RESEARCH ARTICLE

Standardized Tests as Predictors of NCLEX-RN Success

James Montegrico, PhD, RN, CMSRN[1, *]

Abstract

Purpose: This study examined the predictive ability of Assessment Technologies Institute (ATI) standardized tests on Fundamentals of Nursing (FON), Pharmacology (PHARM), Medical-Surgical Nursing (MSN), and RN Comprehensive Predictor (RNCP) on the National Council Licensure Examination-Registered Nurses (NCLEX-RN) performance of nursing graduates.

Background: Various assessment tools in nursing education are used to predict the success of students in nursing licensure examinations. There are inconsistent findings on the predictive ability of course-specific standardized tests on NCLEX-RN success.

Methods: A retrospective correlation research design was used to determine the association between ATI standardized tests and NCLEX-RN success. Secondary data analysis of 141 ATI student scores from 2017 to 2018 from a Southeastern university in the United States were analyzed using descriptive and inferential statistics, set at 0.05 level of significance. Three models of logistic regression were used to determine the predictive ability of ATI standardized exams on NCLEX-RN success.

Results: ATI MSN standardized test is the strongest predictor of NCLEX-RN success, followed by ATI FON and ATI RNCP tests. ATI PHARM standardized test is not predictive of NCLEX-RN success.

Conclusion: Standardized tests can help in identifying students who are at-risk for failing the NCLEX-RN prior to taking the examination. Understanding the impact of standardized testing on NCLEX-RN performance is essential in addressing the students' ability to become successful in the nursing program and NCLEX-RN.

Keywords: *standardized test, nursing education, ATI, nursing students*

Introduction

The rapidly changing health care environment brought about by advances in science and technology and the changing acuity of the patient population posed significant challenges to the health care environment, nursing practice, and nursing education (Duncan & Schulz, 2015; Jeffreys, 2015; Relf, 2016). These changes in the health care system that are addressed in the curriculum contributed to content saturation in nursing education (Giddens & Brady, 2007), which affect the teaching-learning process and its individual and institutional outcomes. Content saturation in nursing education led to a lack of meaningful learning and reduced ability to develop critical thinking and clinical judgment that is expressed in lower classroom test scores, standardized test scores, or the NCLEX-RN. The lack of critical information processing can lead to negative patient outcomes due to the new nurses' inability to prioritize and to provide safe and effective patient care (Getha-Eby et al., 2015).

Entry to professional nursing practice requires successful completion of an accredited nursing program and passing the NCLEX-RN examination. Academic success in nursing programs is typically measured by academic performance, retention, attrition, graduation, standardized tests, and NCLEX-RN pass rates (Evans, 2013; Jeffreys, 2015; Scott & Zerwic, 2015). Simon et al. (2013) claimed that there is an estimated 3,000 nursing graduates who fail the NCLEX-RN annually. However, in 2017 and 2018, the actual number of baccalaureate-prepared nurses who failed the NCLEX-RN was 7,564 and 6,679, respectively (NCBSN, 2019). The American Association of Colleges of Nursing (AACN) and the National League for Nursing

[1] University of North Carolina at Charlotte, USA
[*] Corresponding author email: jmontegr@uncc.edu

(NLN) both recognize the need to strengthen learning environments that address the needs of students in order to be successful in the program (AACN, 2015; NLN, 2016).

The NCLEX-RN exam remains the most commonly measured outcome of academic performance and the effectiveness of nursing programs (Duncan & Schulz, 2015). In spite of the rigorous education in nursing schools nationwide, the graduation rate in the BSN program is 83%. About 15% of national and 9% of North Carolina BSN graduates fail the NCLEX-RN exam the first time (NCBON, 2018; NCSBN, 2018).

Various academic factors are known to contribute to NCLEX-RN success or failure. Some studies show that academic performance, which is reflected as the grade point average (GPA), is highly predictive of passing the NCLEX-RN exam (Abele et al., 2013; Amankwaa et al., 2015; Kaddoura et al., 2017). However, some studies provide conflicting results on the ability of GPA to predict NCLEX-RN success (Korvick et al., 2008; McCarthy et al., 2014; Newton & Moore, 2009; Ukpabi, 2008). These inconsistent and inconclusive findings provided an impetus for this study to identify other academic factors that are predictive of success in the NCLEX-RN exam.

