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Research Report

Use of Statistics in *Physical Therapy* Over a 2-Year Period—2000-2002: Implications for Educators

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Background and Purpose. *Statistics are a tool that can be used to organize, summarize, and interpret information provided by research. An analysis of which statistical techniques are used most often in journals will help to identify those techniques most essential for understanding research. Similar studies have been performed to analyze statistics used in other disciplines such as psychology, education, and various areas of medicine, but no such study has been undertaken in the field of physical therapy. The purpose of this content analysis is to identify the types of statistical techniques used in Physical Therapy.* ***Methods.*** *In order to determine the types of statistics and the frequency of techniques used, all articles from July 2000 through July 2002 were examined for the frequency of statistical techniques.* ***Results.*** *Findings of this study showed that the 10 most common statistical techniques used were as follows (in order of most frequent to least frequent): descriptive statistics, one-way analysis of variance (ANOVA), t test, factorial ANOVA, intraclass correlation, appropriate post hoc analyses, Pearson correlation, regression, chi square, and nonparametric tests analogous to the t test. Understanding these 10 statistical techniques would allow the reader to understand 80% of statistical techniques used in Physical Therapy during this 2-year time period.* ***Discussion and Conclusion.*** *Comprehension of these most common statistical techniques is very important in allowing the reader to begin to understand and critique the physical therapy literature. This article provides new and unique information, which may help educators design statistics courses for professional (entry-level) physical therapist students.*

Key Words: *Research, Statistics.*

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INTRODUCTION

Outcomes research to provide evidence for physical therapy examination and intervention has become a primary goal for the profession of physical therapy.[1] In order to provide the graduating physical therapist with the tools needed to effectively and accurately examine outcomes research, a solid background in research design and statistical analysis is an advantage.[2,3] Evidence of the importance of research in the profession of physical therapy can be found in the *Evaluation Criteria for Accreditation of Education Program for the Preparation of Physical Therapists.*[4] The evaluative criteria for graduates of a professional (entry-level) physical therapy program related to research come under the heading of "Critical Inquiry and Clinical Decision-making" and include:

> *3.8.3.10. Evaluate published studies related to physical therapy practice, research, and education.*[4(p15)]

> *3.8.3.12. Participate in scholarly activities to contribute to the body of physical therapy knowledge (eg, case reports, collaborative research).*[4(p15)]

A case could be made that in order to most effectively meet the evaluative criteria of evaluating published studies and participating in collaborative research, a basic knowledge of statistics is needed. Portney and Watkins[3] defined *statistics* as a means of organizing, summarizing, and analyzing a compilation of numbers representing empirical observations from a group of individuals (raw data) so that the meaning of their numbers can be communicated. Domholdt[2] emphasized the importance of understanding statistics in order to provide a strong basis for understanding the data analysis and results sections of research articles in the physical therapy literature and thereby evaluate published studies. Finally, LaPier emphasized that "with the recent flood of statistical computer programming understanding of the how of a statistical test is less important than understanding the why of statistical tests."[5(p19)]

With these definitions and opinions in mind, to what level should physical therapy educators teach statistics as part of their research and critical inquiry component of the curriculum? More specifically, given that so many statistical tests exist—too many to include even in textbooks devoted solely to statistics—which statistical tests should be taught to entry-level physical therapists?

In a "focused" issue on research in *Gerinotes*, the Journal for the Geriatrics Section of the American Physical Therapy Association (APTA), LaPier and Donavan[6] reviewed "common" statistical procedures. The authors included *t* tests, analyses of variance (ANOVA) (one-way and factorial), Pearson correlation, intraclass correlation coefficient (ICC), linear regression, and nonparametric tests analogous to the *t* test in their description of "common" statistical tests. The inclusion of these tests as "common" is consistent with an article published in the journal of the Cardiopulmonary Section of APTA written a year earlier.[5] However, these 2 articles do not provide evidence that these statistical procedures are truly "common" in physical therapy literature.

