

Another model, logistic regression using upsampling of the test data performed similarly except for identifying noncompliant programs. The upsampled logistic regression of the transformed test data set identified four significant variables to the model—the preceptor-to-student ratio (PSR), the average number of years of faculty clinical experience (FYCE), the average number of years of faculty teaching experience (FYTE), and the number of full-time faculty (FTF) associated with the program. If this model were used, an equation of Compliant(1) = -0.31 – 4.30(PSR) - 0.60(FYCE) + 0.72(FYTE) + 2.54 (FTF) could be used to determine compliance with the mandated three-year aggregate BOC pass rate percentage of 70%. The upsampled test data model correctly predicted compliance 69.70% percent of the time, but only predicted noncompliance 28.57% of the time.

Research Question 3

In the last question, RQ3, this study assessed whether there was a difference between levels of faculty clinical and teaching experience, as well as levels of minimum clinical hours per week and preceptor-to-ratio on undergraduate and graduate programs three-year aggregate BOC pass rate outcomes. In the undergraduate programs, no significant interaction existed between levels of average years of faculty clinical and levels of average years of faculty teaching experience. There was also no significant interaction between the levels of the required minimum clinical hours per week and levels of the preceptor-to-student ratio. For undergraduate programs, no significant main effects existed for any variable. The effect size was small for all four variables, indicating that almost no portion of the three-year aggregate program BOC pass rate was accounted for by any of the studied variables.

In graduate programs, there was no significant interaction between levels of the average years of faculty clinical experience and levels of the average years of faculty teaching experience. In addition, there was no significant interaction between the levels of the required minimum clinical hours per week and levels of the preceptor-to-student ratio. No variables were found to have a significant main effect. The effect size was small and indicated that almost no portion of the three-year aggregate program BOC pass rate was accounted for by any single variable.

Discussion of Findings

The current research study examined whether variables associated with clinical education and faculty demographic characteristics impacted three-year aggregate BOC examination outcomes for athletic training education programs. The overarching goal of this study was to provide program administration with information that can be used to transform athletic training programs in a manner that might improve student credentialing examination outcomes, and therefore program outcomes. A discussion of findings as compared to previous research findings and theory is presented, followed by the implications for program practices, theory, and future research recommendations.

Research Question 1

Across RQ1, there were no variables significant in predicting program three-year aggregate BOC pass rates for first-time undergraduate test takers. However, two variables were found to significantly impact graduate program BOC examination outcomes—the required number of maximum clinical hours per week and the number of dual-appointed faculty. In several areas of medical education, these variables appear to influence credentialing examination outcomes (Barkley et al., 1998; Beeman & Waterhouse, 2001; Gresham et al., 2015; Maring & Costello, 2009; Perrin & Lephart, 1988; Turocy et al., 2000).

The current study shows a link between maximum clinical hours per week and program BOC outcomes. These clinical experiences allow students to apply didactic knowledge in a clinical setting under the direct supervision of a preceptor. The use of clinical experiences is supported through Gagné's theory of instruction which uses a practical component in the learning process like that of clinical education in medical education programs (Gangé & Medsker, 1996). Graduate athletic training programs had an average required maximum clinical hours per week of 33.28 (SD = 11.16) and a median of 30. When assessing the beta weight for the variable, as the number of required maximum clinical hours per week increased by one standard deviation, the three-year aggregate BOC program pass rate decreased by 0.2 percentage points.

This is in contrast to findings across a variety of medical education programs where an increased number of clinical hours positively impacted credentialing examination pass rates (Cavallario & Van Lunen, 2015; Maring & Costello, 2009, Turocy et al., 2000). Cavallario and Van Lunen (2015) reported that athletic training graduate programs had higher BOC pass rate outcomes and a higher average of the total maximum required clinical hours. In addition, Turocy et al. (2000) found that students who gained exactly 400 hours above their required number of clinical hours across the program, had higher BOC pass rates. However, students who gained more than 400 hours above their required number of clinical hours did not see any improvement in the pass rate. Unfortunately, neither of these studies delineated the required maximum number of hours per week, and it is difficult to determine whether institutions included in the study were all on the same academic system, as well as determine which academic system was included. Knowing this would potentially allow for a calculation of the average weekly maximum clinical hours gained per week if all programs were on the same academic system.

At any rate, the Commission on Accreditation of Athletic Training Education deems clinical hours as important to student learning. According to the 2012 CAATE Standards for Professional Programs, programs are required to delineate a minimum and maximum requirement for clinical hours (CAATE, 2012). The current research findings may indicate that graduate programs should require less than 33.28 hours of maximum hours per week in the clinical setting. This may also indicate that a requirement of more than 33.28 hours negatively impacts program BOC pass rate outcomes. In the current study, students who spend more time engaged in clinical experiences might theoretically have less time for studying concepts learned in class.

The number of dual-appointed faculty associated with athletic training graduate programs was also found to impact the ability to predict the three-year aggregate program BOC pass rate percentage. This study found an average of 0.47 (SD = 0.92) dual-appointed faculty with a range of 0 to 3 dual-appointed faculty associated with graduate programs. It appears that having dual-appointed faculty members teaching in the athletic training education program may worsen three-year aggregate BOC program outcomes. Upon assessing the beta weight, as the number of dual appointed faculty increased by one standard deviation, the three-year aggregate program BOC pass rate decreased by 4.32 percentage points. This study's findings are similar to those in a prior study of athletic training undergraduate programs (Williams & Hadfield, 2003). The authors found that when programs separated faculty into either full-time academic or clinical, rather than having dual-appointed faculty, there were improved outcomes on the BOC examination.

The current study found that by splitting faculty time between clinical and academic duties, programs saw reduced pass rates on the BOC examination. Dual-appointed faculty spend a portion of their time engaged in didactic responsibilities such as preparing for class, teaching, and assisting students in the learning process and a portion engaged in real-world patient care. The current study supports the ideas from Williams and Hadfield (2003) that dual-appointed faculty may have difficulty balancing the time required between the two sets of duties which may very well impact the ability to prepare lectures and didactic learning opportunities for students due to assigned clinical responsibilities. Additionally, dual-appointed faculty may not be able to provide one-on-one counseling and instruction to students that require extra assistance with course content and skills. It may also limit the supervision and instruction of students that occur at the clinical site where one-on-one time instruction can often assist students in knowledge and skill retention. This research study's finding furthers the idea that program administrators should continue to reduce the number of dual-appointed graduate faculty associated with the athletic training program.