Conceptual Framework

Jeffrey's Nursing Universal Retention and Success (NURS) model describes the various individual and academic factors that affect students' success, which is measured through course grades and GPA, that eventually affect retention, attrition, and graduation rates (Jeffreys, 2015). The NURS model is appropriate to use in this study because it provides a conceptual basis for examining multidimensional factors that affect undergraduate student success. The model defines outcomes and success in various ways, one of which is the first-time pass rate on the NCLEX-RN. These outcomes are based on the interaction of the major constructs of the model, namely, student profile characteristics, student affective factors, academic factors, environmental factors, academic outcomes, psychological outcomes, surrounding factors, and professional integration factors (Jeffreys, 2015). This model assists in providing a conceptual framework to identify how standardized tests affect the outcome in the NCLEX-RN. Using this model, standardized tests such as ATI test scores on Fundamentals of Nursing (FON), Pharmacology (PHARM), Medical-Surgical Nursing (MSN), RN Comprehensive Predictor (RNCP) were investigated to determine their predictive ability on NCLEX-RN performance.

Literature Review

Several strategies are used in various nursing programs to measure academic success. Traditionally, classroom test scores, course grades, GPA, and NCLEX pass rates have been used to assess student learning and program outcomes. Currently, it is common among nursing programs to implement standardized online assessment in every nursing course at the end of the semester that becomes 2% to 10% of the course grade. Three of the most commonly used standardized tests in nursing programs are those developed by Assessment Technologies Institute (ATI), Health Education Systems, Incorporated (HESI), and the National League for Nursing (NLN) (Brodersen & Mills, 2014; Simon et al., 2013). ATI course-specific mastery tests are used as a summative assessment for nursing courses and as a formative assessment for the NCLEX-RN examination.

Majority of student failures and withdrawals in nursing programs take place during the third year of the baccalaureate program (Salamonson et al., 2014) where several difficult core clinical nursing courses are taken simultaneously. Some nursing courses are predictive of NCLEX-RN passing (McCarthy et al., 2014; Xiao et al., 2014). Fundamentals of Nursing (FON), Pharmacology (PHARM), and Medical-Surgical Nursing (MSN) are the most challenging courses in the nursing program. MSN is one of the commonly failed courses among nursing students (Abele et al., 2013; Herrera & Blair, 2015) that has a strong association with NCLEX-RN passing (Banks et al., 2018; McCarthy et al., 2014; Schooley & Khun, 2014; Sears et al., 2015; Xiao et al., 2014). Emory (2013) claims that PHARM is predictive of NCLEX-RN passing while Xiao et al. (2014) posit that FON is significantly related to passing the licensure exam. These three courses are critical in the nursing program since they comprise approximately more than 60% of the 2019 NCLEX-RN Test Plan. These courses cover a significant percentage on several NCLEX-RN client needs categories including Basic Care and Comfort (6-12%), Safety & Infection Control (9-15%), Pharmacological and Parenteral Therapies (12-18%), Risk Reduction Potential (9-15%), and Physiological Adaptation (11-17%) (NCSBN, 2019). Standardized tests are incorporated as part of the assessment of academic performance in these courses. Competency in standardized tests reflects mastery of the subject matter on nursing courses. Thus, understanding the impact of ATI standardized tests on NCLEX-RN success will help address the inconsistent body of knowledge in explaining factors affecting students' success in the NCLEX-RN.

NCLEX-RN outcome is a multifactorial phenomenon (Brodersen & Mills, 2014). The student's learning system and the nursing educational system are two interdependent systems that had persistently affected student success and NCLEX-RN performance (Carrick, 2011) that are affected by individual, academic, social, and environmental factors (Carthon et al., 2015; Dewitty et al., 2016; Evans, 2013; Gates, 2018, Healey,

2013; Jeffreys, 2015; LaVeist & Isaac, 2013; Metcalfe & Neubrander, 2016; Mooring, 2016; Relf, 2016; Scott & Zerwic, 2015; Zeran, 2016).

The NCLEX-RN

The NCLEX-RN first-time passing rate (FTPR) is a common indicator of the quality of nursing programs (Giddens, 2009; Taylor et al., 2014). The exam evaluates the knowledge and skills of nursing graduates for being new nurses (Chen & Bennett, 2016). It requires critical thinking and problem solving to answer questions related to patient care with increasing complexity (Quinn et al., 2018). As patient acuity and patient care had become more complex, beginning nurses need to have the needed competencies, critical thinking, and clinical judgment to provide quality nursing care and to ensure public safety (Yeom, 2013).

The increased acuity and complexity of patient care are reflected in the practice analysis conducted by the NCLEX Examination Committee, which reviews the exam every 3 years and adjusts the minimum score of passing as needed (Yeom, 2013). As a result, NCLEX-RN is more difficult to pass when the level of difficulty changed (Quinn et al., 2018). For instance, when the exam's level of difficulty increased in 2013, there was a decrease in the NCLEX-RN results from 90.3% FTPR in 2012 to 84.6% FTPR in 2016 (NCSBN, 2019).

