

Identifying Predictors of National Council Licensure Examination for Registered Nurses (NCLEX-RN) Success in an Associate Degree Nursing Program

Jean M. Truman

ASN Program Coordinator and Assistant Professor of Nursing
Department of Nursing
University of Pittsburgh at Bradford
300 Campus Drive
Bradford, PA, USA

Abstract

The purpose of this descriptive correlational study was to compare graduates (N=188) of a specific rural associate degree nursing program who were successful on the initial attempt at National Council Licensure Examination for Registered Nurses (NCLEX-RN) to graduates who were not, using admission and program criteria. Admission variables included age at admission to the nursing program, gender, ethnicity, parental education, high school rank, pre-admission GPA, Scholastic Aptitude Test (SAT) scores, ACT[®] composite scores, and pre-admission science GPA. The program variables were the number of "C" grades in nursing courses and nursing course GPA. Students who passed the NCLEX-RN possessed statistically higher pre-admission GPAs ($p=.011$), nursing course GPAs ($p=.000$), and SAT verbal scores ($p=.009$), and had significantly fewer Cs in nursing courses ($p=.000$) than those who failed. Logistic regression model revealed that SAT verbal and nursing GPA significantly predicted NCLEX-RN success.

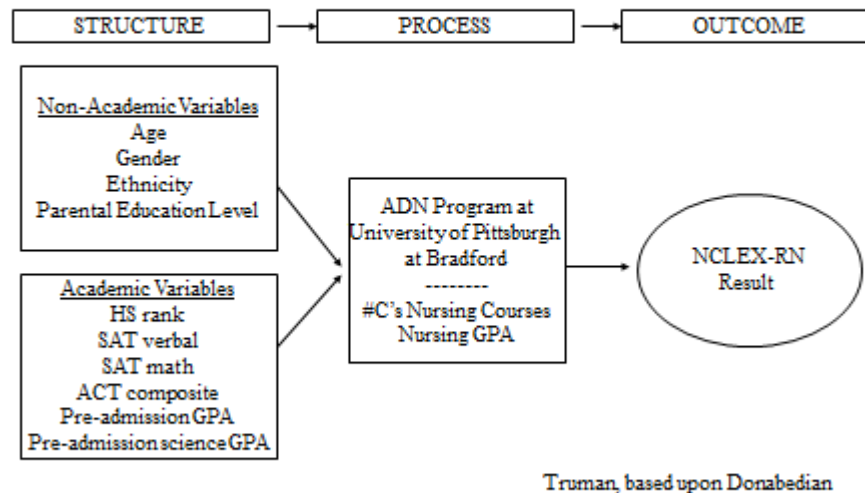
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1. Introduction

Numerous studies have attempted to identify the best predictors of National Council Licensure Examination for Registered Nurses (NCLEX-RN) success. While the Bachelor of Science in nursing (BSN) literature is replete with studies correlating relationships of NCLEX-RN success and failure to individual variables, the Associate Degree in Nursing (ADN) literature is not as rich. The scarcity of research in this area may be due to the NCLEX-RN examination itself. The evolution of the NCLEX-RN 'pass-fail' examination has raised two issues: first, fewer studies have been conducted since the NCLEX-RN 'pass-fail' evaluation (Waterhouse and Beeman, 2003); and secondly, identifying predictors of NCLEX-RN success is less precise, suggesting that there are more inconsistencies in predicting NCLEX-RN success with the 'pass-fail' evaluation (Crow, Handley, Morrison, and Shelton, 2004). The purpose of this study was to compare graduates of a rural ADN program who were successful on the initial attempt at NCLEX-RN to graduates who had failed their initial attempt at NCLEX-RN using both admission and program criteria in an effort to identify predictors of NCLEX-RN success.

2. Conceptual Framework

The framework for this study was based upon the Donabedian Structure-Process-Outcome model. The concepts of the model are structure, process, and outcome, and all are linked together, so that when a structure is good, it will encourage a good process which will encourage a good outcome (Donabedian, 1966). Guided by the Donabedian model, a conceptual model of prediction was substructured, where the characteristics (academic and non-academic variables) of the student were related to structure, the academic program to process, and the NCLEX-RN result to outcome.