Research Question 2

The ability to classify athletic training programs as compliant or noncompliant was the focus of RQ2. Two models were significant in predicting program compliance with the 70% three-year aggregate BOC examination pass rate mandate. The best model had no significant variables that assisted in categorizing programs as compliant or noncompliant. The second model which performed similarly, except for identifying noncompliant programs correctly only 28.57% of the time, found that the preceptor-to-student ratio, the average number of years of faculty clinical experience, the average number of years of faculty teaching experience, and the number of full-time faculty associated with the program were significant in categorizing programs as compliant.

The greatest predictor of program compliance was the number of full-time (core) faculty associated with the athletic training education program. In the current study, as the number of full-time faculty increased by one, the odds of compliance with the mandated 70% three-year aggregate BOC examination program pass rate for first-time test takers increased by 12.66 times. Undergraduate athletic training programs averaged 2.79 full-time faculty with a median of 2. The number of undergraduate athletic training program full-time faculty ranged from 1 to 8. This finding is supported by a previous study which found that a higher percentage of full-time faculty improved nursing board examination outcomes (Stevens, 1996).

Full-time (core) faculty are fully devoted to the athletic training programs in an academic capacity and have no clinical responsibilities. This full-time devotion may provide these faculty with an advantage over their dual-appointed counterparts in preparing content for coursework alongside the numerous other responsibilities that a teaching position requires such as research, professional development, and service. Full-time faculty members may also be better integrated into the program's mission, goals, and philosophy. In addition, full-time faculty may be able to spend more time getting to know and understand student learning styles. These factors may help these faculty impact student learning in a programmatic and individualistic manner. At any rate, it appears that the focus of hiring strategies should be on growing the number of full-time faculty.

The second-largest predictor of compliance with the three-year aggregate pass rate mandate was the average years of faculty teaching experience. In the current study, program faculty ranged from 2 to 64 years of teaching experience with a mean of 12.98 years of teaching experience. In addition, as the average number of years teaching experience increased by one, the odds of compliance with the 70% three-year aggregate BOC examination program pass rate mandate for first-time test takers increased by 2.06 times. Although no research is found on this topic in athletic training education, several studies in other areas of allied health education support the current study's findings (Kuss, 2014; Novak, 2009). The number of years of faculty teaching experience was found to be a significant predictor of physical therapy assistant credentialing examination outcomes for students (Novak, 2009). In addition, Kuss (2014) found a positive correlation between the years of teaching experience and the NCLEX-RN examination outcomes for nursing students. However, a previous study suggests otherwise, Turner (2005) found that in nursing education programs, exam outcomes had a negative correlation with faculty members who had more than 30 years of teaching experience. The Turner study only included nursing programs from one state which makes it less generalizable across nursing programs in the United States. The current study included programs from across the United States which may have impacted the results.

Faculty with prior teaching experience may be more proficient in educating athletic training students. These faculty members have had time to refine their ability in presenting material and skills in a manner that impacts student retention of information. The current study indicated that within the hiring process, the program and university administration should focus on hiring faculty members with 12.98 years or greater of teaching experience. This becomes a difficult task as undergraduate programs transition to entry-level graduate programs. There may be few faculty members with that level of experience along with a doctoral degree which is often a requirement for most university faculty who teach in graduate-level programs.

The average years of faculty clinical experience was found to be the next greatest variable to predict compliance with the 70% three-year aggregate BOC examination program pass rate mandate for first-time test-takers. As the average years of faculty clinical experience increases by one, the likelihood of program compliance increases by 0.55 times. In this study, the average years of faculty clinical experience were 13.43 (SD = 6.42) years and ranged from 1.2 to 32 years. This finding supports previous research that program directors who also teach in the athletic training program should have at least 3-5 years of previous clinical experience (Leard et al., 1991; Leone et al., 2014; Sciera, 1981). In addition, the results of a study by Turner (2005) found that faculty with 0 to 19 years of previous clinical experience were significant in predicting NCLEX-RN pass rates for nursing students.

For faculty teaching in athletic training programs, prior athletic training clinical experience may help faculty translate real-world application of didactic and skills knowledge to students in the classroom. Faculty with clinical experience can often relay real-world problems and solutions to students as part of the learning and critical thinking process. In turn, if students can see a path for the application of didactic content through real-world scenarios, they understand and value concepts learned in class. Therefore, in addition to average years of faculty teaching experience, the average years of faculty clinical experience should also be considered when hiring faculty for athletic training programs. It appears that at least 13.43 years of clinical experience is beneficial for athletic training program faculty.

Last, the preceptor-to-student ratio in the clinical setting was found to be significant in determining compliance with the 70% three-year aggregate BOC examination program pass rate mandate for first-time BOC test takers. Athletic training programs ranged from a 0.2 to 2 preceptor-to-student ratio, with an average of 0.94 (*SD* = 0.57). This means that across the responding undergraduate programs, there were typically more students per preceptor. In the current study, as the preceptor-to-student ratio increased by one, the odds of program compliance increased by 0.01 times.

Findings from previous studies are split and there are few studies available on this subject. In a study by Ladyshewsky et al. (1998), students in a clinical model where there are multiple preceptors-to-multiple students tend to find an improvement in learning outcomes due to the ability of student peers to work together clinically as they learn. In addition, the multiple preceptor-to-multiple student ratio often creates an environment of team collaboration not only between students but also with the preceptors. In contrast, one other study found that a preceptor-to-student ratio of 2:1 has been found to improve student outcomes in clinical education evaluations (DeClute & Ladyshewsky, 1993). The authors felt that this particular model provided students with multiple learning experiences from a variety of preceptors. However, the current study may not have reproduced this finding because the DeClute and Ladyshewsky study was completed at a single university's physical therapy program.

In this study, the preceptor-to-student ratio was such that there are typically more students than preceptors, although not by much. When there are more students per preceptor, students can often be scheduled for clinical experience so that students get time individually with their assigned preceptor. The one-on-one time with preceptors may lend to improved learning capabilities of students while in the clinical setting. In addition, when multiple students are assigned to a clinical site, they may collaborate and learn together while working in a real-world setting with patients. Both of these components may play a part in student retention of knowledge in the clinical setting. When students are scheduled, they may have more time off from the clinical site than a clinical site with a 1:1 preceptor-to-student ratio. The scheduled time off may give students extended study time to learn concepts presented in class and this may carry over to BOC exam success. In athletic training programs, a ratio of a single preceptor-to-multiple students should be the focus for clinical education coordinators as they assign students to clinical sites.