Standardized Assessments

One strategy to improve NCLEX-RN pass rate is the implementation of high-stakes testing such as standardized assessments in the nursing program (Hunsicker & Chitwood, 2018; Lauer & Yoho, 2013; Quinn et al., 2018; Randolph, 2016; Shoemaker et al., 2017). These standardized assessments evaluate students' knowledge and skills in nursing school and identify areas of strengths and weaknesses (McCarthy et al., 2014). In one U.S. state, 97% of all nursing programs used standardized tests and 50% of the programs used the tests in every nursing course (Randolph, 2017). The use of standardized tests early and more frequently in the nursing program are recommended to provide early identification of students who are at risk of NCLEX-RN failing (Brussow & Dunham, 2018) since these results reflect the student's overall academic performance as they progress in the nursing program and are associated with NCLEX-RN performance (Kaddoura, 2017).

High-stakes testing involves the use of tests, such as standardized tests, which are used to make decisions about student progression or completion of a nursing program (Hunsicker & Chitwood, 2018) and serves other purposes such as assessment of student's preparedness for licensure and guidance for curriculum review and revision. The results of these tests can produce positive and negative effects among the students (Hunsicker & Chitwood, 2018). Positive effects include increased motivation, confidence, and knowledge about the subject matter while negative effects are student and faculty stress, bias against minority students and poor test-takers, focus on test scores, attrition, financial loss, and potential litigation (Hunsicker & Chitwood, 2018).

The North Carolina Board of Nursing prohibits the use of high-stakes testing as a sole determinant for progression and when used, this should not be more than 10% of the final grade. In 2012, the NLN Fair Testing Guidelines for Nursing Education was published to assist nursing programs to develop and implement high-stakes testing guidelines in the curriculum (Hunsicker & Chitwood, 2018). Randolph's study (2016) on the effect of standardized testing practices on NCLEX-RN pass rates does not support the use of standardized testing as a high-stakes test and advocates that nursing faculty should consider the implications of developing test policies and their impact on attrition, graduation, NCLEX-RN pass rates, student's well-being, and patient safety.

Exit exams. Exit exams are commonly administered during the last semester of a nursing program to assess the student's readiness for the NCLEX-RN. End-of-program predictive testing is a strategy that is associated with a high NCLEX-RN first-time pass rate (Brodersen & Mills, 2014; Brussow & Dunham, 2018; Kaddoura, 2017). For instance, the HESI exam has 96.4% to 99.2% accuracy in predicting NCLEX-RN success (Nibert & Morrison, 2013). This exam identifies students' strengths and weaknesses in order to assist them plan remediation efforts prior to licensure. It is usually administered as a computerized exam that approximates the NCLEX-RN testing procedure and environment (Brodersen & Mills, 2014). ATI course-specific tests that are administered with remediation produced higher NCLEX-RN FTPR than exit exams that are given without remediation (Shoemaker et al., 2017).

ATI RN Comprehensive Predictor. The ATI RNCP, one of the most commonly used exit exams, is associated with a higher NCLEX-RN pass rate than HESI (Shoemaker et al., 2017). It has demonstrated accuracy in predicting success in the NCLEX-RN (Brodersen & Mills, 2014; Chen & Bennett, 2016; McCarthy et al., 2014). The validity of RNCP as a predictor exam was supported by a factorial analysis that demonstrated strong construct validity with the NCLEX-RN test plan as an indicator of general entry-level nursing ability (Liu & Mills, 2017). The RNCP is a 180-item test, with scores ranging from 0-100 that corresponds to a predicted probability of passing NCLEX-RN (ATI, 2019). In one study, the percentage score of RNCP accurately identified students at risk for passing or failing the NCLEX-RN. A score of 65.3% has a 75.3% chance of passing and a 24.7% chance of

failing. A score of 65.3%-70.7% has a 91.2% chance of passing and an 8.8% chance of failing. A score of >70.7% has a 98.9% chance of passing and a 1.1% chance of failing (Chen & Bennett, 2016). Standardized tests are not valid measures to predict failure in the NCLEX-RN so they should not be used as a sole criterion for readiness to graduation (Hunsicker & Chitwood, 2018). However, Vandenhouten (2008) argued that ATI RNCP predicted 7.7% to 30% of NCLEX-RN failures. Additionally, differences in student scores were noted among those who passed and failed the NCLEX-RN. Students who failed in the NCLEX-RN exam had significantly lower scores on standardized exit exams (Brussow & Dunham, 2018; Brodersen & Mills (2014) and Homard (2013) as cited in Quinn et al., 2018; Vandenhouten, 2008).