Figure 1: Conceptual Model of Prediction

3. Literature Review

A synthesis of the empirical literature conducted following the 1988 NCLEX-RN change to 'pass-fail' evaluation, identifies both admission and program variables that have been correlated with NCLEX-RN outcomes. However, the literature reveals a lack of consistency in prediction of NCLEX-RN success and less consistency in predicting NCLEX-RN failure. Gaps in the literature are supported by the lack of consistencies related to several admission and program variables.

3.1 Non-academic variables

Various studies have found non-traditional aged graduates (>23 years of age) at the time of admission to the nursing program, to be associated with higher NCLEX-RN pass rates when compared to traditional aged graduates (Briscoe & Anema, 1999; Daley, Kirkpatrick, Frazier, Chung, & Moser, 2003). Additionally, Beeson and Kissling (2001) found older age at the time of licensure to be associated with NCLEX-RN success. However, several studies found age not to be a significant predictor of NCLEX-RN success (Beeman & Waterhouse, 2001; Roncoli, Lisanti, & Falcone, 2000; Stuenkel, 2006; Yin and Burger, 2003). A number of studies revealed that gender was not significantly correlated with passing or failing NCLEX-RN (Beeman & Waterhouse, 2001; Beeson & Kissling, 2001; Sayles, Shelton, & Powell, 2003; Yin & Burger, 2003). Contrary to these studies, Haas, Nugent, and Rule (2004) found that men had a greater likelihood of failure on NCLEX-RN than women.

A variable which has been reported in numerous studies, showing inconsistencies in predicting NCLEX-RN success or failure is ethnicity. Studies conducted by Endres (1997) and Yin and Burger (2003) found ethnicity to have no impact on NCLEX-RN success, whereas, other studies (Barkley, Rhodes, & Dufour, 1998; Campbell & Dickson, 1996; Crow et al., 2004; Haas et al., 2004; Salyes et al., 2003), stated that African Americans and minorities were less likely than Whites to pass NCLEX-RN. Very few studies have been conducted that have looked at the education level of the parents as a predictor of NCLEX-RN success (Campbell & Dickson, 1996). The lack of studies that have investigated the education level of the parents as a potential predictor of NCLEX-RN success or failure support further research.

3.2 Academic variables

Two studies found high school rank to be a positive and significant predictor of NCLEX-RN success (Wall, Miller, & Winderquist, 1993; Yin & Burger, 2003). The investigators identified that prediction accuracy was higher for NCLEX-RN success than failure.

Contradictory results have been reported in the literature regarding SAT scores as predictors of NCLEX-RN success or failure (Barkley et al., 1998; Campbell & Dickson, 1996; Crow, et al., 2004). Differences within the SAT scores themselves have also shown inconsistencies. Beeman and Waterhouse (2001) found significant positive correlations with SAT math scores whereas, Waterhouse, Bucher, and Beeman (1994) reported significant positive relationships between SAT verbal scores and NCLEX-RN success. Like the results of prediction reported for SAT scores, the outcomes of ACT[®] scores as a predictor of NCLEX-RN success or failure have been conflicting. Daley et al. (2003) identified that ACT[®] composite scores are positive predictors of NCLEX-RN performance. In opposition, Sayles et al., (2003) found that the ACT[®] score was not a statistically significant predictor of NCLEX-RN success.

Significant positive correlations were found between undergraduate pre-admission college GPA and NCLEX-RN success in studies conducted by Daley et al., (2003), Endres, (1997), and Seldomridge & DiBartolo, (2004). However, contrary to the findings of these studies, research conducted by Briscoe and Anema (1999), Drake & Michael (1995), Gallagher, Bomba, & Crane (2001), Jeffreys (2006), and Stuenkel, (2006) found college GPA, prior to admission to the nursing program, not a significant predictor of NCLEX-RN success. A number of studies have looked at college science GPA, prior to admission to the nursing program and found college science GPA to be predictive of NCLEX-RN success (Beeman & Waterhouse, 2001; Campbell & Dickson, 1996; Higgins, 2005; Waterhouse et al., 1994; Yin & Burger, 2003). In a study directed by Jeffreys (2006) Anatomy & Physiology I course grades were not predictive of NCLEX-RN success for the sample studied.