Research Question 3

In RQ3, this study found no significance in the interaction of average years of faculty clinical and teaching experience or between the required number of minimum clinical hours per week and the preceptor-to-student ratio across undergraduate and graduate athletic training programs. There was also no significance in the interaction of the required minimum clinical hour per week and the average preceptor-to-student ratio. In undergraduate and graduate programs, there were no significant main effects found either variable.

The findings of this study are contrary to previous findings in literature. Turner (2005) found that previous faculty teaching experience as well as previous faculty clinical experience were significant in predicting NCLEX-RN pass rates for nursing students.

The Turner study only included students from one undergraduate nursing program while this study utilized data from programs across the United States. This could account for the difference in the findings of the current study with regards to previous faculty teaching and clinical experience.

The current study's findings were also different from previous research findings with regard to the preceptor-to-student ratio and the required minimum clinical hours per week. Preceptor-to-student ratios that allow for multiple students and multiple preceptors typically see improvement in learning outcomes (Ladyshewsky et al., 1998). DeClute and Ladyshewsky (1993) found that a preceptor-to-student ratio of 2:1 improved student outcomes. Again, this particular study was completed at a single university's physical therapy program as compared to the current study's use of programs from across the United States.

Prior studies in athletic training looked at the total number of required hours and how it impacted student BOC examination outcomes (Draper, 1989; Hickman, 2010; Turocy et al., 2000). However, these studies did not examine the number of minimum clinical hours per week. A more recent study by Cavallario and Van Lunen (2015) found that graduate programs had a higher number of minimum required clinical hours and higher BOC examination pass rates. However, the Cavallario and Van Lunen study did not look at levels of minimum required clinical hours and the impact on BOC pass rates.

Limitations of the Study

A major limitation of this study is that the study utilized the three-year aggregate pass rate data for programs, however, it focused on current program structure and faculty demographic characteristics. The previous two years of program and faculty data may have been impactful to program outcomes. However, there was no way to capture that data in this study and still maintain a short program director survey. The questionnaire would have been too lengthy and fewer program directors may have been willing to complete the survey.

The methods used to collect data were also a limitation. Contact information was accessed from the CAATE website in order to mail and email athletic training education program directors. Several surveys were returned due to incorrect program director information. In those instances, the program contact information was found on program websites and resent. The process of response turn-around may have been extended where mailing was involved. In other programs, the contact was no longer employed at the university and contact information was not found on the program website. Also, for undergraduate programs, several programs had terminated their program therefore, there was no way to capture that data for comparison.

The return rate of graduate programs was low. In many cases, program directors did not respond to email or phone follow-up to complete the survey. It may be that the program directors were busy. There are also numerous emails that program directors receive related to administrative duties which may have decreased response rates. Program directors, as faculty and athletic trainers, are often inundated with a request to complete multiple surveys annually. This combined with the administrative duties of their position, required teaching, research, and service responsibilities associated with their position, along with the day-to-day duties of their job may have reduced the response rate.

A limitation exists with the generalizability of results from RQ2 which sought to categorize programs as compliant or noncompliant with regards to CAATE Standard 11. This study used undergraduate data because of the lack of noncompliant graduate programs. Therefore, the results are not generalizable to graduate programs. This is an important limitation since athletic training programs are transitioning to an entry-level master's degree.

Another limitation of RQ2 was the coding process for the dependent variable. The focus of the research question was to determine compliance with the 70% mandated three-year aggregate BOC examination pass rate for programs. The results of this study found the ability to correctly indicate compliance in 69.7% of cases. However, noncompliance is also an important focus of this research question. Programs that are categorized as noncompliant may be able to use findings from this research to improve their program's three-year aggregate BOC examination pass rate. Unfortunately, this study correctly identified noncompliant programs in only 28.57% of the cases. In this study, compliant programs were coded as 1 and noncompliant as 0. It might be prudent to recode the dependent variable as compliant to 0 and noncompliant to 1 to see what factors identified programs as noncompliant.

Recommendations for Future Research

Overall, several things were found to be impactful to program BOC outcomes. In graduate programs, this research identified the number of required maximum clinical hours per week and the number of dual-appointed faculty associated with graduate programs was useful in predicting program BOC three-year aggregate pass rate outcomes. Although the factorial ANOVAs in this study did not include the number of required maximum clinical hours per week nor the number of dual-appointed faculty as variables, the ability to identify whether particular levels of these two variables may be an area for future research.

This study sought to answer research questions across both undergraduate and graduate athletic training education programs. This was easily done with the exception of RQ2. There were not enough noncompliant graduate programs to be able to assess graduate program data. With the transition of entry-level degrees to a master's degree, any results associated with undergraduate programs, as in RQ2, are difficult to generalize to graduate degrees. Therefore, a study that includes this research question with graduate programs as the focus would be an area of future research interest. In addition, as stated previously as a limitation, it also might be important to see if any variables contributed to noncompliance by recoding the dependent variable. This, combined with other research outcomes, would assist noncompliant programs in determining where changes could be instituted with regards to clinical education and faculty hiring.

Although this particular study did not focus on faculty demographic characteristics such as ethnicity and gender, it may be viable to study whether these program director demographic characteristics impact three-year aggregate BOC examination program pass rates. For this particular study, the focus was on faculty group-level variables. It would have been difficult to collect data on individual faculty ethnicity and gender. However, it is a viable option to focus on the program director demographic characteristics and its impact on program three-year aggregate BOC examination pass rates. It might also be a prudent to examine faculty, including program directors, demographic characteristics, like ethnicity and gender, and its impact on annual program pass rates.

Conclusions

This study examined undergraduate and graduate athletic training program clinical structure and faculty demographic characteristics and their impact on program BOC examination outcomes as defined by the three-year aggregate pass rate. The total population surveyed was 361 athletic training program directors, 289 undergraduate and 72 graduate. Of those, 136 undergraduate and 38 graduate program directors were study participants. The research used correlational and group comparison methods across undergraduate and graduate athletic training education program data. Findings in the research were similar to those in athletic training and other areas of medical education.

This study found that in graduate athletic training programs, the number of required maximum clinical hours and the number of dual appointed faculty were important in predicting program three-year aggregate BOC pass rate outcomes for first-time test takers. Among undergraduate athletic training education programs, the average number of terms a student is engaged in clinical experiences, as well as the number of full-time faculty were significant in predicting program classification as compliant with the CAATE-mandated 70% three-year aggregate program pass rate.