One method that can be used as a guide for developing a baseline for the statistical procedure that should be presented to physical therapist students in an entry-level curriculum is to survey the statistics that are utilized in the official journal of APTA—*Physical Therapy*. Such an analysis will identify the statistical techniques that are used most often and, therefore, may be most essential for the understanding and evaluation of published studies related to physical therapy practice, research, and education. To date, no study has provided information as to the types and frequency of statistics utilized in *Physical Therapy*. Therefore, the purpose of this study was to perform content analysis to identify the types of statistics used in *Physical Therapy*.

METHODS

Types of Articles

According to the "Information for Authors" published in a recent issue of *Physical Therapy*, a man-

uscript is considered for review if it fits into 1 of 6 categories of peer-reviewed articles: Case Report, Research Report, Technical Report, Literature Review, Perspective, and Update.[7] All original articles published in *Physical Therapy* from July 2000 through July 2002 were reviewed for inclusion in the content analysis. (Note: the January 2001 issue of the journal was a publication of the second edition of the *Guide to Physical Therapist Practice* and was not included in this review. Therefore, 24 issues of *Physical Therapy* were analyzed.) The articles were reviewed individually and according to categories established by the editors of *Physical Therapy*. A priori, it was decided that all articles categorized as Research Report would be included for further data analysis.

Procedures

I examined each article that was included for analysis, with assistance from a professor with over 20 years of experience teaching research and applied statistics to students in the health sciences and serving as statistical consultant to the authors of theses and dissertations. Only those statistical techniques expressly stated within an article or presented in a table within an article were used for assessment. All techniques present within the article were identified and tabulated. If a given technique was used more than once in the same article, the technique was coded only once. For example, if an ICC was used to determine intrarater reliability in addition to interrater reliability, ICC was coded one time for the article.

Statistics were classified into categories. Classification into the categories was based on a review of categories used in other studies examining journals using similar procedures[8-17] and a review of statistical techniques in statistical textbooks.[18-20]

Data Analysis

The frequency of occurrence by technique and the cumulative frequency by technique during the 2-year period were tabulated. Frequency of occurrence by technique is an indication of how many times each statistic occurred. For example, data were tabulated indicating how many times a one-way ANOVA occurred in articles published divided by the total number of statistical techniques reviewed in *Physical Therapy*.

Cumulative frequency by technique is a tabulation of frequency to indicate how much of the statistics in the literature a reader would be able to understand with a certain level of knowledge about statistics. To determine cumulative frequency by technique, the following procedure was used:

1. The frequency that each statistic was used was ranked from highest (most frequent) to lowest (least frequent).
2. In hierarchical order based on frequency (from most frequent to least frequent), each statistic was examined as to the frequency of use in combination with a more frequent statistic. This number was then divided by the total number of statistics used during the 2-year period to determine a percentage.

RESULTS

During the time from July 2000 through July 2002, 138 articles were published in *Physical Therapy*. Upon review of the types of articles in the journal, a seventh category, which was not included in the listing in the "Information for Authors"[7] was identified. This seventh category was called Special Series. Given that these Special Series manuscripts were invited, this category was not included in the content analysis of statistics.

Of these 138 articles, 90 (65.2%) were identified as Research Reports. The remaining 34.8% of the articles (which consisted of Special Series, Case Reports, Perspectives, Updates, and Technical Reports) were not included. The frequency of occurrence of each type of article is presented in Table 1.

Twenty-five categories of statistics were identified in these articles, combining for a total of 307 identified statistical techniques in the 138 articles. A listing and description of all of the statistical techniques that were used to assess the statistical content of the articles for this study are presented in Table 2. In addition, a brief statement of the inclusive criteria for each category is given in the table.

Table 3 presents information on the number and percentage of occurrence of statistical methods used in *Physical Therapy* in descending order of frequency. The most common statistics used were descriptive statistics, which resulted in 88 (28.7%) of the 307 occurrences of statistics during the 2-year span. The one-way ANOVA (7.8%), *t* test (7.5%), factorial ANOVA (6.8%), ICC (6.5%), and *post hoc* testing (6.5%) rounded out the top 7 most frequently used statistics.