3.3 Program variables

Beeman and Waterhouse (2001) used discriminant analysis to determine predictors of NCLEX-RN success using 289 baccalaureate nursing students. The best predictor of NCLEX-RN success for this sample was the number of C+ or lower grades in nursing theory courses, which significantly negatively correlated to NCLEX-RN success. Similar findings were reported by Beeson and Kissling (2001), Daley, et al., (2003), Barkley, et al., (1998), Roncoli, et al., (2000), and Seldomridge and DiBartolo (2004). The grade point average of nursing courses has also been a variable found predictive of NCLEX-RN success. Many studies concur that higher nursing GPAs are characteristic of students who are successful on NCLEX-RN (Beeson & Kissling, 2001; Haas, et al., 2004; Daley, et al., 2003; Gilmore, 2008; Landry, Davis, Alameida, Prive, Renwanz-Boyle, 2010; Seldomridge & DiBartolo, 2004).

4. Methods

Following institutional review board approval, a descriptive correlational design using de-identified data from academic records and from NCLEX-RN score reports was used. The variables were chosen based upon the nursing program demographics and because no clear predictor of success was identified in the ADN literature. Academic and non-academic variables studied included: age at program admission, gender, ethnicity, parental education, high school rank, pre-admission GPA (both high school and college), Scholastic Aptitude Test (SAT) scores (both verbal and math), ACT[®] composite scores, and pre-admission science GPA. The program variables studied were the number of "C" grades in the nursing didactic courses and nursing course GPA.

5. Sample

The purposive sample included all graduates (n=188) of the ADN program from 1998 through May 2007 who met the following inclusive criteria: (a) successfully completed the ADN nursing program, and (b) had taken the NCLEX-RN and appeared on the official NCLEX-RN score report. There were no exclusionary criteria.

6. Data Analysis

Published research (Briscoe & Anema, 1999; Drake & Michael, 1995; Lengacher & Keller, 1990; Sayles, et al., 2003; and Woodham & Taube, 1986) was reviewed to calculate an estimate of effect size for the independent variables. Effect sizes for the variables of age at admission to the nursing program, gender, ethnicity, parental education, high school rank, pre-admission GPA, SAT scores, ACT[®] composite scores, and pre-admission science GPA ranged from .14 to .63. For this study, a medium effect size of .364 was used, as it was the average for the effect sizes from previous research. Power analysis was conducted to estimate required sample size using G*Power 3 (Faul, Erdfelder, Lang, & Buchner, 2007). For this study using a two-tailed correlation, with an effect size (ES) of $r = .364$, an error probability $\alpha = 0.05$, $\beta = 0.05$ and power $(1-\beta) = 0.95$, the predicted sample size was calculated to be one hundred and twenty-one ($n = 121$).

Applying the post hoc approach with an effect size of .356 and a sample size of one-hundred and thirty-five subjects ($n = 135$) (from the logistic regression model), an error probability $\alpha = 0.05$, and $\beta = 0.05$, the power for this study was $(1-\beta) = 0.99$. Statistical Package for Social Sciences (SPSS) version 15.0 was utilized for data analysis. Descriptive statistics, mean, median, mode and standard deviation, were used to identify the characteristics of the continuous sample. Comparisons between categorical variables by passage or non-passage were analyzed by Chi square; comparisons using continuous data were evaluated by independent samples t-test. The strength of the association between variables was determined by Pearson's product moment correlation r . Logistic regression was used to estimate the probability of success or failure of the independent variables. Missing data were noted in the analysis and reported with study results. The data set was fixed; therefore there was no attrition. The level of significance was set at $p < .05$.

7. Results

There were 138 graduates who passed the NCLEX-RN on the first attempt (73.4%) and 50 graduates who failed the NCLEX-RN on the first attempt (26.6%).

7.1 Non-academic Variables

The vast majority, 97.9%, of this sample were Caucasian ($n = 184$) and 86.7% were female ($n=163$). Age ranged from 17 to 52 years (mean= 25.53, $SD = 8.7$). Almost 40% percent of the sample was < 20 years of age, while only 10% percent were over 38 years of age. Greater than 65% of the subjects' mothers ($n = 76$) and greater than 67% of the subjects' fathers ($n = 85$) possessed no formal education beyond a high school degree. There were no statistically significant differences between those subjects who passed or failed the NCLEX examination on these non-academic variables.