As noted in the research, faculty demographic characteristics and clinical education are essential pieces to athletic training program structure, and they have implications on program three-year aggregate BOC pass rate outcomes. The findings of this study can help program administration structure clinical education experiences and focus on the hiring and retention of faculty that can improve program outcomes. Since athletic training programs are and will continue to be held to a mandate of a 70% or better three-year aggregate first-time pass rate on the BOC examination, it is important for programs to focus on maintaining or improving program outcomes (CAATE, 2012; CAATE, 2020). As the number of graduate degree programs continues to grow, it will be imperative to continue the research in these programs to determine whether the findings from this research continue to hold true and whether findings from future graduate research are similar to the current study's findings across undergraduate athletic training programs.

REFERENCES

Adel, H. E., Lorch, A., DeAngelis, T., Vause-Earland, T., & Mollo, K. (2013). The standardized patient encounter: A dynamic educational approach to enhance students' clinical healthcare skills. *Journal of Allied Health, 42*, 229-235. Retrieved from MEDLINE database. (PMID No. 24326920)

American Occupational Therapy Association, Inc. [AOTA] (2014). *Academic programs annual data report: Academic year 2013-2014*. Retrieved from http://www.aota.org/-/media/corporate/files/educationcareers/accredit/2013-2014-annual-data-report.pdf

American Physical Therapy Association [APTA]. (2005). *Minimum required skills of physical therapist graduates at entry-level*. Retrieved from https://www.apta.org/uploadedFiles/APTAorg/About_Us/Policies/BOD/Education/MinReqSkillsPTGrad.pdf

American Physical Therapy Association [APTA]. (2015). *About the National Physical Therapy Examination*. Retrieved from http://www.apta.org/Licensure/NPTE/

Bach, E. & Wadsworth, J. (2001). *A history of the physical therapy examination*. FSBPT Forum, 16(1). Retrieved from https://www.fsbpt.org/Free-Resources/NPTE-Articles-Old/A-History-of-the-Physical-Therapy-Examination

Barkley, T. W., Rhodes, R. S., & Dufour, C. A. (1998). Predictors of success on the NCLEX-RN: Among baccalaureate nursing students. *Nursing and Health Care Perspectives, 19*(3), 132-137. Retrieved from OVID database. (Accession No. 00063518-199805000-00023)

Beeman, P. B., & Waterhouse, J. K. (2001). NCLEX-RN performance: Predicting success on the computerized examination. *Journal of Professional Nursing, 17,* 158-165. doi: 10.1053/jpnu.2001.24860

Blanzola, C., Lindeman, R., & King, M. L. (2004). Nurse internship pathway to clinical comfort, confidence, and competency. *Journal for Nurses in Staff Development, 20,* 27-37. Retrieved from OVID database. (Accession No. 106749945)

Board of Certification, Inc. [BOC] (2010). *How to use the role delineation study/practice analysis, 6th edition*. Omaha: NE. Retrieved from BOC website: http://www.bocatc.org/system/document_versions/versions/7/original/boc-how-to-use-rd-pa6-20170606.pdf?1496766881

Board of Certification, Inc. [BOC] (2013). *Crosswalk analysis*. Retrieved from http://www.bocatc.org/system/comfy/cms/files/files/000/000/325/original/Crosswalk_Analysis.pdf

Board of Certification, Inc. [BOC] (2014). *Timeline*. Retrieved from http://www.bocatc.org/timeline

Board of Certification, Inc. [BOC] (2015). *The BOC annual report*. Omaha: NE. Retrieved from http://bocatc.org/system/comfy/cms/files/files/000/000/358/original/2015_Annual_Report.pdf

Board of Certification, Inc. [BOC] (2016a). *BOC exam candidate handbook*. Retrieved from http://www.bocatc.org/system/comfy/cms/files/files/000/000/240/original/2015_Exam_Report.pdf

Board of Certification, Inc. [BOC] (2016b). *Exam references*. Retrieved from http://www.bocatc.org/system/comfy/cms/files/files/000/000/329/original/Exam_References_2016-2017.pdf

Board of Certification, Inc. [BOC] (2016c). *Examination report for 2015-2016 testing year*. Retrieved from http://www.bocatc.org/system/comfy/cms/files/files/000/000/240/original/2015_Exam_Report.pdf

Board of Certification, Inc. [BOC] (2017). *Board of Certification, Inc. (BOC) exam development style guide*. Retrieved from http://www.bocatc.org/system/comfy/cms/files/files/000/000/447/original/Exam_Development_Style_Guide.pdf

Board of Certification, Inc. [BOC] (2018). *Board of Certification, Inc. (BOC) 2017-2018 Testing Year Report*. Cary, NC: Castle Worldwide, Inc.

Brandon, A. F., & All, A. C. (2010). Constructivism theory analysis and application to curricula. *Nursing Education Perspectives, 31,* 89-92. Retrieved from CINAHL database. (Accession No. 105182440)

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How people learn: Brain, mind, experience, and school.* Washington, DC: National Academies Press.

Caldwell, L. M., Tenofsky, L. M., & Nugent, E. (2010). Academic and clinical immersion in an accelerated nursing program to foster learning in the adult student. *Nursing Education Perspectives, 31,* 294-297. Retrieved from www.nlnjournals.org

Carr, W. D., & Drummond, J. L. (2002). Collaboration between athletic training clinical and classroom instructors. *Journal of Athletic Training, 37,* S182-S188. Retrieved from http://natajournals.org

Cavallario, J. M., & Van Lunen, B. L. (2015). Preparation of the professional athletic trainer: A descriptive study of undergraduate and graduate degree programs. *Journal of Athletic Training, 50,* 760-766. doi: 10.4085/1062-6050-50.1.13

Commission on Accreditation of Athletic Training Education [CAATE]. (2012). *Standards for the accreditation of professional athletic training programs*. Retrieved from http://caate.net/wp-content/uploads/2015/12/2012-Professional-Standards.pdf

Commission on Accreditation of Athletic Training Education [CAATE]. (2014). *Historical overview*. Retrieved from http://caate.net/historical-overview

Commission on Accreditation of Athletic Training Education [CAATE]. (2016). *Commission on Accreditation of Athletic Training Education policies and procedures*. Austin, TX: Commission on Accreditation of Athletic Training Education. Retrieved from http://caate.net/wp-content/uploads/2016/05/Posted-Policy-Procedure-Manual.pdf

Commission on Accreditation of Athletic Training Education [CAATE]. (2017). *Program outcomes*. Retrieved from http://caate.net/program-outcomes

Commission on Accreditation of Athletic Training Education [CAATE]. (2020). *Pursuing and maintaining accreditation of professional programs in athletic training*. Retrieved from http:// https://caate.net/wpcontent/uploads/2020/11/

