3

Rapid #: -2747624

Ariel
IP: 129.63.184.201

Status	Rapid Code	Branch Name	Start Date
Pending	TFH	Tufts Hirsh Health Sciences	8/28/2009 7:38:57 AM

CALL #: **Shelved By Title**

LOCATION: **TFH :: Tufts Hirsh Health Sciences :: HHSL Journal Stacks**

TYPE:	Article CC:CCL
JOURNAL TITLE:	The American journal of emergency medicine.
USER JOURNAL TITLE:	Am J Emerg Med
TFH CATALOG TITLE:	The American journal of emergency medicine.
ARTICLE TITLE:	Methods of data analysis in the emergency medicine literature
ARTICLE AUTHOR:	Menegazzi JJ, Yealy DM, Harris JS
VOLUME:	9
ISSUE:	
MONTH:	
YEAR:	1991
PAGES:	225-227
ISSN:	
OCLC #:	8996781
CROSS REFERENCE ID:	34389
VERIFIED:	

LM 8/30/09 7PM

BORROWER: **ULN :: OLeary Library**

PATRON: **Ricard,Amanda**

PATRON ID:	-
PATRON ADDRESS:	-
PATRON PHONE:	-
PATRON FAX:	-
PATRON E-MAIL:	-
PATRON DEPT:	-
PATRON STATUS:	-
PATRON NOTES:	

Methods of Data Analysis in the Emergency Medicine Literature

JAMES J. MENEGAZZI, PHD,*† DONALD M. YEALY, MD,‡
JOHN S. HARRIS,†

The authors hypothesized that data analysis in the current emergency medicine literature uses relatively few methods and sought to determine the frequency distributions of each method of analysis. The authors defined their population as original contributions in three refereed emergency medicine journals from September, 1985 through July, 1989. Letters to the editor, brief reports, reviews, and case reports were excluded. The authors reviewed 250 randomly selected articles and identified the method(s) of data analysis in each. The absolute frequency distribution of statistics were as follows: descriptive statistics only, 31%; contingency tables, 35% (χ^2, 28.4%; Fisher's exact test, 13.2%; McNemar's test, 0.4%); Student's *t*-test, 34%; ANOVA/ANCOVA, 12%; regression techniques, 8% (simple linear regression, 4.0%; multiple regression, 3.6%; logistic regression, 1.6%); nonparametric tests, 7% (Mann-Whitney, 2.8%; Wilcoxon, 2.4%; Dunnett, 0.8%; Kolmogorv-Smirnov, 0.4%; Kruskal-Wallis, 0.4%); multiple comparisons, 6% (Scheffé, 4.4%; Newman-Keuls, 2.0%); correlation techniques, 4% (Pearson product-moment correlation coefficient, 2.8%; Kendall's τ, 0.8%; Spearman's ρ, 0.4%); confidence intervals, 2%. Correction techniques were used in 9% (Dunn-Bonnferoni, 4.8%; Yates correction, 4.4%). No statistics were found in 2% of the articles reviewed. Five statistical methods account for the vast majority (97% cumulative) of statistical uses in emergency medicine literature. This information should prove useful in deciding which tests should be emphasized in educating emergency physicians. (Am J Emerg Med 1991;9:225-227. Copyright © 1991 by W.B. Saunders Company)

Emergency medicine research has become increasingly sophisticated over recent years. It is becoming difficult to critically evaluate medical literature without a basic knowledge of statistics and experimental design. Undergraduate and graduate medical training allows little time for the study of these topics. While we have not yet attempted to quantify residents' knowledge base, it is our impression that emergency medicine residents are ill-prepared to detect statistical errors in the literature they read, and/or to design experiments. Emergency physicians are also faced with the additional problem of working variable shifts, adding to the difficulty in taking courses in biostatistics and research design. As a result, emergency physicians often perceive that the task of developing a statistical knowledge base is insurmountable.

To develop a curriculum for our residency program, we examined the frequency distribution of statistics used in emergency medicine literature. From this we hoped to identify a manageable core of techniques to account for the majority of data analysis methods used.

METHODS

We defined our population as original contributions in three prominent refereed emergency medicine journals from September 1985 through July 1989. These were *The American Journal of Emergency Medicine, Annals of Emergency Medicine,* and *The Journal of Emergency Medicine*. Letters to the editor, brief reports, reviews, and case reports were excluded from consideration. Although brief reports sometimes contain comparative analyses, we believed that their inclusion might skew our findings towards underuse of inferential statistics. The total population of original contributions during the study period was 712 articles. We then retrospectively reviewed 250 randomly selected articles (100 from each of the first two journals, and 50 from the last) and identified the method/s of data analysis in each. On selecting each issue for examination, a number was assigned to each original contribution, starting with 1 and ending with the last manuscript. Three to five articles were then randomly selected from each issue, never exceeding one half of the total contributions in a given issue. This was done to prevent overrepresentation of a given type of analysis, which might occur if a single issue was topic focused. For example, resuscitation research is commonly interested in survival as the dependent variable, and this would limit the types of analyses used. A randomization schedule generated by minicomputer software (Epistat, version 3.5) was used for selection. Frequency distributions for each statistical technique were generated along with cumulative distributions of the statistics. No effort was made to determine if the statistics had been appropriately used based on the design and types of variables used in each article.