ATI course-specific tests. Several standardized assessments showed varying associations with NCLEX-RN outcomes. Some studies claimed that FON has a significant association ($r = .225$; $p<.001$) with NCLEX-RN success (McCarthy et al., 2014; Vandenhouten, 2008). MSN has a significant correlation ($r = .257$; $p<.001$) with NCLEX-RN success (McCarthy et al., 2014). MSN was also claimed to be critical in understanding difficult nursing concepts and passing the NCLEX-RN (Herrera & Blair, 2015). While Vandenhouten (2008) and Yeom (2013) argued that MSN ($p = .01$; $p = .009$) and PHARM ($p = .01$; $p = .019$) are significant predictors of NCLEX-RN success.

These various studies estimated the predictive ability of these tests on NCLEX-RN success. However, the inconsistent evidence on the impact of standardized tests on NCLEX-RN (Kaddoura et al, 2017) provided a rationale for this study.

Significance of the Study

Addressing factors affecting student academic outcomes supports the American Association of Colleges of Nursing (AACN), National League of Nursing (NLN), and Institute of Medicine (IOM) recommendations for ensuring success in baccalaureate programs and in helping address the issue of nursing shortage (AACN, 2017; NLN, 2016; Relf, 2016). The study is significant to nursing students and nursing education, in particular, and the nursing profession, in general. Effects of NCLEX-RN failure can have effects at the individual and institutional level (Brussow & Dunham, 2018; Quinn et al., 2018; Yeom, 2013).

The study is *significant to the students* because it identifies academic factors, such as standardized tests, that affect performance in the NCLEX-RN. This provides direction among students in identifying their areas of academic strengths and weaknesses prior to taking the NCLEX-RN. For the student, failing the exam may affect one's identity, confidence, anxiety, social stigma, financial stress, and hope of becoming a nurse (Shoemaker et al., 2017). Findings of the study can provide perspective to nursing students in addressing courses that they need to focus on to become successful in the nursing program and in the NCLEX-RN.

The study is *significant to nursing programs and to nursing education* since it helps determine the ability of standardized exams to predict NCLEX-RN performance. It can guide nursing faculty members to develop effective and empirically-based student-centered interventions that address the identified areas of weaknesses based on standardized exams in order to help students become successful in the NCLEX-RN. The results of standardized exams can be used as a tool to increase the chances of passing the NCLEX-RN (Amankwaa et al., 2015; Kaddoura et al., 2017; McCarthy et al., 2014; Wambuguh et al., 2016; Xiao et al., 2014). For the nursing program, a low NCLEX-RN pass first-time rate may affect recognition, accreditation, and public perception about the program's quality. Failure of graduates means a reduced number of potential nurses hired by health care organizations (Yeom, 2013). Nursing programs need to ensure students are prepared prior to taking the NCLEX-RN (Shoemaker et al., 2017; Quinn et al., 2018). Low NCLEX-RN pass rates may risk the loss of program accreditation or approval. National vs. state guidelines differ. The Commission on Collegiate Nursing Education set a standard of 80% FTPR or an average of 80% FTPR over 3 years and the Accreditation Commission for Education in Nursing requires FTPR to be at or above the national 3-year average (Shoemaker et al., 2017).

Based on this background and significance, the following research questions and methods were identified to determine the ability of standardized tests to predict NCLEX-RN performance.

Methods

Research Question

The main purpose of the study was to examine the predictive ability of the ATI test scores in FON, PHARM, MSN, and RNCP on NCLEX-RN success. It attempted to answer the following research questions:

1. What are the ATI course-specific scores and NCLEX-RN first-time pass rate of the 2017-2018 BSN graduates?
2. Is there a significant difference in ATI course-specific scores according to students who passed and failed the NCLEX-RN?
3. Is there a significant difference in ATI course-specific scores among the three cohorts of BSN graduates who passed and failed the NCLEX-RN?
4. What is the degree of association between ATI course-specific scores and ATI RN Comprehensive Predictor exam?

5. To what extent do standardized ATI course-specific test scores predict NCLEX-RN success?

Research Design

A retrospective correlational research design was used to determine the association and predictive value of standardized ATI test scores on NCLEX-RN performance. Correlational studies are appropriate in determining correlation or association among variables (Polit & Beck, 2017). Specifically, the study examined the association and ability of ATI course-specific test scores in FON, PHARM, MSN, and RNCP to predict NCLEX-RN success. It determined the mean differences in the ATI scores between those who passed and failed the NCLEX-RN performance and the mean differences in ATI scores among the three cohorts.

Participants

As a retrospective study, the study used secondary data on ATI scores and NCLEX-RN performance of 141 baccalaureate nursing graduates from a U.S. Southeastern University from Fall 2017 to Fall 2018. Inclusion criteria include completion of four ATI course-specific nursing tests (FON, PHARM, MSN, and RNCP) and completion of the NCLEX-RN exam. The ATI standardized tests on FON and PHARM were taken during their second semester, MSN during the third, and RNCP during the fourth semester in the nursing program.