Pursuing-and-Maintaining-Accreditation-AND-Guide-to-2020-Standards-FInal_Oct-2020.pdf

DeClute, J., & Ladyshewsky, R. (1993). Enhancing clinical competence using a collaborative clinical education model. *Physical Therapy, 73,* 683-689. Retrieved from MEDLINE database. (PMID No. 8378424)

Delforge, G. D. (1982). The athletic training major: A report from the Professional Education Committee. *Athletic Training, 17*, 288-290. Retrieved from http://natajournals.org

Delforge, G. D., & Behnke, R.S. (1999). The history and evolution of athletic training education in the United States. *Journal of Athletic Training, 34,* 53-61. Retrieved from http://natajournals.org

Diefenbeck, C. A., Hayes, E. R., Wade, G. H., & Herrman, J. W. (2011). Student-centered outcomes evaluation of the clinical immersion program: Five years later. *Journal of Nursing Education, 50,* 628-635. doi: 10.3928/01484834-20110729-02

Draper, D. O. (1989). Students' learning styles compared with their performance on the NATA certification exam. *Athletic Training, 24,* 234-235, 275. Retrieved from http://natajournals.org

Ebel, R. G. (1999). *Far beyond the shoe box*. New York, NY: Forbes.

Ehrenberg, A. C., & Häggblom, M. (2007). Problem-based learning in clinical nursing education: Integrating theory and practice. *Nursing Education in Practice, 7,* 67-74. doi: 10.1016/j.nepr.2006.04.005

Engelhard, C., & McCallum, C. (2015). A description of current curricular design models used in physical therapy clinical education and their relationship to pass rates on the National Physical Therapy Examination. *Internet Journal of Allied Health Sciences and Practices, 13*(4), 1-9. Retrieved from http://nsuworks.nova.edu /ijahsp/

Erickson, M. A., & Martin, M. (2000). Contributors to initial success on the National Athletic Trainers' Association Board of Certification examination as perceived by candidate sponsors: A Delphi study. *Journal of Athletic Training, 35,* 134-138. Retrieved from CINAHL database. (Accession No. 107119154)

Federation of State Boards of Physical Therapy [FSBPT]. (2016a). *NPTE candidate handbook for the National Physical Therapy Examinations: PT and PTA*. Retrieved from http://www.fsbpt.org/Portals/0/documents/free-resources/CandidateHandbook 201606.pdf

Federation of State Boards of Physical Therapy [FSBPT]. (2016b). *NPTE exam year reports*. Retrieved from https://www.fsbpt.org/FreeResources/ NPTEPassRateReports/ NPTEExamYearReports.aspx

Field, A., Miles, J., & Field, Z. (2012). *Discovering statistics using R.* Thousand Oaks, CA: SAGE Publications Inc.

Freesemann, K. W. (2000). *An evaluation of select athletic training education programs administration and educational structure* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses database. (Order No. 3018000)

Gangé, R. M., & Medsker, K. L. (1996). *The conditions of learning: Training applications.* Fort Worth, TX: Harcourt Brace College.

Gatti-Petito, J., Lakatos, B. E., Bradley, H. B., Cook, L., Haight, I. E., & Karl, C. A. (2013). Clinical scholarship and adult learning theory: A role for the DNP in nursing education. *Nursing Education Perspectives, 34,* 273-276. Retrieved from CINAHL database. (Accession No. 104100880)

George, D. & Mallery, M. (2010). *SPSS for Windows step by step: A simple guide and reference*, 17.0 update (10th ed.) Boston, MA: Pearson.

Grace, P. (1999). Milestones in athletic trainer certification. *Journal of Athletic Training, 34,* 285-291. Retrieved from http://natajournals.org

Gresham, B. B., Thompson, M., Luedtke-Hoffmann, K., & Tietze, M. (2015). Institutional and program factors predict physical therapist program graduation rate and licensure examination pass rate. *Journal of Physical Therapy Education, 29*(4), 27-36. Retrieved from CINAHL Plus database. (Accession No. 110468630)

Harrelson, G. L., Gallaspy, J. B., Knight, H. V., & Leaver-Dunn, D. (1997). Predictors of success on the NATABOC certification examination. *Journal of Athletic Training, 32,* 323-327. Retrieved from http://natajournals.org

Healey, W. E. (2008). Physical therapist student approaches to learning during clinical education experiences: A qualitative study. *Journal of Physical Therapy Education, 22*(1), 49-58. Retrieved from CINAHL database. (Accession No. 105767064)

Henderson, A., & Scott, T. (2011). Facilitating learning in clinical practice: Evaluation of a trial of a supervisor of clinical education role. *Nurse Education in Practice, 11,* 288-292. doi: 10.1016/j.nepr.2011.01.003

Hickman, K. M. (2010). *Board of Certification examination success and clinical education* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses Global database. (Order No. DP19847)

Iwasiw, C. L., & Goldenberg, D. (1993). Peer teaching among nursing students in the clinical area: Effects on student learning. *Journal of Advanced Nursing, 18,* 659-688. doi: 10.1046/j.1365-2648.1993.18040659.x

Kaakinen, J., & Arwood, E. (2009). Systematic review of nursing simulation literature for use of learning theory. *International Journal of Nursing Education Scholarship, 6*(1), 1-20. Retrieved from CINAHL database. (Accession No. 2009-09388-017)

Kuhn, M., & Johnson, K. (2013). *Applied predictive modeling*. New York, NY: Springer Publishing.

Kuss, C. A. (2014). *The relationship between educational preparation of nursing faculty and associate degree program pass rates on the National Council Licensure Examination for Registered Nurses*. (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses database. (Order No. 3639147)

Ladyshewsky, R. K., Barrie, S. C., & Drake, V. M. (1998). A comparison of productivity and learning outcome in individual and cooperative physical therapy clinical education models. *Physical Therapy, 78,* 1288-1298. Retrieved from MEDLINE database. (PMID No. 9859948)

Laurent, T., & Weidner, T. G. (2002). Clinical-education—setting standards are helpful in the professional preparation of employed, entry-level certified athletic trainers. *Journal of Athletic Training, 37,* S-248-254. Retrieved from http://natajournals.org

Leard, J. S., Booth, C., & Johnson, J. C. (1991). A study of career pathways of NATA curriculum program directors. *Athletic Training, 26,* 211-214. Retrieved from http://natajournals.org

Lekkas, P., Larsen, T., Kumar, S., Grimmer, K., Nyland, L., Chipchase, G. J., Buttrum, P., Carr, L., & Finch J. (2007). No model of clinical education for physiotherapy students is superior to another: A systematic review. *Australian Journal of Physiothearpy, 52,* 19-28. doi: 10.1016/S0004-9514(07)70058-2

Leone, J. L., Judd, M. R., & Colandreo, R. M. (2008). Descriptive qualities of athletic training education program directors. *Athletic Training Education Journal, 2,* 43-49. Retrieved from http://natajournals.org

Levy, L. S., Sexton, P., Willeford, K. S., Barnum, M. G., Guyer, M. S., Gardner, G., & Fincher, A. L. (2009). Clinical instructor characteristics, behaviors and skills in allied health care setting: A literature review. *Athletic Training Education Journal, 4*(1), 8-13. Retrieved from http://natajournals.org

Lindquist, M., Arrington, S., & Scheopner, K. (2007). *The BOC Exam: The first 40 years.* Omaha, NE: Jacob North Printing.

