Statistics Used in Current Nursing Research

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ABSTRACT

Undergraduate nursing research courses should emphasize the statistics most commonly used in the nursing literature to strengthen students' and beginning researchers' understanding of them. To determine the most commonly used statistics, we reviewed all quantitative research articles published in 13 nursing journals in 2000. The findings supported Beitz's categorization of kinds of statistics. Ten primary statistics used in 80% of nursing research published in 2000 were identified. We recommend that the appropriate use of those top 10 statistics be emphasized in undergraduate nursing education and that the nursing profession continue to advocate for the use of methods (e.g., power analysis, odds ratio) that may contribute to the advancement of nursing research.

A dilemma faced by teachers of nursing research in undergraduate baccalaureate programs is identifying the key concepts that would be most meaningful to students as they enter professional practice. Statistics have been an integral part of nursing practice and research since the beginning of modern nursing. Florence Nightingale's innovative use of descriptive statistics and her use of the now-famous radial graphs, sometimes called *coxcombs,* represents an early and effective use of statistical analysis of data in nursing research. This marked the spread of the use of statistical analysis in nursing, which migrated from the larger field of 19th-century biomedical research (Nightingale, 1859).

Nursing curricula include a component of statistical methods as part of nursing research courses to enable students to understand current research and contribute to its ongoing discussion. Learning statistics can be a difficult task for any student, and nursing students often struggle with learning the concept and the transfer of their knowledge to nursing literature (Schuster & Ritchey, 1998). Such difficulty can often deter students from furthering their nursing degree (Stranahan, 1995).

In developing statistics courses for undergraduate nursing students, it is important to consider how to teach statistics, what statistics to teach, and what statistics are common in the literature to provide students with a basic comprehension of data that will enable them to interpret statistical results. Therefore, it is important to identify the statistical tests and procedures needed to comprehend modern nursing research.

Nursing journals frequently publish articles in which a basic understanding of statistics is assumed for an educated reading of the research. To guide nursing instructors, we aimed in this research to identify the statistical tests used most frequently in nursing research articles. We anticipate that this information could then help faculty in emphasizing the statistics nurse readers would most likely encounter.

THEORETICAL FRAMEWORK

The teaching of statistics can be linked to the Conversation Theory of Gordon Pask (1975). His theory focused on the premise that "learning occurs through conversations about a subject matter which serve to make knowledge explicit" (Theory Into Practice Database, n.d., Overview Section, ¶1). Pask's (1975) theory serves as a foundational component to student learning of statistics through the application of cognitive learning. His methods of teaching relationships and the use of problem-solving strategies facilitate an under-

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standing of statistics. Pask's work provided the early steps for later use of learning theories related to teaching statistics. An appropriate assumption made on the basis of Pask's theory is to teach statistics so students have the advantage of performing statistics while learning the concepts.

LITERATURE REVIEW

Johnson (1984) and Knapp and Miller (1987) wrote two of the early articles addressing the incorporation of statistical concepts and biometrical methods into undergraduate nursing curricula. Johnson (1984) argued that many nursing students have high levels of anxiety regarding their mathematical ability and recommended that statistical concepts be taught simultaneously with a nursing research course. Knapp and Miller (1987) recommended that in addition to requiring college algebra, statistics, and an introduction to biomedical computing, nursing programs must ensure that these courses are relevant to nursing. Similarly, Stranahan (1995) concluded that being enrolled in both classes simultaneously is more beneficial to learning. In addition, Schuster and Ritchey (1998) agreed and found that an interdisciplinary statistics course incorporating the mathematics of both statistics and nursing research enabled students to interpret "the meaning of the statistics within the context of the nursing research literature" (p. 34).

Johnson (1984), Knapp and Miller (1987), Beitz and Wolf (1997), and Robinson (2001) asserted that to make statistics meaningful, the examples used in teaching statistical techniques need to be relevant to learners. Beitz and Wolf (1997) recommended that to make statistical concepts seem less abstract, educators should build in concrete activities that make the concepts more meaningful. According to Beitz (1998), students' greatest confusion in using statistics is in transferring statistical knowledge and selecting the most appropriate statistical test for a given situation. To that end, Beitz developed an organized table that lists the statistical tests central to nursing research and provides students with an overview of the definition and application of a variety of statistical measures. Robinson (2001) acknowledged Beitz's work and developed the Guidelines for Statistical Analysis (p. 137), as well as the Golden Rules for Statistical Analysis Adequacy (p. 138).

Authors agree that knowledge of statistics is a vital and essential skill, necessary for the progression of the nursing profession, and needed for students to be able to read, interpret, and integrate nursing research (Robinson, 2001; Schuster & Ritchey, 1998; Taylor & Muncer, 2000).

The literature offers little information regarding which, if any, statistical techniques are used most frequently and which should therefore receive greater emphasis in statistics courses. Although Beitz (1998) developed a chart listing the major statistical tests, she provided no explanation of the criteria for a test to be considered *major.* If frequently used tests could be identified, taught, and emphasized in undergraduate programs, educators could spend more time providing application opportunities and less time on seldom used or higher level statistics that are beyond the needs of beginning learners.