Sampling

G power was used to estimate the sample size for correlational studies with a priori power of 0.80, an effect size of 0.30, and a 0.05 level of significance. Initial G power computation required sample size of 128. Allowing for potential missing data, an additional 20% of the sample size was added for a total of 154 participants. There were 152 participants initially considered based on ATI records. After accounting for 6 participants who had course failures and missing data on 5 participants, a total of 141 were included in the study. The guideline on events per variable for logistic regression sampling was used to determine the sample size for logistic regression (Peduzzi et al., 1996; Vittinghoff & McCulloch, 2007).

Data Gathering Procedure

The study was approved by the Institutional Review Boards (IRB) of the University of North Carolina at Greensboro (UNCG) and the University of North Carolina at Charlotte (UNCC). Approval from the Director of Nursing was sought prior to data gathering. Data on ATI scores and NCLEX-RN results were used to gather the information needed for this pilot study. Permission for use of ATI data was sought from ATI. ATI scores on the four standardized ATI course-specific tests were retrieved from the ATI website. NCLEX-RN data on graduates on passed and failed were acquired from the school of a nursing administrative assistant who kept track of NCLEX-RN results for the school. The data were initially identified, manually recorded, and merged in an Excel spreadsheet. After all ATI scores and NCLEX-RN results were collected, each student was assigned number codes. The data were then immediately de-identified for data analysis.

Data Analysis

Both descriptive and inferential statistics using SPSS version 25 were used to analyze the data. Descriptive statistics such as frequency, percentage distribution, mean, and standard deviation were used to describe the graduates' scores on the four ATI course-specific nursing tests and NCLEX-RN performance. Inferential statistics, such as t-test, Mann-Whitney test, Pearson correlation, and Spearman rho correlation were used to determine the association and predictive value of ATI scores on NCLEX-RN success. Analysis of variance (ANOVA) was used to determine the mean differences in ATI scores among the three cohorts of graduates. Logistic regression analysis was used to determine the predictor variables of NCLEX-RN success (Polit, 2010). Three models of logistic regression, simple (model 1), hierarchical (model 2), and simultaneous (model 3) were analyzed to determine the model that provides the best prediction for NCLEX-RN success among the ATI courses. The order of variable entry using the hierarchical model was determined based on the chronology of ATI standardized test administration in the nursing program. However, the simple regression model was chosen a priori in order to determine the predictive ability of each standardized test in predicting NCLEX-RN success. One-tailed test at $p<0.05$ was used to assess statistical significance.

Assumptions on using the correlation and regression statistics such as normality, variance, linearity, residuals, and goodness-of-fit were assessed. Shapiro-Wilk test of normality of score distribution showed that FON-failed ($p=0.021$), FON-passed ($p=0.05$), MSN-failed ($p=0.002$) and RNCP-passed ($p<0.001$) were not normally distributed. The Shapiro-Wilk test for normality of residuals was likewise not satisfied ($p<0.001$). Levene's test for homogeneity of variances showed that all scores have equal variances ($p>0.05$).

Based on the assessed assumptions, *t*-test, Pearson correlation, and ANOVA were used to analyze scores with a normal distribution. The Mann-Whitney *U* test, Spearman rho, and Kruskal-Wallis H tests were used to analyze scores that had violations of normality. Post-hoc analysis using Tukey's test and Mann-Whitney *U* test pairwise comparisons between cohorts

were done. The Hosmer-Lemeshow test determined the goodness-of-fit of the various models for logistic regression. Simple regression model for FON, PHARM, and RNCPE had adequate goodness-of-fit (p>0.05). Simultaneous regression showed a lack of model fit (p<0.001). The hierarchical regression model had a goodness-of-fit for FON (p=0.215) and FON vs. PHARM (p=0.289) but not with the inclusion of MSN (p<0.001) and RNCPE (p<0.001).

Results

This section presents the research questions (RQ) and the findings of this study.

RQ 1: What are the ATI course-specific scores and NCLEX-RN first-time pass rate of the 2017-2018 BSN graduates?

A total of 141 students' records from Fall 2017 to Fall 2018 were analyzed for this study (Table 1). More than third (37.5%) graduated in Spring 2018 and majority of the students (94.3%) passed the NCLEX-RN on the first take.

Overall, the students had the highest ATI mean score (68.0±8.8) in MSN and the lowest in PHARM (62.6±10.4) (Table 2). Among those who passed the NCLEX-RN, their highest ATI mean score was MSN (68.7±8.4) and the lowest was PHARM (63.0±10.5). Conversely, among those who failed the NCLEX-RN, PHARM was the highest ATI mean score (56.5±6.7) and FON was the lowest (55.4±8.7)

RQ 2: Is there a significant difference in ATI course-specific scores according to NCLEX-RN performance?