Longabach, T. (2012). *Number of clinical hours in the nursing programs and National Council Licensure Examination for Registered Nurses (NCLEX-RN) passing rate*. (Doctoral dissertation). Retrieved from https://kuscholarworks.ku.edu/handle/1808/10708

Maring, J., & Costello, E. (2009). Education program and student characteristics associated with pass rates on the National Physical Therapy Examination for physical therapy assistants. *Journal of Physical Therapy Education, 23*(1), 3-11. Retrieved from CINAHL Plus database. (Accession No. 105366525)

Maring, J., Costello, E., Ulfers, M., & Zuber, E. (2013). Curriculum, faculty, and cohort variables predicting physical therapy assistant program graduate success on the National Physical Therapy Examination. *Journal of Physical Therapy Education, 27*(2), 33-40. Retrieved from CINAHL Plus database. (Accession No. 104281000)

Mathies, A. L., Denegar, C. R., & Arnhold, R. W. (1995). Changes in athletic training education as a result of changing from NATA-PED to CAAHEP. *Journal of Athletic Training, 30,* 129-132. Retrieved from http://natajournals.org

McLean, J. L., Jr. (1969). Does the National Athletic Trainers' Association need a certification examination? *Journal of the National Athletic Trainers' Association, 4*(1), 10-12. Retrieved from http://natajournals.org

Merriam, S. B., & Bierema, L. L. (2014). *Adult learning: Linking theory And practice*. San Francisco, CA: John Wiley & Sons, Inc.

Mertler, C. A., & Vannatta, R. A. (2013). *Advanced multivariate statistical methods*. Glendale, CA: Pyrczak Publishing.

Middlemas, D. A., Manning, J. M., Gazzillo, L. M., & Young, J. (2001). Predicting performance on the National Athletic Trainers' Association Board of Certification examination from grade point average and number of clinical hours. *Journal of Athletic Training, 36,* 136-140. Retrieved from http://natajournals.org

Miller, S. (1970). Approval of athletic training curriculums at colleges and universities. *Journal of the National Athletic Trainers' Association, 5*(2), 10-11. Retrieved from http://natajournals.org

Mohr, T., Ingram, D., Hayes, S., & Du, Z. (2005). Educational program characteristics and pass rates on the National Physical Therapy Examination. *Journal of Physical Therapy Education, 19*(1), 60-66. Retrieved from CINAHL Plus database. (Accession No. 106492957)

National Athletic Trainers' Association [NATA]. (2004). *Appropriate medical care for the secondary school-age athlete communication*. Retrieved from https://www.nata.org/sites/default/files/appropriatemedcare4secondaryschoolageathlete.pdf

National Athletic Trainers' Association [NATA]. (2010). *Athletic training services: An overview of skills and services performed by Certified Athletic Trainers*. Dallas, TX: Department of State Legislative and Regulatory Affairs. Retrieved from https://www.nata.org/sites/default/files/guide_to_athletic_training_services.pdf

National Athletic Trainers' Association [NATA]. (2011). *Athletic training education competencies: 5th edition*. Retrieved from NATA website: https://caate.net/wp-content/uploads/2014/06/5th-Edition-Competencies.pdf

National Council of State Boards of Nursing [NCBSN]. (2014). *2014 NCLEX pass rates*. Retrieved from https://www.ncsbn.org/3826.htm

National Athletic Trainers' Association [NATA]. (2015). *Strategic Alliance degree statement*. Retrieved from http://www.atstrategicalliance.org/strategic-alliance-degree-statement

National Council of State Boards of Nursing [NCBSN] (Producer). (2016). *2016 NCLEX-RN detailed testing plan*. Retrieved from https://www.ncsbn.org/ 2016_RN_Test_Plan_Candidate.pdf

National Council of State Boards of Nursing [NCBSN] (Producer). (2017). *NCSBN historical timeline* [Online video]. Retrieved from https://www.ncsbn.org/70.htm

National League of Nursing [NLN]. (2012). *Outcomes and competencies for graduates of Practical/Vocational, Diploma, Baccalaureate, Master's, Practice Doctorate, And Research Doctorate programs of nursing*. New York: NY, National League of Nursing.

Nemshick, M. T., & Shepard, K. F. (1996). Physical therapy clinical education in a 2:1 student-to-instructor education model. *Physical Therapy, 76,* 968-981. Retrieved from https://academic.oup.com/ptj

Novak, M. K. (2009) *The relationship between physical therapist assistant faculty characteristics and program outcomes on the National Physical Therapy Examination* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses Global database. (Order No. 3397165)

Novak, M. K., Brown-Cross, D., & Echternach, J. (2011). The National Physical Therapy Examination's first time pass rates and their relationships to education program faculty attributes. *The Internet Journal of Allied Health Sciences and Practice, 9*(4), 1-13. Retrieved from http://augusta.openrepository.com/augusta/ bitstream/10675.2/439/3/novak_national+physical+therapist+assistant+examinati ons.pdf

O'Connor, A., Cahill, M., & McKay, E. A. (2012). Revisiting 1:1 and 2:1 clinical placement models: Student and clinical educator perspectives. *Australian Occupational Therapy Journal, 59,* 276-283. doi: 10.1111/j.1440-1630.2012.01025.x

O'Shea, M. E. (1980). *A history of The National Athletic Trainers' Association*. Greenville, NC: The National Athletic Trainers' Association.