Table 3 also contains the cumulative frequency by technique, which indicates how many statistics a reader would be able to understand with a certain level of knowledge about statistics. For example, with an understanding of descriptive techniques alone, a reader would have access to over one fourth of the total techniques used (28.7%). Knowledge of the 4 most frequently used statistics (descriptive statistics, one-way ANOVA, *t* test, factorial ANOVA) would allow the reader to be able to understand one half (50.8%) of all statistical techniques used. In order for a reader to comprehend 80% of the statistical techniques currently used in the literature, additional knowledge in the following 6 statistics (10 statistics in all) would be required: intraclass correlation, *post hoc* testing, Pearson correlation, regression, chi square, and nonparametric tests analogous to the *t* test. One would need to be familiar with an additional 15 categories of statistical techniques in order to be able to understand 100% of the techniques utilized in *Physical Therapy*.

DISCUSSION

This report provides new and unique information, which may help educators design statistics courses for entry-level physical therapist students. This study may also be of interest to clinicians who want to understand the statistics used in their professional journal.

A review of previous research into the use of statistical techniques in articles from other health-related journals[8-17] using procedures similar to those used in this study demonstrated findings comparable to those of this study. In all previous research and in this study, descriptive statistics were determined to be the most frequently occurring of all techniques. For example, in the study of statistical analysis in the *New England Journal of Medicine*, the researchers determined that 58% of the articles published during the years 1978 and 1979 used either no statistics or descriptive statistics alone.[9] The *t* test was the next most frequently

Table 1
Frequency of Occurrence of Each Type of Article in *Physical Therapy* July 2000 Through July 2002

Type of Article	No. of Articles	% of Articles
Research Report	90	65.2
Special Series	15	10.9
Case Report	13	9.4
Update	10	7.2
Perspective	7	5.1
Technical Report	3	2.2
Literature Review	0	0
Total	138	100

Table 2.
Categories of Statistical Methods Used to Assess the Statistical Content of Articles[a]

Category	Description
Chi-square test	Chi square, Fisher exact test
Cochran *Q* test	Analysis of whether proportions are significantly different
Cronbach alpha	Provides estimates of reliability
Descriptive statistics	Mean, median, mode, range, standard deviation, standard error of the mean
Discrimanant analysis	A form of regression used when the dependent variable is categorical
Epidemiological statistics	Sensitivity, specificity, odds ratio, receiver operating characteristics
Factor analysis	Varimax, orthogonal rotation, principal component analysis
Factorial ANOVA	ANOVA with 2 or more independent variables
Fisher *r*	Analysis that compares correlated coefficients
ICC	A reliability coefficient based on analysis of variance
Kappa coefficient	A coefficient of agreement
Meta analysis	A process of statistically combining the findings of several studies to obtain a summary analysis
Nonparametric ANOVA	Nonparametric equivalent of one-way ANOVA, including Kruskal-Wallis test, Friedman test
Nonparametric *t* test	Nonparametric equivalent for *t* test, including Sign test, Wilcoxon test, Mann-Whitney test
One-way ANCOVA	Use of covariant with one independent variable
One-way ANOVA	ANOVA with one independent variable
MANOVA/MANCOVA	ANOVA with more than one dependent variable
Other correlations	Partial correlation, canonical correlation
Other reliability analysis	Generalizability coefficient, modified Webster correlation scale, Kendall tau, methodological rigor
Pearson correlation	Correlation, parametric data
Post hoc multiple comparison	Tukey honestly significant difference, Newman-Keuls procedure, Duncan multiple range procedure, Scheffé contrast, Fisher least significant difference
Regression	Linear, polynomial, stepwise regression
Spearman correlation	Nonparametric equivalent for correlation
Trend analysis	Trend analysis, celeration lines, time-series analysis
t test	One-sample, matched-pair, and 2-sample *t* tests

[a]ANOVA=analysis of variance, ICC=intraclass correlation coefficient, ANCOVA=analysis of covariance, MANOVA=multivariate analysis of variance, MANCOVA=multivariate analysis of covariance.

used statistic (24%). A study that assessed statistical techniques in 8 otolaryngology journals in combination with *JAMA*, the journal of the American Medical Association showed that 43.8% of the articles published between 1983 and 1984 reported only descriptive statistics or no statistics.[14] Again, the *t* test was the next most frequently used statistic (4%).