There was a significant mean difference in FON (U=240.5, p=0.008), MSN (U=4.036, p<0.001), and RNCP (U=3.30, p=0.001) among those who passed and failed the NCLEX-RN. Although the PHARM mean score was higher (63.0+10.5) among the students who passed compared to those who failed (56.5+6.8), this was not statistically significant (t=1.739, df=139, p=0.086).

RQ 3: Is there a significant difference in ATI course-specific scores and NCLEX-RN performance among the three cohorts of BSN graduates?

There was a significant difference in the PHARM [F(2,138)=9.108, p<0.001] between the Fall 2017 and Spring 2018 (mean difference=-5.69, p=0.17) and Fall 2018 (mean difference=-8.93, p=<.001) cohorts.

Table 1. *Distribution of respondents (N=141)*

	Frequency	Percent
Year of graduation		
Fall 2017	41	29.1 %
Spring 2018	53	37.6 %
Fall 2018	47	33.3 %
NCLEX Results		
Passed	133	94.3 %
Failed	8	5.7 %
Total	141	100.00 %

Table 2. *Comparison of ATI scores based on NCLEX-RN performance (N=141)*

	NCLEX-RN	N	ATI Score, mean (±) SD (in percentage)	Mann-Whitney *U* Test or *t*-test
FON	Pass	133	64.4 (±) 9.2	*U*=240.5, p=0.008*
	Failed	8	55.4 (±) 8.7	
	Total	141	63.9 (±) 9.8	
PHARM	Pass	133	63.0 (±) 10.5	*t*=1.739, *df*=139, *p*=0.086
	Failed	8	56.5 (±) 6.8	
	Total	141	62.6 (±) 10.4	
MSN	Pass	133	68.7 (±) 8.4	*U*=136, *p*=<0.001*
	Failed	8	56.4 (±) 8.1	
	Total	141	68.0 (±) 8.8	
RNCP	Pass	133	66.9 (±) 9.4	*U*=135, *p*<0.001*
	Failed	8	55.7 (±) 5.9	
	Total	141	66.3 (±) 9.6	

*Note. SD-standard deviation; U-Mann-Whitney U Test; FON-Fundamentals of Nursing, PHARM-Pharmacology, MSN-Medical-Surgical Nursing, RNCP-Comprehensive Predictor; * Mean difference is significant at p<0.05.*

Table 2. *Mean difference in ATI scores according to cohort (N=141)*

	N	Mean (±) SD	ANOVA or H Test	Post-hoc Test (Tukey or U test)
FON				
Fall 2017	41	62.1 (±) 9.3	H=3.0, p=0.223	
Spring 2018	53	65.5 (±) 9.1		
Fall 2018	47	63.7 (±) 9.6		
PHARM				
Fall 2017	41	57.5 (±) 11.4	F(2,138)=9.108, p<0.001*	p=0.017*[a] p<0.001*[b]
Spring 2018	53	63.2 (±) 9.2		
Fall 2018	47	66.4 (±) 9.2		
MSN				
Fall 2017	41	65.6 (±) 8.8	H=7.407, p=0.025*	p=0.017*[a]
Spring 2018	53	70.5 (±) 8.2		
Fall 2018	47	67.3 (±) 8.9		
RNCP				
Fall 2017	41	67.0 (±) 67.0	H=0.844, p=0.656	
Spring 2018	53	67.5 (±) 67.5		
Fall 2018	47	64.1 (±) 9.6		

*Note: SD-standard deviation; U-Mann-Whitney U Test; F-ANOVA test; H-Kruskal-Wallis test; FON-Fundamentals of Nursing, PHARM-Pharmacology, MSN-Medical-Surgical Nursing, RNCP-Comprehensive Predictor; *Mean difference is significant at p<0.05; aFall 2017 vs. Spring 2018; bFall 2017 vs. Fall 2018.*

Likewise, a significant difference in MSN (H=7.407, 2 df, p=0.025; Kruskal-Wallis) mean scores were found among the three cohorts. There were no differences in the FON and RNCP mean scores among the cohorts.

RQ 4: What is the degree of association between ATI course-specific scores and ATI RN Comprehensive Predictor exam?

There is a significant strong correlation (r_s=0.538 to r_s=0.651, p<0.001) among all ATI scores and RNCP (Table 4). MSN has the highest correlation with RNCPE (r_s=0.651, p<0.001) while PHARM has the lowest, although still a strong correlation (r_s=0.538, p<0.001). Moreover, MSN has a significant strong correlation with FON (r_s=0.639, p<0.001) and PHARM and (r_s=0.660, p<0.001). PHARM has a strong correlation with FON (r_s=0.516, p<0.001).