Oztuna, D., Elhan, A., & Tuccar, E. (2006). Investigation of four different normality tests in terms of type 1 error rate and power under different distributions. *Turkish Journal of Medical Sciences, 36,* 171-176. Retrieved from https://journals.tubitak.gov.tr/medical/issues/sag-06-36-3/sag-36-3-7-0510-10.pdf

Parker, B. C., & Myrick, F. (2009). A critical examination of high-fidelity human patient simulation within the context of nursing pedagogy. *Nurse Education Today, 29,* 322-329. doi: 10.1016/j.nedt.2008.10.012

Perkins, S. A., & Judd, M. R. (2001). Dilemmas of program directors: Then and now. *Journal of Athletic Training, 36,* 396-400. Retrieved from ProQuest database.

Perrin, D. H., & Lephart, S. M. (1988). Role of the NATA Curriculum Director as clinician and educator. *Athletic Training, 23,* 41-43, 63. Retrieved from http://natajournals.org

Potter, P. A., & Perry, A. G. (2009). *Fundamentals of nursing*. St. Louis, MO: Mosby Elsevier.

Pryor, R. R., Casa, D. J., Vandermark, L. W, Stearns, R. L., Attanasio, S. M., Fontaine, G. J., & Wafer, A. M. (2015). Athletic training services in public secondary schools: A benchmark study. *Journal of Athletic Training, 50*, 156-162. Retrieved from http://natajournals.org

Rothgeb, M. K. (2008). Creating a nursing simulation laboratory: A literature review. *Journal of Nursing Education, 47,* 489-494. Retrieved from CINAHL database. (Accession No. 105566339)

Sciera, J. L. (1981). The role of the NATA program director. *Athletic Training, 16,* 125-126. Retrieved from http://natajournals.org

Searcy, J. S. (2006). *Analysis of clinical experiences in athletic training education programs and performance on the BOC certification examination*. (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses Global database. (Order No. 3245501)

Secomb, J. (2006). A systematic review of peer teaching and learning in clinical education. *Journal of Clinical Nursing, 17,* 703-716. doi: 10.1111/j.1365-2702.2007.01954.x

Seegmiller, J. G. (2003). A model for clinical education in athletic training. *The Internet Journal of Allied Health Sciences and Practice, 1,* 1-3. Retrieved from http://nsuworks.nova.edu/ijahsp/

Starkey, C., & Henderson, J. (1995). Performance on the athletic training certification examination based on candidates' routes to eligibility. *Journal of Athletic Training, 30,* 59-62. Retrieved from MEDLINE database. (PMID No. 16558313)

Starkey, C., & Ingersoll, C. D. (2001). Scholarly productivity of athletic training faculty members. *Journal of Athletic Training, 36,* 156-159. Retrieved from http://natajournals.org

Staurowsky, E., & Scriber, K. (1998). An analysis of selected factors that affect the work lives of athletic trainers employed in accredited educational programs. *Journal of Athletic Training, 33,* 244-248. Retrieved from http://natajournals.org

Stevens, B. B. (1996). *A study of the relationship between faculty qualifications and program attributes and student outcomes in schools of nursing in West Virginia from 1985 to 1994*. (Doctoral Dissertation). Retrieved from ProQuest Dissertations and Theses database. (Order No. 9716382)

Turner, L. F. (2005). *Faculty and program predictors of pass rates of graduates of nursing programs in West Virginia on the National Council Licensure Examination for Registered Nurses 1991 to 2000*. (Doctoral Dissertation). Retrieved from ProQuest Dissertations and Theses database. (Order No. 3176448)

Turocy, P. S., Comfort, R. E., Perrin, D. H., & Gieck, J. H. (2000). Clinical experiences are not predictive outcomes on the NATABOC examination. *Journal of Athletic Training, 35,* 70-75. Retrieved from http://natajournals.org

U.S. Bureau of Labor Statistics, U.S. Department of Labor. (2020). *Occupational outlook handbook*. Retrieved from https://www.bls.gov/ooh/healthcare/athletic-trainers.htm

U.S. Department of Education, National Center for Education Statistics. (2013). *Dual enrollment programs and courses for high school students at postsecondary institutions: 2010-11* (NCES 2013-002). Retrieved from http://nces.ed.gov/pubs2013/2013002.pdf

Wallace, J. (2016). Nursing student work-study internship program: An academic partnership. *Journal of Nursing Education, 55,* 357-359. doi: 10.3928/01484834-20160516-11

Washburn, J. (2006). *The influence of participation in student nurse extern programs on NCLEX-RN pass rates for first-time candidates*. (Master's thesis). Retrieved from http://commons.emich.edu/theses/98/

Weidner, T.G. (2009). *The Athletic Trainer's pocket guide to clinical teaching*. Thorofare, NJ: SLACK Incorporated.

Williams, R. B., & Hadfield, O. D. (2003). Attributes of curriculum athletic training programs related to the passing rate of first-time certification examinees. *Journal of Allied Health, 32,* 240-245. Retrieved from CINAHL database. (Accession No. 106733638)

APPENDIX A

Institutional Review Board Approval Form

Institutional Review Board (IRB)
For the Protection of Human Research Participants
PROTOCOL EXEMPTION REPORT

PROTOCOL NUMBER:	**03570-2017**	**INVESTIGATOR:**	**Ms. Stacey Walters**
		SUPERVISING FACULTY:	**Dr. Lantry Brockmeier**
PROJECT TITLE:	***A Quantitative Analysis of Board of Certification Outcomes for Athletic Training Programs.***		

INSTITUTIONAL REVIEW BOARD DETERMINATION:

This research protocol is **Exempt** from Institutional Review Board (IRB) oversight under Exemption **Category 2**. You may begin your study immediately. If the nature of the research project changes such that exemption criteria may no longer apply, please consult with the IRB Administrator (irb@valdosta.edu) before continuing your research.

ADDITIONAL COMMENTS:

- Compiled data (email correspondence, listserve addresses, data lists, mailing addresses, etc.) must be securely maintained for a minimum of three years.

☒ ***If this box is checked, please submit any documents you revise to the IRB Administrator at irb@valdosta.edu to ensure an updated record of your exemption.***

APPENDIX B

Expert Panel Review Cover Letter and Survey

Athletic Training Program and Faculty Characteristics Survey

Dear Expert Panel Reviewer:

I need your help! Your knowledge and expertise will provide verification of items on the *Athletic Training Program and Faculty Characteristics Survey* or allow the improvement of the instrument by rewording items, removing items, or including additional items. Your help is essential and I appreciate the time that you are taking to examine the instrument for me.