Of interest is to compare the content analysis of the frequently used statistics in *Physical Therapy* to the definition of "common" statistical tests as presented by LaPier and Donavan.[6] These authors defined common statistical tests as *t* test, ANOVA (one-way and factorial), Pearson correlation, ICC, chi square, regression, and nonparametric tests analogous to the *t* test. Examining the combined frequencies of how often these statistical tests occurred in *Physical Therapy* from the data presented in Table 3 indicates that these tests account for 86% of the statistics used. Such a high percentage provides evidence that the definition of "common" statistical tests is accurate.

Also of interest is the frequent use of nonparametric statistics in *Physical Therapy*. Traditional course work in research design and statistics usually emphasizes parametric statistics, while sometimes overlooking the importance of nonparametric statistics. Combining frequency of all nonparametric statistics from the data presented in Table 3 indicates that 11.4% of the statistics used in *Physical Therapy* were nonparametric, possibly emphasizing the importance of including these types of analysis in the curriculum.

One limitation to this study is that at no time was an attempt made to determine if the statistical test utilized in each study was used appropriately. If a statistic was used in the study being analyzed, the test was simply tallied. Although it can be assumed that the editors do an excellent job of ensuring the quality and accuracy of the statistical methods of the studies published in *Physical Therapy*, it is ultimately up to the readers to assess the appropriateness of the statistical methods on their own in order to judge the strength of the study being presented.

An additional limitation to this study is that only one journal was analyzed over a 2-year period. In order to provide more information as to the types of statistics used in the physical therapy professional literature, future research is needed to analyze types of statistical techniques being used among the different areas within the realm of physical therapy, such as pediatrics, geriatrics, education, orthopedics, and sports. Additionally, a comparison of physical therapy literature to other professional literature, such as current medical journals, could be performed to determine similarities and differences.

A final limitation is that no consensus exists as to the categories used in this study for the classification of the statistical analysis. For example, a category could have been used called "*correlation*" and that category could have included: ICC, Pearson, Spearman rho, and partial and canonical correlations. An attempt was made to base the classification of techniques on generally agreed categories that most readers would be familiar. It is believed that the way in which the data are presented in Table 3 allows the reader to mix and match the statistical tests as the reader sees fit.

CONCLUSION

This study has identified the most common statistical techniques reported in *Physical Therapy*. Data analysis indicated that the 10 most common statistical techniques used were (in order of most frequent to least frequent): descriptive statistics, one-way ANOVA, *t* test, factorial ANOVA, ICC, appropriate *post hoc* analyses, Pearson correlation, regression, chi square, and nonparametric tests analogous to the *t* test. Understanding these 10 statistical techniques would allow the reader to understand 80% of statistical techniques used in *Physical Therapy* during this 2-year time period.

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Table 3
Frequency of and Cumulative Frequency of Statistics Used in Physical Therapy[a]

Technique	#	%	Cum#	Cum%
Descriptive	88	28.7	88	28.7
One-way ANOVA	24	7.8	112	36.5
t test	23	7.5	135	44
Factorial ANOVA	21	6.8	156	50.8
ICC	20	6.5	176	57.3
Post hoc	20	6.5	196	63.8
Pearson correlation	17	5.5	213	69.4
Regression	16	5.2	229	74.6
Chi square	12	3.9	241	78.5
Nonparametric *t* test	12	3.9	253	82.4
Cronbach alpha	9	2.9	262	85.3
Factor analysis	9	2.9	271	88.3
MANOVA/MANCOVA	7	2.3	278	90.6
Spearman correlation	7	2.3	285	92.8
Nonparametric ANOVA	4	1.3	289	94.1
Other reliability analysis (generalizability coefficient, modified Webster correlation scale, Kendall tau)	4	1.3	293	95.4
Kappa coefficient	3	1	296	96.4
Other correlations (canonical, partial)	3	1	299	97.4
Epidemiological	2	0.7	301	98
Trend analysis	2	0.7	303	98.7
Cochran *Q* test	1	0.3	304	99
Discriminant analysis	1	0.3	305	99.3
Fisher *r*	1	0.3	306	99.7
Meta-analysis	1	0.3	307	100