Graduate nursing research courses could build on this knowledge, as Knapp and Miller (1987) suggested. Graduate courses could explore the lesser known but equally as important and higher level statistical techniques. The purpose of this article was to identify the most frequently used statistics in nursing research today so that educators would be able to share the results with beginning nursing researchers, enabling them to apply and critique this information.

A content analysis of current nursing research provides many useful results. It informs readers of current topics of professional interest and summarizes the principle methods used in research. It identifies the topics that might be highlighted in classroom discussions to empower students to become more literate readers of nursing journals. This study joins a number of analyses of statistical methods in professional research (Beitz, 1998; Polit & Sherman, 1990; Robinson, 2001; Taylor & Muncer, 2000), which identify the key statistical tools used in research. As such, it serves as a guide to educators about appropriate classroom topics and a resource to learners of essential research skills.

METHOD

We reviewed a selection of 462 articles from 13 nursing journals published in 2000. In choosing the journals for inclusion in the study, we believed it desirous to incorporate those with wide readership, as well as those publishing extensive scholarship. The nursing journals used in this study were identified through a three-step process. First, we used the "Brandon/Hill Selected List of Print Nursing Books and Journals" (B/H) by Hill and Stickell (2002). The B/H is a "guide for nurses and librarians who find themselves responsible for choosing a collection of current nursing literature" (Hill & Stickell, 2002, p. 100); it also includes a comprehensive list of journals identified as key components of any library.

Using the B/H list, we then cross-referenced those journals with the *Key and Electronic Nursing Journals: Characteristics and Database Coverage, 2001 ed.* (KENJ), a comprehensive guide of more than 200 national and international nursing journals compiled by Margaret Allen (2001). Journals are included on the KENJ list on the basis of criteria of peer review; research percentages (i.e., percentages of research articles for the journal for a particular year); inclusion in the B/H, the Canadian Nursing Association list, and/or the Nursing Research Journals Index; or being indexed in the British Nursing Index, CINAHL, PubMed/Medline, and other databases.

The final step was to identify those journals for which the annual percentage of published research articles was 40% or more. Thirteen journals, representing 11 specialty areas, were chosen using this process. See **Table 1** for a complete list of the journals selected, including the percentage of research published annually and the number of articles reviewed for this study. Each issue of the selected journals was reviewed, and all quantitative research articles (N = 462) were scrutinized for the kinds of statistical methods used. By mutual agreement, we designed a data-reporting grid,

focusing on the specific statistical methods used. Because all authors were responsible for data collection, interrater reliability was established via concurrent review of two previously published research articles, with group discussion and review to determine consistency of data identification.

RESULTS

After all 462 articles were reviewed, it became apparent that regardless of journal orientation or focus, authors used and consistently reported using similar statistical methods. These similarities served as the basis for creating a set of categories of statistical methods that would summarize our review. The typology used by this study, although developed independently, came to mirror the descriptions of statistical techniques noted in other studies (Beitz, 1998); the results are reported in **Table 2.**

TABLE 1

Journals Selected for Inclusion in the Study, Percentage of Research Published Annually, and Number of Articles Reviewed

Journal Title	Specialty Area	% of Research Published Annually	No. of Articles Reviewed
American Journal of Critical Care	Critical care	73	28
Applied Nursing Research	Research	71	22
Cancer Nursing	Cancer	69	34
Heart & Lung: The Journal of Acute and Critical Care	Critical care	58	25
Journal of Advanced Nursing	Research	65	160
Journal of Community Health	Community health	60	12
Journal of Nursing Administration	Administration	35[a]	28
Journal of Nursing Care Quality	Administration	41	15
Journal of Nursing Education	Education	46	22
Journal of Nursing Scholarship	Research	48	27
Journal of Obstetric, Gynecologic, and Neonatal Nursing	Maternal-child	40	24
Nursing Research	Research	83	42
Western Journal of Nursing Research	Research	73	23

[a] *Although below the cut-off point of 40% research published annually, this journal was selected for its accessibility and wide readership.*

Descriptive Statistics

Descriptive statistics were the tools used most frequently in the nursing research articles. Measures of central tendency and dispersion accounted for approximately 63% of the statistics used. Authors assumed readers were familiar with the basic concepts of mean, median, variance, and standard deviation, as well as the use of percentiles and percentages in research. Many articles also displayed these statistics in plots or graphs. Although these tools were often carried into more formal discussions, they in themselves often provided useful and relevant information gained from the nursing research. These techniques are an assumed base of knowledge for nurses and are another indication of the ongoing need for nursing students to master mathematical skills early and comprehensively, as advocated by Knapp and Miller (1987).

Inferential Statistics

Most authors subjected their instrument to a measurement of reliability; the most commonly applied measurement was Cronbach's alpha. However, the next step of analysis, the examination of the scores of the instrument, varied widely. Many authors simply tabulated the scores or plotted their frequency.