7.2 Academic Variables

Academic variables of the sample are depicted in Table 1. Those who passed the NCLEX-RN ($M = 3.22$, $SD = .47$) had significantly higher pre-admission GPA ($p = .011$) than those who failed the NCLEX-RN ($M = 2.93$, $SD = .51$). Those who passed the NCLEX-RN ($M = 509.09$, $SD = 84.36$) scored significantly higher on the SAT verbal ($p = .009$) than those who failed ($M = 476.44$, $SD = 55.76$).

Table 1: Academic variables against pass/fail

Variable	NCLEX-RN Result	Sample Size	Mean	Standard Deviation	Sig
High School Rank	fail	21	24.38	12.80	$p = .537$
	pass	40	27.03	20.42	
SAT verbal	fail	39	476.44	55.76	$p = .009^*$
	pass	99	509.09	84.36	
SAT math	fail	39	482.33	66.94	$p = .646$
	pass	99	488.59	73.55	
ACT Composite	fail	3	21.00	2.65	$p = .568$
	pass	8	20.13	2.03	
Pre-Admission ASN GPA	fail	23	2.93	.51	$p = .011^*$
	pass	21	3.22	.47	
Pre-Admission Science GPA	fail	46	2.96	.82	$p = .444$
	pass	126	3.07	.77	

* denotes significance beyond .05

High school rank is recorded as a percentage.

Due to the small sample, ACT was omitted from any further statistical analysis.

GPA was based upon a 4 point scale from 0.00 to 4.00.

Pre-Admission GPA included college GPA if student earned 12 or more college credits; or high school GPA for students directly admitted from high school or those who earned 11 or < college credits.

Pre-Admission science GPA recorded for students admitted directly from high school or students with no college credits in natural sciences (biology, chemistry, anatomy, physiology). College science GPA was recorded for students earning college credits in the natural sciences.

7.3 Program Variables

Nursing grade point average was operationalized as the cumulative GPA which a student earned during the ADN program. Nursing GPAs were reported for 187 subjects ($M = 2.54$, $SD = .43$). Only twelve percent of subjects had nursing GPAs greater than 3.00, while eighty-eight percent of subjects earned GPAs of 3.00 or less.

The number of "C" grades was operationalized for this study as the number of "C" grades recorded on the students' academic transcript for all nursing courses. Because students earning grades lower than C were not included in the study, the data were entered as binary (1=C, 0= \geq B-).

Those who passed the NCLEX-RN had significantly higher GPAs in nursing didactic courses ($M = 2.65$, $SD = .43$, $p = .000$) than those who failed the NCLEX-RN ($M = 2.25$, $SD = .24$). Those who passed the NCLEX-RN had significantly fewer Cs in nursing didactic courses ($M = 2.10$, $SD = 1.57$, $p = .000$) than those who failed the NCLEX-RN ($M = 3.60$, $SD = .95$). The total number of C grades earned in nursing didactic courses was negatively correlated with NCLEX-RN success.

8. Logistic Regression

Logistic regression was used to model the probability of success or failure of the independent variables (age at admission to the nursing program, gender, ethnicity, mother education, father education, high school rank, pre-admission GPA, SAT verbal, SAT math, ACT composite, pre-admission science GPA, nursing didactic GPA, and number of C grades in nursing didactic course) on the criterion variable (DV) NCLEX-RN result. The dichotomous outcome for this study was the NCLEX-RN result, pass or fail.

The primary assumptions of logistic regression were tested. Frequencies of all study variables were analyzed for variance. Ethnicity was a constant (skewness = 8.03, kurtosis = 70.08), so this variable was omitted. ACT ($n = 11$) and high school rank ($n = 61$) had very small sizes so they were also eliminated from the model.

Ordinary Least Square (OLS) regression was run to test for multicollinearity. This analysis revealed that the number of C grades in nursing didactic courses and nursing GPA were so highly correlated with each other that they were intrinsically bound. In an effort to eliminate the multicollinear relationships between these two redundant variables, the number of C grades variable was deleted to eliminate redundancy. By removing the variable number of C grades, the variance inflation factor (VIF) for nursing GPA was reduced from 6.99 to 1.65, with an increase in tolerance from 1.40 to .60.

