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A SURVEY OF THE STATISTICAL TECHNIQUES REPORTED IN DENTAL JOURNALS

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치의학논문에 사용된 통계학방법에 관한 조사

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최근에 들어서 개인용컴퓨터가 대중화되고 통계처리를 위한 컴퓨터 소프트웨어들을 쉽게 이용할 수 있게 됨에 따라 치의학연구에 있어서도 컴퓨터를 이용한 자료의 통계적 분석이 증가되고 있으며 그 방법도 갈수록 복잡하고 다양해지고 있다. 따라서 오늘날 급속히 발전하는 새로운 치의학지식의 습득을 위하여 치의학잡지에서 증가되고 있는 통계적 분석방법을 이해하고 평가할 수 있는 통계학지식이 요구된다.

이에 저자는 1975년, 1980년 그리고 1986년에 발행된 5종류의 치의학잡지에서 보고된 논문에서 통계학방법의 종류와 빈도 그리고 통계학방법의 경향을 조사하여 치의학분야의 통계학교육에 필요한 통계학방법을 제시하고자 하였다.

Recently, as a personal computer has become popular and statistical software packages easily could be used, statistical procedures are employed without difficulty. And the use and complexity of statistical procedures has been increased in research articles.[1,2,4,8,9] Today dental knowledge is advancing too rapidly. Journal serves as an important channel to learn new knowledges. If reader is unable to understand the statistical workings of published article, to obtain new knowledge is difficult. Dentist should receive statistical education to understand and evaluate the current research papers in dental journals.

The purposes of this survey are to (1) describe the statistical techniques and its frequency with which were reported in dental journals, (2) investigate statistical trend, and (3) determine if statistical education covers these statistical techniques.

Materials and Methods

I inventoried the statistical techniques reported in 1886 articles appearing in the 1975, 1980, and 1986 issues of 5 dental journals. The journals consisted of American Journal of Orthodontics (A.J.O.), Journal of American Dental Association (J.A.D.A.), Journal of Oral and Maxillofacial Surgery (J.O.S.), Journal of Periodontology (J. Perio), and Journal of Prosthodontics (J. Prosth.). Articles such as original research articles, case reports, and literature review were employed. Each article using statistical procedure was categorized as table 1.

Table 1. Categories of statistical methods.

1. Descriptive statistics only
2. T-test: one-sample, two-sample, matched-pair t-test.
3. Analysis of variance: one-way, two-way, MANOVA.
4. Chi-square
5. Pearson correlation
6. Multiple comparision: LSD, Tukey, SNK and Duncan test, Scheffe, and Neumann-Keuls procedures.
7. Simple linear regression
8. Multiple linear regression: includes stepwise regression.
9. Nonparametric test: Mann-whitney test, Kruskal-Wallis test, Wilcoxon matched-pairs signed-ranks test, Friedman test, Fisher's exact test, Kolmogorov-Smirnov test.
10. Nonparametric correlation
11. P value not specified.
12. Others: discriminant, factor, cluster analysis, etc.

No matter how many times a specific statistical procedure was used within one article, it was recorded only once for that article. If two statistical procedures were used within one article, each statistical procedure was counted seperatively. I omitted mathematical procedures requiring no particular knowledge of statistics for the reader to comprehend (such as sum, mean, percentage, and range). If the concept of dispersion (SD, SDE) was used with mathematical procedures, it was included in the "descriptive statistics only" category. Only when the article did not contain the statistical procedure of any of the other categories, it was included in this category. If a "P value" was reported, I attempted to identify the statistical technique to be used. Articles that referred to the statistical significance of a hypothesis test but did not explicitly identify a particular technique were included in the "P value not specified" category. Any technique cited less than two times per year in all journals surveyed was combined into the "Others" category. All articles reviewed scored according to Table 1 category. The frequency of statistical techniques was calculated for each journal in 1975, 1980, and 1986. To determine if statistical education covers these statistical techniques, two textbooks of statistics were chosen that are popularly employed on master-course at college of Dentistry in Korea.: Methods of medical statistics written by Lee,[10] and medical statistics by Academy of Korean medical statistics.[11]

Results

The proportion of articles employing statistical procedures increased dramatically over the surveyed interval. The percentage of sta-

tistical articles rose from 26% in 1975 to 46% in 1986. (table 2)

Table 2. Numbers of articles and statistical articles.

