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By Faculty for Faculty

Use of Statistical Tests in Doctor of Nursing Practice Projects

Matthew Jones, Maria deValpine, Maria McDonald, Carolyn Schubert

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A B S T R A C T

A working knowledge of statistical tests, their application, and interpretation is vital to evidence-based practice. A purposive sample of Doctor of Nursing Practice (DNP) projects listed in ProQuest (N = 667) were assessed for general use of statistics and data on the most frequently used statistical tests were compiled. Results enumerated the top 10 tests used with the top 3 methods reliant on basic and descriptive statistics. Application to practice and contributions to the evidence-base from DNP Projects are discussed. Potential statistical and methods issues are presented, along with some possible remedies. To improve project outcomes and professional practice, scoping of DNP statistical education is needed.

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Introduction

Evidence-based practice (EBP) is an essential component in providing the best delivery of care as informed by patient data, patient preferences, and professional health care literature. EBP competency requires a combination of knowledge, skills, and attitude to apply information in the clinical context effectively. Statistical competency is a critical component of EBP competency and health care practice today.[1] However, most research on statistics education for nurses has centered around baccalaureate-level education.[2] As more programs evolve their curriculum into tiers of advanced practice, there is a gap about how to define statistical competency for graduate-level, practice-based health professions programs—specifically, doctorate of nursing practice (DNP) programs.

New competencies for nurses in advanced practice roles provide some initial ideas about statistical competency for evidence-based practice. Melynk et al.[3] identified EBP competencies for both practicing nurses and those in advanced practice roles through a Delphi survey of EBP mentors across the United States. In addition to being able to critically appraise the literature, a nurse in an advanced practice role:

- leads transdisciplinary teams in applying synthesized evidence to initiate clinical decisions and practice changes,
- generates internal evidence through outcomes management and EBP implementation projects for the purpose of integrating best practices,
- measures processes and outcomes of evidence-based clinical decisions, and
- participates in the generation of external evidence with other health care professionals.

The nursing profession has endorsed the DNP degree for nurse practitioners and those in broader advanced practice roles.[4] This new level of nursing education supports the increasing need for leadership and quality improvement in addition to practice knowledge. The American Association of Colleges of Nursing[5] states that there should be “less emphasis on … research methodology and statistics than is apparent in research-focused programs” (p. 3). Despite this recommendation, “the common place approach [is] to cover many topics without sufficient depth for each.”[6(p23)] To find the right level of statistics education, faculty should tailor “education to baseline knowledge, learner background, and future goals [to increase] learning potential while minimizing classroom time.”[1(p138)] Further definition and scoping of statistical competence and education are needed for nurses in advanced practice.

There is wide variation in the literature about examples of statistical education for advanced nursing practice. DiMaria-Ghalili Ostrow[7] described teaching advanced practice nursing students how to run descriptive and inferential statistics in Excel. Lauver and Phalen[8] focused on a large number of topics, such as research design, univariate analysis, and logistic regression, analyzed using SPSS. Polancich et al[9] designed a course to focus on clinical data management and analysis. Kuerban[10] notes that most DNP programs only have a single statistics course, limiting how much content can be learned. Each of these scopes is quite different and creates unevenness in preparation for practice.

Understanding the needs for statistical competency in practice is an important consideration. There is, however, limited evidence about the statistical competency needs for nurses in advanced practice. Kim and Hayat[11] found that for nurses with master’s degrees, the most frequent practice activities involving statistical knowledge were reading professional literature and quality improvement projects. Less than a quarter of respondents’ activities were related to completing data analyses or designing research studies. The most frequently taught statistical techniques included graphs, basic tests like chi-square, analysis of variance, and simple regression, but the methods were used by only 29–59% of

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Table 1
Carnegie Classification Counts of Sample

Carnegie Classification of School	n	%
R1: Doctoral universities—Very high research activity	17	23.94
R2: Doctoral universities—High research activity	11	15.49
D/PU: Doctoral/professional universities	20	28.17
M1: Master's colleges and universities—larger programs	14	19.72
M2: Master's colleges and universities—medium programs	1	1.41
M3: Master's colleges and universities—smaller programs	1	1.41
Special focus	5	7.06

One institution not listed in the table was classified as baccalaureate, and 1 was a non-U.S. university, not classified.

respondents. There is minimal information in the literature about the level of statistical competency needed for advance practice nurses prepared with the DNP.

This brief report aims to identify the statistical techniques commonly used in DNP projects. Trends of use can inform recommendations to scope statistical education for DNP students, improve design and analysis for quality improvement projects, and, ultimately, benefit patient outcomes in practice.

Methods

There are many places where universities choose to publish their completed DNP projects. We chose the ProQuest Dissertation Theses database because it provided a large sampling frame for DNP Projects, with 71 DNP programs choosing to index its projects there. The Proquest database is the official digital archive for the Library of Congress and also serves as the database of record for graduate research.[12] Projects from all 71 programs were selected, regardless of designation as research-intensive versus teaching-focused universities. The Carnegie classifications of the sample are listed in Table 1.