[a]ANOVA=analysis of variance, ICC=intraclass correlation coefficient, MANOVA=multivariate analysis of variance, MANCOVA=multivariate analysis of covariance. # = number of times the statistic was used during the 2-year period, % = percentage of use of statistic during the 2-year period, Cum# = cumulative frequency during the 2-year period, Cum% = percentage during the 2-year period.

REFERENCES

1. Connolly BH, Lupinnaci NS, Bush AJ. Changes in attitudes and perceptions about research in physical therapy among professional physical therapist students and new graduates. *Phys Ther.* 2001;81:1127-1134.
2. Domholdt E. *Physical Therapy Research: Principles and Application.* Philadelphia, Pa: WB Saunders Co; 2000.
3. Portney LG, Watkins MP. *Foundation of Clinical Research: Application to Practice.* 2nd ed. Upper Saddle River, NJ: Prentice Hall; 2000.
4. Commission on Accreditation in Physical Therapy Education. *Evaluative Criteria for Accreditation of Education Programs for the Preparation of Physical Therapists.* Alexandria, Va: American Physical Therapy Association; 2000.
5. LaPier TK. Research corner: the when and why of statistical tests. *Cardiopulmonary Physical Therapy.* 1999;10:19-21.
6. LaPier TK, Donavan C. Statistical care scenarios in geriatric physical therapy research. *Gerinotes.* 2000;7:11-17.
7. Instructions for authors. *Phys Ther.* 2002;81:404-406.
8. Dickinson G, Rusnell D. A content analysis of Adult Education. *Adult Education.* 1971;21:177-185.
9. Emerson JD, Colditz GA. Use of statistical analysis in the New England Journal of Medicine. *N Engl J Med.* 1983;309:709-713.
10. Fromm BS, Snyder VL. Research design and statistical procedures used in the Journal of Family Practice. *J Fam Pract.* 1986;23:564-566.
11. Goodwin LD, Goodwin WL. An analysis of statistical techniques used in the Journal of Educational Psychology, 1979-1983. *Educational Psychology.* 1985;20:13-21.
12. Hokanson JA, Bryant SG, Gardner R, et al. Spectrum and frequency of use of statistical techniques in psychiatric journals. *Am J Psychiatry.* 1986;143:1118-1125.
13. Hokanson JA, Ladoulis CT, Quinn FB, Bienkowski AC. Statistical techniques reported in pathology journals during 1983-1985: implications for pathology educators. *Arch Pathol Lab Med.* 1987;111:202-207.
14. Hokanson JA, Stienberg CM, McCracken MS, Quinn FB. The reporting of statistical techniques in otolaryngology journals. *Arch Otolaryngol Head Neck Surg.* 1987;113:45-50.
15. Menegazzi JJ, Yealy DM, Harris JS. Methods of data analysis in the emergency medicine literature. *Am J Emerg Med.* 1991;9:225-227.
16. Rudolph A, McDermott RJ, Gold RS. Use of statistics in the Journal of School Health 1979-1983: a content analysis. *J Sch Health.* 1985;55:230-233.
17. Welch GE, Gabbe SG. Review of statistics usage in the American Journal of Obstetrics and Gynecology. *Am J Obstet Gynecol.* 1996;175:1138-1141.
18. Huck S. *Reading Statistics and Research.* New York, NY: Longman Publisher; 2000.
19. Tabachnick BG, Fidell LS. *Using Multivariate Statistics.* Philadelphia, Pa: Harper & Row; 1989.
20. Bohrnstedt GW, Knoke D. *Statistics for Social Data Analysis.* Itasca, Ill: FE Peacock Publishers; 1988.