Year	No of articles reviewed	No of statistical articles
1975	461	120 (26%)
1980	658	226 (34%)
1986	767	352 (46%)

The proportion of statistical articles in 5 dental journals was shown in table 3. In American Journal of Orthodontics the percentage of statistical articles increased most dramatically, from 28% in 1975 to 81% in 1986. In Journal of Oral and Maxillofacial Surgery statistical procedure was most infrequently used (6% in 1975, 23% in 1986). This journal included a lot of case reports.

The frequency and percentage of the various statistical procedures used in all articles reviewed are presented in table 4. The procedures are listed in the table in the order determined by the frequency of their use. T-test was most commonly used in statistical articles in dental field. The first five listed in table 4 consistuted about three-fourths of all statistical procedures (t-test, analysis of variance, descriptive statistics, pearson correlation, and chi-square).

Table 3. Numbers of articles and statistical articles for each journal reported in 1975, 1980, and 1986.

Name of Journal	Year	No of articles reviewed	No of statistical articles
A.J.O.	1975	71	20 (28.2%)
	1980	92	47 (51.1%)
	1986	93	75 (80.6%)
J.A.D.A.	1975	89	18 (20.2%)
	1980	110	27 (24.5%)
	1986	110	41 (37.3%)
J.O.S.	1975	80	5 (6.3%)
	1980	135	12 (8.9%)
	1986	181	41 (22.7%)
J. Perio	1975	83	35 (42.2%)
	1980	102	60 (58.8%)
	1986	107	48 (44.9%)
J. Prosth.	1975	138	42 (30.4%)
	1980	219	80 (36.5%)
	1986	276	147 (53.3%)

Table 4. Frequency and percentage of statistical procedures in all articles reviewed.

Statistical procedures	No of article	Percentage
T-test	233	23.6%
Analysis of variance	220	22.3%
Descriptive statistics	114	11.6%
Pearson correlation	86	8.7%
Chi-square	81	8.2%
Multiple comparision	80	8.1%
Nonparametric test	69	7.0%
Simple regression	25	2.5%
Multiple regression	24	2.4%
Nonparametric correlation	22	2.2%
Others	6	0.6%

The statistical trend was shown in table 5. The percentage of articles in which t-test was used decreased from 28.7% in 1975 to 20.6% in 1986. The percentages of articles in which multiple comparision and nonparametric test

Table 5. Statistical trend in 5 dental journals.

Statistical procedures	1975	1980	1986
T-test	43 (28.7%)	83 (26.2%)	107 (20.1%)
Analysis of variance	33 (22.0%)	61 (19.2%)	126 (24.3%)
Descriptive statistics	20 (13.3%)	33 (10.4%)	66 (11.8%)
Pearson correlation	12 (8.0%)	25 (7.9%)	49 (9.4%)
Chi-square	12 (8.0%)	33 (10.4%)	36 (6.9%)
Multiple comparision	4 (2.7%)	26 (8.2%)	50 (9.6%)
Nonparametric test	7 (4.7%)	25 (7.9%)	37 (7.1%)
Simple regression	3 (2.0%)	5 (1.6%)	17 (3.3%)
Multiple regression	5 (3.3%)	6 (1.9%)	13 (2.5%)
Nonparametric correlation	3 (2.0%)	10 (3.2%)	9 (1.7%)
Others	0 (0%)	2 (0.6%)	4 (0.8%)

Table 6. Comparision with the contents in two textbooks.