Logistic regression was then run to test model fit, parameter estimates (un-standardized betas, odds ratios, confidence intervals) and influential cases to examine the variable effects on the criterion outcome (NCLEX-RN pass or fail). Only forty-three cases (22.9%) were included in the analysis of the first logistic regression. The instability of the model which resulted from too few cases prompted the investigator to omit the independent variables mother education ($n = 116$), father education ($n = 126$), and pre-admission GPA ($n = 101$). The resulting model yielded one hundred and thirty-five cases (71.8%) and included the following independent variables: age at admission to the nursing program, gender, SAT verbal, SAT math, pre-admission science GPA, and nursing didactic GPA. The model included the strongest variables for regression and the model was stable.

The independent variables included in the model were analyzed individually to test their bivariate relationships. Then, the model independent variables were analyzed simultaneously to examine their relationship with the outcome while controlling the effects of all others as constant.

The resulting analysis revealed that the p value, chi-square, and relationships did not significantly change. The investigator concluded that the models were parsimonious and desirable.

The results of this model revealed that SAT verbal and Nursing didactic GPA significantly predict NCLEX-RN success. Odds ratio for SAT verbal (OR = 1.01, $p = .027$) was interpreted as for every 1 point increase in SAT verbal, the chance of passing the NCLEX-RN increases by 1%. The odds ratio for Nursing didactic GPA showed the greatest prediction of NCLEX-RN success ($r^2 = 35.09$, $p = .000$), interpreted as for every 1.0 point increase in nursing didactic GPA, the subject was 35 times as likely to pass the NCLEX-RN (Table 2 Unadjusted and Adjusted Odds Ratios in the Logistic Regression)

Table 2: Unadjusted and Adjusted Odds Ratios in the Logistic Regression ($n = 135$)

Predictor Variable	Unadjusted Odds Ratio				Adjusted Odds Ratio			
	Odds Ratio	95.0% C.I. for EXP(B)		p	Odds Ratio	95.0% C.I. for EXP(B)		p
		Lower	Upper			Lower	Upper	
Age	1.01	.97	1.05	.53	1.02	.95	1.09	.59
Gender	1.67	.69	4.08	.26	2.27	.61	8.47	.22
SAT Verbal	1.01	1.00	1.01	.03*	1.01	1.00	1.02	.03*
SAT Math	1.00	.97	1.01	.64	.99	.99	1.00	.11
Pre-admission Science GPA	1.18	.77	1.80	.44	.84	.44	1.63	.61
Nursing Course GPA	36.51	9.30	143.31	.00*	35.09	6.86	179.43	.00*

* denotes statistical significance
Sex coded as 1=female, 2=male

9. Discussion

Numerous studies have been conducted attempting to identify the best predictors of NCLEX-RN success by nursing programs. Although nursing program variables have been reported as predictive of NCLEX-RN success and failure, most of these studies focused on BSN program graduates, despite the fact that ADN graduates comprise the majority of those taking the NCLEX-RN. Additionally, Waterhouse and Beeman (2003) found that fewer studies have been conducted since the inception of the NCLEX-RN 'pass-fail' evaluation and Crow, et al., (2004) reported less precision in predicting NCLEX-RN success with the 'pass-fail' evaluation. Therefore, in an effort to increase the breadth of research related to ADN program predictors of the NCLEX-RN pass-fail evaluation, this study explored admission and program variables of ADN graduates to identify correlations between the chosen variables and NCLEX-RN outcome.

Independent t-tests identified those who passed the NCLEX-RN had significantly higher pre-admission GPAs, scored significantly higher on the SAT verbal, had significantly higher GPAs in nursing didactic courses, and had significantly fewer Cs in nursing didactic courses compared to those who failed the NCLEX-RN.

The overall predictive logistic regression model was statistically significant, with the predictive accuracy revealing 87.6% correct prediction for NCLEX-RN success and only 50% correct prediction for NCLEX-RN failure. Greater accuracy of predicting NCLEX-RN success over NCLEX-RN failure is prevalent in the published research. The statistically significant predictors for this model were SAT verbal score, with every 1 point increase in SAT verbal, the chance of passing the NCLEX-RN increases by 1%, and the overall nursing didactic GPA, for every 1.0 point increase in nursing didactic GPA, the subject was 35.09 times as likely to pass the NCLEX-RN.