Table 4. *Correlation matrix between ATI scores and RNCPE (N=141)*

	FON	PHARM	MSN	RNCPE
FON	-			
PHARM	.516*	-		
MSN	.639*	.660*	-	
RNCP	.620*	.538*	.651*	-

*Note: FON-Fundamentals of Nursing, PHARM-Pharmacology, MSN-Medical-Surgical Nursing, RNCP-Comprehensive Predictor; rs-Spearman rho correlation coefficient; *Correlation is significant at p<0.001.*

RQ 5: To what extent do standardized ATI course-specific test scores predict NCLEX-RN success?

Three logistic regression models estimated the best model that can explain the predictive ability of the ATI courses on NCLEX-RN success (Table 5). Simple logistic regression (model 1) shows that when each ATI course is considered separately, MSN emerged as the strongest predictor of NCLEX-RN success [B=1.264, (95% CI=1.091, 1.465), p=0.002], followed by FON [B=1.112 (95% CI (1.022, 1.210), p=0.013], then RNCP [B=1.083 (95% CI=1.011, 1.161), p=0.024]. Hierarchical logistic regression (model 2), which reflects the chronological placement of the courses in the curriculum, shows two standardized tests that are predictive of NCLEX-RN. These are MSN (B=1.324 (95% CI=1.080, 1.599), p=0.006], which is a stronger predictor than FON [B=1.083 (95% CI=1.011, 1.161), p=0.043]. When ATI scores are analyzed cumulatively during progression in the curriculum, MSN remains a strong predictor of NCLEX-RN success. Simultaneous logistic regression (model 3) strongly supports the consistent predictive ability of MSN [B=1.317 (95% CI=1.074, 1.614), p=0.008] as the strongest predictor of NCLEX-RN success. The three models identified MSN as the strongest predictor of NCLEX-RN.

Discussion

The primary aim of the study was to assess the ability of ATI standardized scores to predict NCLEX-RN success. The secondary aims were to determine the mean difference of ATI scores among those who passed and failed the NCLEX-RN and among the three cohorts of students and to identify associations between ATI course-specific scores and RNCP.

In this study, MSN is the strongest predictor of NCLEX-RN success across all three logistic regression models, which is consistent with the findings of Simon et al. (2013), Vandenhouten (2008), and Yeom (2013). This finding supports Herrera & Blair's (2015) claim that MSN is critical for analyzing difficult concepts and passing the NCLEX-RN. MSN is one of the most challenging courses in the nursing program and one of the commonly failed courses among nursing students (Abele et al., 2013; Herrera & Blair, 2015). It is usually offered across several semesters in the

Table 4. *Logistic regression of ATI scores on NCLEX-RN performance*

	Model 1 B (95% CI) p-value	Model 2 B (95% CI) p-value	Model 3 B (95% CI) p-value
FON	1.112 (1.022, 1.210) 0.013*	1.100 (1.003, 1.207) 0.043*[a] 1.002 (0.893, 1.124) 0.971[b]	0.979 (0.864, 1.109) 0.741
PHARM	1.061 (0.990, 1.137) 0.092	1.023 (0.941, 1.113) 0.586[c] 0.944 (0.843, 1.058) 0.323[d]	0.942 (0.838, 1.059) 0.316
MSN	1.264 (1.091, 1.465) 0.002*	1.314 (1.080, 1.599) 0.006*[e]	1.317 (1.074, 1.614) 0.008*
RNCPE	1.083 (1.011, 1.161) 0.024*	1.035 (0.963, 1.112) 0.356	1.035 (0.963, 1.112) 0.356

*Note: Model 1-simple logistic regression; Model 2-hierarchical logistic regression; Model 3-simultaneous logistic regression; aFON vs. PHARM; bFON vs. PHARM and MSN; cPHARM vs. FON; dPHARM vs. FON and MSN; eMSN vs. FON and PHARM; FON-Fundamentals of Nursing, PHARM-Pharmacology, MSN-Medical-Surgical Nursing, RNCPE-Comprehensive Predictor Examination; *Predictor is significant at p<0.05.*

nursing curriculum. Students who demonstrate achievement of low scores on MSN concepts who are considered at-risk need to be monitored and remediated as early as possible. There is a need to reinforce MSN concepts as it represents a large portion of the NCLEX-RN test plan covering mostly the category of client need *Physiological Adaptation* (NCSBN, 2019).

FON emerged as the second strongest predictor of NCLEX-RN success based on two logistic regression models. This reinforces the results of previous studies (McCarthy et al., 2014; Schooley & Kuhn, 2013; Vandenhouten, 2008). There is a need to emphasize FON concepts in the curriculum as this serves as the foundational course for all clinical courses, primarily MSN. Since FON and MSN are the two strongest predictors of NCLEX-RN success in this study, there is a need for students to diligently focus on these courses in the nursing program. PHARM is consistently identified as a non-predictor of NCLEX-RN success among the three regression models, which contradicts the findings of Vandenhouten (2008) and Yeom (2013).