The ProQuest database search was organized to retrieve the most recent projects from each university. The first 15 projects per school that appeared in the ProQuest search were included for review as they were the most recent, given the organization of the search. The only inclusion criterion was that the DNP project include a quantitative technique. Project abstracts were reviewed to see if a quantitative approach was used. If it was unclear from the abstract, the Methods section was then examined to determine eligibility. If any of the first 15 projects did not contain quantitative data, they were replaced with the most recent quantitative project submitted. If 15 projects did not exist per university, then all the projects that were obtained and met the inclusion criterion were included. Projects were excluded if statistical applications were not mentioned.

The final sample consisted of 667 DNP projects. Data collection included the recording of statistical procedures used for each project, whether statistical power was mentioned, and if power was mentioned, whether a priori sample size was achieved. These data were collected by noting which methods were stated in the abstract and also reviewing the methods section of the project. Descriptive statistics in the form of counts and percentages were calculated for the 10 most frequently used quantitative approaches in the Projects.

Results

Twenty-seven percent ($n = 180$) of the sample relied on 1 statistical method to answer the project question(s). The paired samples t test (21%) followed closely by chi-square[1] (20.7%), and descriptive statistics (20.5%) were the most common approaches (see Table 2).

Table 2
Percentage of Statistical Methods Used in DNP Project

Statistical Method	*n*	%
Paired (dependent) samples *t* test	140	21
Chi-square	138	20.7
Descriptive statistics (only method used)	137	20.5
Independent samples *t* test	86	12.9
Wilcoxon signed-rank	58	8.7
One-way ANOVA	55	8.2
Mann-Whitney	31	4.6
Linear regression (OLS)	17	2.5
Logistic regression	12	1.8
ANCOVA	4	.6

ANCOVA = analysis of covariance; ANOVA = analysis of variance; DNP = doctor of nursing practice; OLS = ordinary least squares.

Twenty-seven percent ($n = 180$) of the sample relied on 1 statistical method to answer the project question(s). Previous research performed by Kuerban[10] identified descriptive statistics as the most commonly used method in DNP projects. Projects might use descriptive statistics along with inferential tests, but using descriptive statistics as the only method trails slightly behind other methods (20.5%).

The 10 most common tests resemble what a student might receive in a research methods/basic statistics sequence. However, the slightly more advanced approaches that might appear in such a sequence (ie, ordinary least squares, logistic regression, analysis of covariance) appeared infrequently in the sample. Statistical power was mentioned in 51.4% ($n = 343$) of the projects. Of those that mentioned power, 60% ($n = 206$) did not meet the stated a priori sample size. This finding aligns with previous research indicating that DNP Projects tend to have very small sample sizes[10] and may continue to suffer from issues of statistical power.

Discussion

In addition to the challenge of defining statistical competency for these practice-based programs, DNP programs have a wide range of possible summative assessment products, such as a practice portfolio, a practice change initiative, or a manuscript to document and summarize educational achievement. Because of this, the level of statistical competency can be difficult to identify because it should be less than the PhD level but more than the existing master's level.

In a review of statistics used in the nursing literature, Zellner et al[13] found that the most frequent statistics used were descriptive statistics about measures of central tendency (mean) and measures of dispersion (percentages, percentiles, quartiles, standard deviation). Therefore, as a reader, the level of statistical competency may not need to be that high. Additionally, this raises the question of whether DNP programs need to teach statistics beyond the descriptive level. If projects and literature do not demand more complex analysis and if faculty advisor expectations do not require such analysis, time spent in other coursework may be more appropriate. However, it is difficult to ignore the broader array of statistics used in the professional literature from other health fields. A goal of the DNP is to provide nurses in advanced practice with the ability to translate research into practice. To perform successfully, DNPs must have some basic understanding of these other statistical methods. Doing the advanced analysis themselves may be unnecessary but the ability to translate evidence into practice with a proper understanding of methods is critical. If DNPs are using elementary statistical methods in projects and not interpreting the

[1] The documents typically listed this method as "chi-square," not noting specifically that it was Pearson's chi-square or if another chi-square approach was used.

concepts correctly, this suggests analysis is flawed, and evidence for practice may get lost in translation.

DNP students are only exposed to basic statistics, but the understanding and ability to use such statistics may be challenged. Fear and lack of confidence with statistics may lead to the high use of descriptive statistics as the sole method. Additionally, low sample sizes continue to plague DNP projects. Students may see descriptive statistics as the only option in the absence of enough data for inferential tests. There is often a gap between the required statistics course and data analysis time period in DNP projects, which may also contribute to overreliance on descriptive methods.