RESULTS

The absolute and cumulative frequency distributions of statistics used in emergency medicine literature are presented in Table 1. Note that the sum of individual tests may be greater than the overall percentage for a type of statistic because two or more tests were used in a single article. Descriptive statistics only (ie, mean, median, standard deviation, standard error of the mean, and range) were the only statistics used in 31% of the articles reviewed. Contingency tables accounted for 35% of the statistical uses in emergency medicine literature we reviewed. Student's *t*-test was the next most commonly used statistic, used in 34% of the articles reviewed. Analysis of variance (ANOVA) and analysis of covariance (ANCOVA) accounted for an additional 12%

From the *Division of Emergency Medicine, University of Pittsburgh School of Medicine, the †Center For Emergency Medicine Of Western Pennsylvania, Pittsburgh, PA, and the ‡Division of Emergency Medicine, Texas A & M University College of Medicine, Temple, TX.

Manuscript received August 16, 1990; revision accepted December 24, 1990.

Address reprint requests to Dr Menegazzi, Center For Emergency Medicine, 230 McKee Pl, Suite 500, Pittsburgh, PA 15213.

Key Words: Data analysis, statistics, emergency medicine.

0735-6757/91/0903-0005$5.00/0

TABLE 1. Relative and Cumulative Distributions of Statistical Methods from 250 Randomly Selected Manuscripts

Method	Percent Articles	Cumulative Percent
Descriptive only	31.0	31.0
Contingency tables	34.8	66.0
χ^2	(28.4)	
Fisher's exact test	(13.2)	
McNemar's test	(0.4)	
Student's *t*-test	33.6	84.8
ANOVA/ANCOVA	11.6	92.8
Regression techniques	8.4	96.8
Simple linear regression	(4.0)	
Multiple regression	(3.6)	
Logistic regression	(1.6)	
Nonparametric tests	6.8	97.2
Mann-Whitney	(2.8)	
Wilcoxon	(2.4)	
Dunnett	(0.8)	
Kolmogorov-Smirnov	(0.4)	
Kruskal-Wallis	(0.8)	
Multiple comparisons	6.4	98.0
Scheffe	(4.4)	
Newman-Keuls	(2.0)	
Correlation techniques	4.0	98.4
Pearson product-moment	(2.8)	
Kendall's tau	(0.4)	
Spearman's rho	(0.4)	
Confidence intervals	2.0	
No statistics	2.0	100.0

of the statistical techniques observed. Regression techniques account for another 8%, nonparametric tests for an additional 6%, and multiple comparisons were used in 6% of the articles we reviewed.

Additional tests accounted for relatively small increments in the total distribution of statistics used. Correction techniques (Dunn-Bonnferoni, 5%; Yates' correction for continuity, 4%) were used in 9% of the articles and confidence intervals in only 2% of the articles. No statistics were found in 2% of the articles we reviewed.

DISCUSSION

There are relatively few statistical techniques used in a large sample of articles reviewed from three prominent emergency medicine journals. By developing a basic understanding of these few techniques, emergency physicians can greatly enhance their ability to critically evaluate emergency medicine literature. Whereas the number of statistical methods used was relatively small, the uses observed are consistent with the nature of emergency medicine experimentation and investigation.

Because descriptive statistics are commonly the only statistics provided, physicians should familiarize themselves with which statistics best represent measures of central tendency. For example, the median is often a better descriptor of central tendency than the mean when a distribution is skewed, or when ordinal data are collected.[1,2] Also, investigators often prefer to present the standard error of the mean rather than the standard deviation because it will always be the smaller of the two numbers. The standard error should never be used to describe the variability surrounding a sample mean.[3]

The use of contingency tables is to be expected in emergency medicine research because outcome variables are commonly dichotomous in nature, (ie, nominal variables). Much research is interested in survival/nonsurvival and yes/no kinds of questions. Researchers frequently only need to decide whether to use χ^2 or Fisher's exact test on 2×2 contingency tables.[4,5] A simple rule of thumb is to use Fisher's exact when the total number of subjects is less than 20 or there is less than five in any group.[6,7] In addition to being more precise than χ^2, Fisher's exact test has the advantage of either a one-tailed or two-tailed test.

Student's *t*-test has been shown to be the most commonly used statistical test in general medical literature.[8] This test is appropriate when comparisons are made between means of two groups, and interval data (eg, blood levels of a drug, body weight, heart rate) are being compared. Two groups are commonly compared in emergency medicine literature, such as placebo or control groups versus treatment groups. Caution must be used when using Student's *t*-test because it cannot be appropriately used to make multiple comparisons without correcting for effects on the type I error rate. When interval data has been gathered and comparisons are being made between greater than two groups, or when multiple comparisons are being made, ANOVA, ANCOVA, or a multiple comparison technique must be used.[9,10]

Because ordinal data is often gathered during emergency medicine investigation (eg, visual analog pain scales, Glascow coma scores) nonparametric tests accounted for an additional 6.4% of statistical uses.[11] Regression techniques are useful for predicting the outcome of one variable based on data obtained through another variable. This is also a technique that is often of interest to the emergency physicians in trying to decide which factors might influence outcome.