The number of C grades in nursing didactic courses was not included in the logistic regression model because the number of C grades in nursing didactic courses and nursing GPA were so highly correlated with each other that they were intrinsically bound. The more C grades (associated with a GPA of 2.00) a student earned, the lower the nursing GPA became. It is important that the results of this study be viewed with the understanding of this concept.

Each of the individual nursing courses revealed significant group differences between the grade earned in the course and NCLEX-RN outcome. Additionally, those who passed the NCLEX-RN had higher mean scores compared to those who failed the NCLEX-RN. Summing together the individual course number of C grades revealed statistical significance for those who passed the NCLEX-RN, with fewer C grades being more predictive of NCLEX-RN success.

Parental education was not shown to be a statistically significant predictor of NCLEX-RN success for this sample. Because of lack of sample size (mother education $n = 116$, father education $n = 126$) parental education could not be included in the logistic regression model. The high percentage of students whose parents possessed not formal education beyond high school provides an opportunity for concentrated remediation, peer tutoring and faculty mentoring to assist with academic support for these students.

10. Limitations

Although this study identified variables which correlated with or were predictive of NCLEX-RN success, causality could not be established because of the study design. Also, because a pre-existing de-identified data set was used, the investigator was unable to manipulate the variables. Random missing data throughout the data set (due to previous collection methods) disallowed the inclusion of several variables in the logistic regression model.

The identified predictors of NCLEX-RN success in this study were unique to this sample population of young, female, white, middle class students. The study was conducted at a single ADN program at a regional university in northwestern Pennsylvania which serves a rural population that was culturally and racially homogeneous. These methodological limitations have produced study results which may have limited generalizability, however, many nursing programs contend with similar concerns. The results of this study can be of value in narrowing the gaps to identifying common variables predictive of NCLEX-RN success in ADN nursing graduates.

11. Implications for Nursing Education

Student success on the NCLEX-RN is an imperative benchmark for nursing programs. NCLEX-RN pass rates dictate program reputation and enrollments, accreditation, and students passing the NCLEX-RN fulfill a response to the nursing shortage. Identifying students who are predicted of NCLEX-RN success during the university admission process is essential.

Nursing programs need to revise admission policies to reflect the results of research findings for their programs. Caution must be taken, however, that admission standards are not raised so high as to decrease the number of students admitted to nursing programs, thereby escalating the existing void of nurses fashioned by the nursing shortage. In addition, progression policies should be reviewed and appropriate changes made based upon empiric research. Care should be exercised that we do not risk raising attrition rates as we strive to raise our NCLEX-RN scores (Rogers, 2010).

More research needs to be done to identify predictors of NCLEX-RN success, as well as predictors of NCLEX-RN failure with greater accuracy (Seldomidge & DiBartolo, 2004). Research has been unable to identify one uniform variable predictive of NCLEX-RN success or failure across all programs.

Nurse educators must look at their own program demographics, curriculum, faculty and university resources to identify the best constellation of variables for student success on NCLEX-RN. Supplementary to non-academic and academic variables, research should continue to be conducted to explore other student variables which may impact NCLEX-RN success or failure, including, but not limited to student support systems (both internal and external), student demands (both inside and outside of the classroom), repeat classes, and prior healthcare experience (Schmidt & MacWilliams, 2011).

12. Conclusion

Predicting student success by investigating both academic and non-academic variables of NCLEX-RN success has been looked at in the literature extensively in the past 25 years (Haas, et.al., 2004; Schmidt & MacWilliams, 2011). Predictors of NCLEX-RN success vary from nursing program to nursing program, due in part to the pedagogical variations among the programs. As the NCLEX-RN licensure examination changes, based upon the test plan, the predictors of success and failure also change (Beeman & Waterhouse, 2001). Moreover, the review of the literature finds inconsistency in predicting NCLEX-RN success or failure with the current pass-fail evaluation.

As nursing educators, we are bound by a moral duty to educate nursing students to competently and safely care for the patients they serve. In an effort to respond to the nursing shortage, nursing program admission committees are charged with selecting students who are likely to successfully complete the program, pass the NCLEX-RN, and enter the profession in a timely fashion to fill the identified void of nurses. This charge creates an ethical responsibility to admit students who can be successful on the first attempt at NCLEX-RN.

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