Findings from this research align with previous research indicating that DNP projects often have very small sample sizes, therefore continuing to suffer from low statistical power.[10] Kuerban's[10] research noted that the mean DNP Project sample size was 49. In many cases, it can be much smaller than this, and it is not uncommon to see samples less than 10. In our experience, DNP projects are often described as pilot projects. Whether this is due to an inability to gain a larger sample or a lack of understanding of statistical power's importance is not clear. To contribute to the evidence base and to change practice, it will be essential to ensure that students are exposed to the concept of statistical power before developing their projects. Because of limited or incorrect use of statistics, the contributions to practice of these DNP projects may be limited, undermining the utility of the DNP.

Oster and Enders' advice "that tailoring education to baseline knowledge, learner background, and future goals increases learning potential while minimizing classroom time"[1(p.138)] is an important idea to incorporate into these very fast-paced DNP programs. Commonly, DNP programs enlist math or statistics departments to consult with students on their projects. In our experience, DNP students are often unable to take advantage of such expert consultation due to a mismatch of language, leveling, and analytic software skills. The challenge of classroom time is also real as DNP programs are generally limited credit programs compared to PhD programs, and intended to be of short duration.

The "tailoring" of statistical education to which Oster and Enders[1] refer may be accommodated through the use of DNP project teams and the expertise contained therein. Ideally, the project team would be selected to include experts in particular methods, serving to both direct students to methods appropriate to their project topic and to teach those methods in a "just in time" approach. In our experience, however, the project team is designated according not to methodologic expertise necessarily, but to topical interest, faculty research agendas, or readily available and willing advisors and preceptors. Project team members will come with some methodologic expertise, but such expertise does vary and may not be well matched with student topical interest or feasibly implemented project ideas. At our own institution, our methodologist created a series of "just in time" videos of common statistical methods and examples for students to use as they develop their project methodology. The videos have yet to be evaluated, but students in our program, like students around the country, seem to be opting for simpler, descriptive approaches for the most part.

On the basis of our review of the 667 DNP projects, we present some additional issues in Table 3 that might arise for faculty and students during the project process.

The field can benefit from additional investigation into the use of statistical methods in DNP projects and statistical education in these programs. This brief should serve as a steppingstone to improving understanding and, eventually, patient outcomes. Future research may want to draw distinctions in the analysis between research-intensive and teaching-focused universities. Similarly, perhaps differentiating between preparation of nurses entering DNP programs (ie, BSN to DNP) might provide additional insight. Additionally, investigating DNP Projects for correct use and interpretation of statistics might be useful, along with examining alignment between design, statistical tests, and conclusions.

Conclusions

Nurses make up the largest component of the health care workforce. Statistical literacy is important at all levels. Statistical competency, being a requirement for safe and effective practice, is key to nurses as advanced practitioners and these new leaders and practitioners must understand their project outcomes and those shared in the literature to improve outcomes. With more health professions advancing their scope of practice and expanding the scientific base of knowledge, advanced statistical competency is key. For nurses in advanced roles and their DNP projects, there are additional needs to understand how to apply statistical techniques to design and measure interventions focused on improving the quality, cost, and delivery of health care. Traditionally, advanced statistical education occurs in PhD, research-focused educational programs, but there is now clearly a need to rescope statistical education for DNP students, their programs, and for the systems within which they work. Improved practice and patient outcomes rely on such understanding.

Table 3
Potential Methods Issues Facing Faculty and Students

Potential Issues for Student/Faculty	Possible Remedy
Small sample size	The focus of many projects might be clinic site/organization-specific, therefore generalization to a larger population is not an issue. The site might be the population. Descriptive statistics might be as useful as inferential tests requiring statistical power and larger sample sizes.
Pilot study designation	If the sample size is small, refrain from referring to the project as a "pilot study" as a justification technique. Pilot studies have a technical definition (see National Institutes of Health[14]), and a small "sample" might be the entire population, depending on scope.
Inferential tests	Conducting an inferential test, simply for the sake of having a *P* value might not add value and may detract from the project. If the sample is small, lack of statistical power may have something to do with large *P* values. Moreover, as already noted, the small sample might more closely represent a population.
Effect sizes	With smaller sample sizes, *P* values might not be that meaningful, and inferential tests will lack statistical power. Faculty may want to consider focusing more on effect sizes to demonstrate the magnitude of a relationship between variables/conditions.
P values are not effect sizes	A *P* value does not represent a magnitude of an effect/strength of a relationship. Avoid referring to lower *P* values as being "more clinically significant."
The best laid plans often go awry	Educate students on the realities of data collection. Data can be incomplete, messy, etc. Providing methodological options "just in time" for students might assist them with answering project questions and meeting goals.

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Matthew Jones, PhD, is contributing faculty, School of Public Policy and Administration. Walden University, College of Social Behavioral Sciences, Minneapolis, MN. He can be reached at Matthew.jones2@mail.waldenu.edu. Maria deValpine, RN, MSN, PhD, is a professor, James Madison University School of Nursing, Harrisonburg, VA. Maria McDonald, RN, MSN, FNP, is a student at University of Virginia School of Nursing, Charlottesville, VA. Carolyn Schubert, MLIS, is an associate professor, James Madison University Libraries, Harrisonburg, VA.

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