Interestingly, although most researchers used well-known statistical methods, such as *t* tests, analysis of variance (ANOVA), and regression analysis in its many forms, individual research needs often guided authors to other, lesser known tests. Although it is possible to compile a list of common statistical tests (e.g., the top 10 list presented in **Table 3**), a comprehensive handbook of statistical methods is always an important reference tool to consult when reading nursing research (Polit, 1996).

Additional Findings

Articles addressing the nature of biomedical research (Cummings & Rivara, 2003; International Committee of Medical Journal Editors, 1997) have suggested that it would be more appropriate to use odds ratios as a way of expressing research outcomes. Where the outcomes of logistic regression have required it, this method of statistical reporting was described. In reviewing the articles for this study, we found that this approach is just beginning to be used in nursing research and, in fact, would have been number 11 if the top 10 list were expanded.

Our readings also confirmed that nursing research has not included reference to the appropriateness of sample size, which often limited the generalization of study conclusions (Kachoyeanos, 1998; Polit & Sherman, 1990). Although sample sizes were usually clearly defined and the methods used for sample selection discussed, a closer analysis of sample

TABLE 2

Statistics Used in the Journal Articles Reviewed and Frequency of Their Occurrence

Statistic	*n* (%)
Descriptive statistics: Measures of central tendency	
Mean	261 (12.4)
Median	41 (2)
Mode	12 (0.6)
Frequency distribution	189 (9)
Graphs and plots	
Bar graphs	61 (2.9)
Dot plot	16 (0.8)
Line graph	25 (1.2)
Skew	3 (0.1)
Descriptive statistics: Measures of dispersion	
Variance	4 (0.2)
Standard deviation	209 (10)
Range	129 (6.1)
Percentages, percentiles, and quartiles	361 (17.2)
Inferential statistics: Parametric	
Z score	4 (0.2)
t test, independent and dependent	124 (5.9)
Analysis of variance (ANOVA), all kinds	100 (4.8)
Multiple comparison/post-hoc tests (e.g., Scheffe, Tukey)	34 (1.6)
Analysis of covariance (ANCOVA)	12 (0.6)
Correlation	109 (5.2)
Cronbach's alpha	82 (3.9)
Regression, all kinds	77 (3.7)
Odds ratio	27 (1.3)
Discriminant analysis	2 (0.1)
Factor analysis	23 (1.1)
Inferential statistics: Nonparametric	
Chi square	114 (5.4)
Mann-Whitney test	18 (0.9)
Kruskal-Wallis test	9 (0.4)
Wilcoxon's test	13 (0.6)
Fisher's exact test	12 (0.6)
McNemar test	5 (0.2)
Power analysis	24 (1.1)
Total	2100 (100.1)

Note. Percentages do not equal exactly 100% due to rounding.

TABLE 3

Top 10 Statistics[a] Used in the Journal Articles Reviewed and Frequency of Their Occurrence

Statistic	*n* (%)
Descriptive statistics: Measures of central tendency	
Mean	261 (12.4)
Frequency distribution	189 (9)
Descriptive statistics: Measures of dispersion	
Standard deviation	209 (10)
Range	129 (6.1)
Percentages, percentiles, and quartiles	361 (17.2)
Inferential statistics: Parametric	
t test, independent and dependent	124 (5.9)
Analysis of variance (ANOVA), all kinds	100 (4.8)
Correlation	109 (5.2)
Cronbach's alpha	82 (3.9)
Inferential statistics: Nonparametric	
Chi square	114 (5.4)
Total	1678 (79.9)

[a] *The top 10 statistics represent approximately 80% of all statistical measures used in the 462 articles reviewed.*

size was often lacking. Readers were then required to consult standard works on research design and sampling methods to judge the adequacy of the sample for the research questions explored. Nurse researchers are still not using power analysis, which is used to estimate the size of a sample needed to obtain a significant result, in their discussions. Kachoyeanos (1998) noted that "In recent review of nursing research, the overall lack of adequate statistical power became quite clear" (p. 105). In addition, Polit and Sherman (1990) stated that "nursing research needs to pay greater attention to issues of power in designing their studies" (p. 368).

CONCLUSION

The widespread use of statistical methods in a variety of nursing journals underscores the importance of including statistical skills in nursing education. A review of more than 400 nursing research articles revealed that regardless of journal orientation and focus, the same 10 statistics were repeatedly used in approximately 80% of the research. These 10 statistics were included in the chart developed by Beitz (1998) and termed "major statistics and statistical tests" (p. 49). We contend that initial statistics and nursing research courses should emphasize these 10 statistics to strengthen students' and beginning researchers' understanding.

Pask's Conversation Theory (1975), while applicable to any teachable subject, provides an extensive overview and

discussion of the use of learning statistics. The main emphasis of the theory is to teach back what a person had learned; in other words, manipulation of the subject matter facilitates learning. Although not all students learn in the same manner, using Pask's theory would allow students to learn the subject as well as the relationships among the concepts, which aids in the understanding and application of statistics and how this applies to nursing.

At the same time, as nursing research becomes more sophisticated, it is clear that greater understanding of the techniques and issues of quantitative study needs to be emphasized. The nursing profession should continue to move forward in the use of more advanced statistical analyses, including logistic regression and power analysis.

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