The result of this study also shows that ATI scores in all course-specific tests of those who passed the NCLEX-RN are significantly higher than those who failed the exam. This supports the claim of other studies that those who failed the NCLEX-RN had lower ATI scores (Brussow & Dunham, 2018; Brodersen & Mills (2014) and Homard (2013) as cited in Quinn et al., 2018; Vandenhouten, 2008). Nursing faculty can use these standardized tests as an objective measure to identify students at-risk for NCLEX-RN failure and to provide remediation measures to help students become successful as they progress throughout the nursing program.

ATI course-specific tests also showed a strong correlation with RNCP. Consistent with their predictive abilities, MSN had the strongest correlation with the exit exam, followed by FON. This finding is consistent with several studies (Brussow & Dunham, 2018; McCarthy et al., 2014; Schooley & Kuhn, 2013; Simon et al., 2013). This shows that MSN and FON are important courses that are needed to pass the RNCP and the NCLEX-RN.

Limitations

There are several limitations in this study that may have affected the validity of the results. These include limited sample size, few NCLEX-RN failures, and few course-specific standardized tests. Future studies need to be conducted to include larger sample size and include more course-specific standardized tests to determine the ability of the other tests to predict NCLEX-RN success. Studies that will include more NCLEX-RN failures are also desired. Furthermore, the results of this study were based on an analysis of one baccalaureate nursing program. Studies that include a comparison between baccalaureate and associate nursing programs should also be considered.

Conclusion and Implications to Nursing Education

The results of this study are significant to nursing education and nursing research. Standardized tests can be used as valid and reliable assessments in predicting a student's success in the NCLEX-RN. However, they should not be used in predicting NCLEX-RN failure since the evidence in the literature limits its use for predicting failure. These tests serve as an essential source of information about the proficiency and mastery of students on certain subject areas at various stages of the nursing program. They can be used as guides for remediation for at-risk students on specific courses throughout the nursing program. Identifying specific areas of academic strengths and weaknesses is critical in assessing individual outcomes of the teaching and learning process. Since nursing courses are interrelated, addressing the areas of weaknesses will help develop the students in enhancing their knowledge and proficiency as they progress in the nursing program. Students who are in the last semester of the program who have a low predicted probability of passing based on the exit exam should be encouraged and supported since these are identified as at-risk for failing the NCLEX-RN.

The standardized tests can provide individual and group feedback that the students and faculty members, respectively, can use in tailoring individualized and/or group remediation for at-risk students. Early remediation is critical not only in ensuring NCLEX-RN success but also in developing and reinforcing critical knowledge that is needed for effective critical thinking and clinical judgment. These are qualities that are essential in providing safe and quality patient care.

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ABOUT THE AUTHOR

James Montegrico, PhD, RN, CMSRN, is a lecturer and lead faculty at the University of North Carolina at Charlotte - School of Nursing, Charlotte, NC, USA. He earned his Doctor of Philosophy (Nursing Science) at the University of North Carolina at Greensboro - School of Nursing, Greensboro, NC, USA. He completed his Master of Science in Nursing at Saint Paul University Philippines (Tuguegarao City) and Bachelor of Science in Nursing at the University of Santo Tomas, as a Magna Cum Laude graduate and academic scholar. His research interests include nursing education, nursing workforce, internationally educated nurses, NCLEX-RN, and HIV/AIDS.

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2015. Her involvement in public health made contributions in establishing the referral and reporting system of hospitals and community in the National Capital Region (NCR) for Tuberculosis (TB) case finding and treatment as a Technical Field Staff of the World Health Organization (WHO) - Philippines CATCH Project in 2010-2012. She graduated Cum Laude in her Bachelor of Science in Nursing (BSN) at Benguet State University in 2005 and earned her Master of Science in Nursing (MSN) at Saint Louis University, Baguio City in 2014.

Erlinda C. Palaganas, is a full professor of Management and University Scientist 1 at the University of the Philippines Baguio. She is a BSN graduate of the UERMMMCI, Molave'79, a Master's degree holder for Public Health from the University of the Philippines Manila and a PhD in Nursing from the University of Sydney, NSW, Australia. She has conducted interdisciplinary/ multidisciplinary inter-country researches and a prime mover in enhancing qualitative research in the country. She is the founding president of the Philippine Nursing Research Society Inc. Her research interests include social issues such as migration, poverty, equity in health, gender and development concerns, and indigenous studies.

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What is evidence? Evidence is factual knowledge or data that lends support to or casts doubt on a hypothesis. It is information on which we base our beliefs and ideas of how the world works.

— Morris (2004)