The relatively infrequent use of confidence intervals should be addressed. Too often there is a tendency to focus on the means generated within a single study rather than paying heed to the breadth of values the mean could reasonably have assumed if the study were repeated.[12-15] Authors should be encouraged by editors to provide confidence intervals where appropriate because it provides the reader with additional useful information.

We have used the information from this investigation to assist us in formulating a residency statistics curriculum, presented in Table 2. This 10 lecture series is presented monthly in 1 hour sessions during Emergency Medicine Grand Rounds. The two months excluded (June and July) allow for the transition of new residents. The purpose of the series is to provide the residents with the skills needed to critically evaluate medical literature and to design their own research. In addition to the lecture series, articles presented at each month's Journal Club are also scrutinized methodologically. Emphasis is placed on whether the experimental design is capable of answering the research question(s) and controls potential threats to validity, and whether the appropriate statistics were used.

There are several limitations to this report. Clearly, there is a potential selection bias involved with the present investigation. Only three journals were selected for inclusion in the study; they were chosen for their topic-focused nature.

TABLE 2. Statistics Curriculum

I. Introductory Overview of Biostatistics
II. Statistical Power and Confidence
III. Threats to Validity in Research
IV. Basic Experimental and Quasi-Experimental Designs
V. Choosing a Statistical Test for Your Data
VI. Contingency Tables
VII. Student's *t*-Test and It's Alternatives
VIII. ANOVA, ANCOVA, and Multiple Comparisons
IX. Correlation and Regression
X. Nonparametric Tests

A 10 lecture statistics curriculum presented once monthly at Emergency Medicine Grand Rounds (2 summer months excluded during transition of interns).

Obviously emergency physicians avail themselves of a broader range of journals. While familiarity with these few tests will be sufficient for most physicians in training, junior faculty, and clinicians, research fellows and faculty will likely need more extensive training in experimental design. Physicians also need to familiarize themselves with additional techniques more commonly used in epidemiological studies and reports generated by quality assurance investigations. Finally, a study of this type should ideally be revised every few years as emergency medicine research continues to become increasingly sophisticated.

CONCLUSION

Five statistical methods account for the vast majority of statistics used in emergency medicine literature—97% cumulative. By developing a basic knowledge of these five statistical tests, emergency physicians can greatly improve their ability to critically evaluate emergency medicine literature. Information provided by this study should prove useful when deciding which tests should be emphasized in educating emergency physicians.

REFERENCES

1. Rosner B: Fundamentals of Biostatistics (ed 2). Boston, MA, Duxbury. 1986, pp 6-23
2. Elston RC, Johnson WD: Essentials of Biostatistics. Davis, Philadelphia, PA, 1987, pp 47-52
3. Glantz SA: Biostatistics: How to detect, correct and prevent errors in the medical literature. Circulation 1980;1:1-7
4. Elston RC, Johnson WD: Essentials of Biostatistics. Davis, Philadelphia, PA, 1987, pp 155-176
5. Moses LE, Emerson JD, Hosseini H: Analyzing data for ordered categories. *In* Bailar JC, Mosteller F (eds): Medical Uses of Biostatistics. Waltham, MA, NEJM Books. 1986.
6. Ellenbaas RM, Ellenbaas JK, Cuddy PG: Evaluating the medical literature part two: Statistical analysis. Ann Emerg Med 1983;12:610-620
7. McKinney WP, Young MJ, Hartz A, et al: The inexact use of Fisher's exact test in six major medical journals. JAMA 1989;261:3430-3433
8. Emerson JD, Colditz GA: Use of statistical analysis in *The New England Journal of Medicine*. N Engl J Med 1983;309:709-713
9. Rosner B: Fundamentals of Biostatistics (ed 2). Boston, MA, Duxbury. 1986, pp. 240-267
10. Gore SM, Jones IG, Rytter EC: Misuse of statistical methods: Critical assessments of articles in BMJ from January to March 1976. Br Med J 1977;1:85-87
11. Gaddis GM, Gaddis ML, Morse V: Glascow coma scores and revised trauma scores from trauma patients are not normally distributed. Ann Emerg Med 1990;19:4:461
12. Rothman KJ: A show of confidence. N Engl J Med 1978; 299:1362-1363 (editorial)
13. Bulpitt CJ: Confidence intervals. Lancet 1987;494-497
14. Gardner MJ, Altman DG: Confidence intervals rather than *P* values: Estimation rather than hypothesis testing. Br Med J 1986;292:746-750
15. Simon R: Confidence intervals for reporting results of clinical trials. Ann Intern Med 1986;105:429-435