The purpose of the *Athletic Training Program and Faculty Characteristics Survey* is to determine whether variables associated with program characteristics, including clinical education, and faculty demographic characteristics have an impact on Board of Certification (BOC) program outcomes. The *Athletic Training Program and Faculty Characteristics Survey* is currently a 17-item instrument with completion and selection items. The researcher is currently seeking data from the Commission on Accreditation of Athletic Training Education which could reduce the survey to an eight-item instrument. Questions would remain the same, however any questions related to CAATE-provided data would be excluded from the instrument to reduce the workload for athletic training program directors completing the survey.

Thank you in advance for your assistance!

Sincerely,

Stacey D. Walters, MAT, LAT, ATC, RN

Expert Panel Review

Athletic Training Program and Faculty Characteristics Survey

Directions: Please bubble in the circle that best represents your response. If you answer "No" to items 1 - 6, please supply an explanation in the space provided. However, if you answer "Yes" to item 7, please provide an explanation.

1. Do the items match the stated purpose of the instrument?

OYes

ONo

If your answer to number 1 is "No", please indicate which item or items do not match the purpose of the instrument.

2. Are the directions clear?

OYes

ONo

If your answer to number 2 is "No", please indicate how you would make the directions clear.

3. Do the directions match the task that the participants are being asked to complete?

OYes

ONo

If your answer to number 3 is “No”, please indicate how you would improve the directions.

4. Is each item understandable?

OYes

ONo

If your answer to number 4 is “No”, please indicate the item or items that are not understandable. How would you make this item or these items more understandable?

5. Is each item unambiguous (i.e., asking one question only)?

OYes

ONo

If your answer to number 5 is “No”, please indicate the item or items that are ambiguous. How would you modify this item or these items?

6. Is each item grammatically correct?

OYes

ONo

If your answer to number 6 is "No", please indicate the item or items that are not grammatically correct. How would you modify this item or these items?

7. Is there any subsection that requires an additional item or items to improve the instrument?

OYes

ONo

If your answer to number 7 is "Yes", please indicate the subsection that requires an additional item or items along with the possible item or items.

Thank you for your time and effort!

APPENDIX C

Letter to Undergraduate and Graduate Program Directors

August 25, 2018

Dear Undergraduate Athletic Training Program Director:

I need your help. Please assist me with my doctoral dissertation examining program and faculty variables and their impact on Board of Certification (BOC) program outcomes. Your response is important. Information received from athletic training program directors will help determine the impact of clinical education and faculty demographic characteristics on program BOC pass rates.

Please complete the enclosed survey and return in the enclosed, stamped envelope by October 26, 2018. However, if you prefer to complete the survey electronically, you may go to https://bit.ly/2vVhmoL. The survey should take no more than 20 minutes to complete. In order to lessen the burden on program directors, some information will be collected from CAATE and program websites. **Program directors are being asked to provide the institution name which will be used to match the data obtained from the websites and the program director survey for data analysis.** Your responses will be kept confidential and only group level data will be reported. The research complies with the Valdosta State University International Review Board's guidelines for studies including human participants.

Thank you in advance for your time and contribution to expanding the knowledge of athletic training program and faculty demographic characteristics and program BOC program outcomes. If you have any questions, please feel free to contact me at 229-293-6071 or email me at swalters@valdosta.edu.

Sincerely,
Stacey D. Walters, MAT, LAT, ATC, RN
Valdosta State University
Educational Leadership
Doctoral Student

August 25, 2018

Dear Graduate Athletic Training Program Director:

I need your help. Please assist me with my doctoral dissertation examining program and faculty variables and their impact on Board of Certification (BOC) program outcomes. Your response is important. Information received from athletic training program directors will help determine the impact of clinical education and faculty demographic characteristics on program BOC pass rates.

Please complete the enclosed survey and return in the enclosed, stamped envelope by October 26, 2018. However, if you prefer to complete the survey electronically, you may go to https://bit.ly/2Mi2x9L. The survey should take no more than 20 minutes to complete. In order to lessen the burden on program directors, some information will be collected from CAATE and program websites. **Program directors are being asked to provide the institution name which will be used to match the data obtained from the websites and the program director survey for data analysis.** Your responses will be kept confidential and only group level data will be reported. The research complies with the Valdosta State University International Review Board's guidelines for studies including human participants.

Thank you in advance for your time and contribution to expanding the knowledge of athletic training program and faculty demographic characteristics and program BOC program outcomes. If you have any questions, please feel free to contact me at 229-293-6071 or email me at swalters@valdosta.edu.

Sincerely,
Stacey D. Walters, MAT, LAT, ATC, RN
Valdosta State University
Educational Leadership
Doctoral Student

APPENDIX D

Undergraduate and Graduate Program Director Survey

Clinical Education, Faculty Characteristics, and BOC Pass Status Survey

Purpose: This research study explores clinical education and faculty characteristics which may impact athletic training program BOC examination pass rates.

Consent: Your submission of this survey indicates your consent for participation. All responses will be kept confidential and only group-level results will be reported.

Directions: Please answer each question regarding BOC first-time pass rates for the 2014-2017 testing years (the testing period is April to February). For questions where an answer selection appears [ex. (1)], blacken the number between the parentheses below the selection.

Program Clinical Education			
1.	What is the program's **minimum** number of required clinical education hours **per week**?	___________	
2.	What is the program's **maximum** number of required clinical hours **per week**?	___________	
3.	How many **academic terms** are students assigned to a **clinical experience**?	___________	
4.	What is the **average preceptor to student ratio** of your program?	___________	
5.	Does your athletic training program **require a clinical capstone experience** where senior-level students are immersed in an external or internal clinical setting?	Yes (1)	No (2)

Program Faculty Characteristics		
6.	How many teaching faculty have a **doctorate degree**?	___________
7.	What is the average years of **clinical experience** across all faculty teaching in the athletic training program?	___________
8.	What is the average years of **teaching experience** across all faculty teaching in the athletic training program?	___________

9.	How many athletic training faculty members are **full-time** (100% academic)?	___________	
10.	How many athletic training faculty members are **dual-appointed** (share time between academics and clinical duties)?	___________	
11.	How many athletic training faculty are **part-time** or adjunct faculty?	___________	

Program Characteristics			
12.	How many **years** has your program been **accredited** as an undergraduate and/or graduate program?	___________	
13.	How many students does your program accept each **year**?	___________	
14.	Is there a **BOC prep course** in the athletic training curriculum?	Yes (1)	No (2)
15.	Does your program currently include a **capstone academic course** (where students must carry on research, give a presentation, etc.)	Yes (1)	No (2)
16.	What is the **annual budgetary amount** allotted for the athletic training academic program?	___________	

Institutional Demographics		
17.	Institution name	______________________