Statistical procedures	A text	B text
Descriptive statistics	O	O
T-test	O	O
One-way ANOVA	O	O
Two-way ANOVA	O	O
MANOVA	X	X
Multiple comparision	X	X
Chi-square	O	O
Simple regression	O	O
Multiple regression	X	X
Pearson correlation	O	O
Nonparametric test	O	X
Nonparametric correlation	X	X
Others (discriminant, factor, cluster)	X	X

were used prominently increased in 1980. The proportion of articles employing others statistical procedures (Discriminant, Factor, Cluster analysis, etc.) increased from 0% in 1975 to 0.8% in 1986.

Table 6 shows comparision with the contents in two textbook of statistics to determine if these cover statistical procedures used in dental journals. Two textbooks did not contain statistical procedures such as MANOVA, multiple regression analysis, nonparametric correlation, others. B textbook did not contain also nonparametric test.

The proportion of articles employing these statistical procedures absent in two textbooks were shown in table 7. The percentage rose from 8% in 1975 to 16.4% in 1986. A reader who studied with these textbooks may not understand the statistical analysis in 16.4% of total articles.

Table 7.

Statistical procedure	1975	1980	1986
Multiple regression	3.3%	1.9%	2.5%
Multiple comparision	2.7%	8.2%	9.6%
Nonparametric correlation	2.0%	3.2%	1.7%
MANOVA	0%	0%	1.7%
Others	0%	0.3%	0.8%
Total	8%	13.6%	16.4%

Discussion

A great knowledge of statistics would enable dentist to evalute more critically research finding.[7] The question of which statistical concepts and techniques in dentistry need to be mastered is not answered. In this survey were presented the statistical procedures needed to understand and evaluate the current statistical articles.; descriptive statistics, t-test, analysis of variance with multiple comparision, chi-square, simple and multiple regression analysis, pearson correlation, nonparametric test with nonparametric correlation, and others (discriminant, factor, cluster analysis, etc.).

Descriptive statistics include measures of central tendency and variability. Statistical parameters such as the mean and median are examples of measures of central tendency, and the range, variance and standard deviation (S.D.) measure variability.

One sample t-test is used to test the hypothesis that the sample originates from a population with a known mean. Two sample t-test procedure is used to test hypotheses about the equality of two means when only two groups are used. It answers the question whether or not there is a significant difference between two groups. Typically, it is used when the independent variable is manipulated at two levels, one level for the experimental group and a different level for the control group. Matched-pair t-test procedure is used in case that there is a corresponding pair in the other group.

Analysis of variance (ANOVA) is used to test the hypothesis that several population means are equal. One-way analysis of variance is the case with a single dependent variable. The extention of univariate analysis of variance to the case of multiple dependent variables is termed multivariate analysis of variance (MANOVA). A significant F statistic indicates only that the population means are probably unequal. It does not pinpoint where the differences are. Multiple comparision tests are available for determining which population means are different from each other.

Pearson correlation is used to quantify the strength of linear relationship between two variables. It is frequently used as an intermediate step in determining regression equations that may be used to make predictions. Simple linear regression is used to determine the best fitted regression equation if there is a linear relationship between two variables. Multiple linear regression is used in case with multiple independent variables.

When the conditions of random sampling and normal distribution are not met, nonparametric statistics are indicated such as Mann-Whitney, Wilcoxon matched-pairs signed ranks, Kruskal-Wallis, and Friedman test. The Chi-square test is used when research data are in the form of classified frequencies, such as the frequency of subjects falling into certain discrete categories. The Chi-square test is used in both cause-and-effect and association types of re-

search. An alternative test for Chi-square is Fisher's exact test when the total sample size and the expected values are small.[5)]

Discriminant analysis is the statistical technique used to identify the variables that are important for distinguishing among the groups and to develop a procedure for predicting group membership for new cases whose group membership is undetermined. Factor analysis is a statistical technique used to identify a relatively small number of factors that can be used to represent relationships among sets of many interrelated variables. Cluster analysis is to search relatively homogenous groups of objects.[6)]

Hayden[3)] reported that the proportion of research reports employing interpretive statistical techniques almost tripled in Pediatrics, from 24% in 1952 to 68% in 1982. In 1982 nonparametric tests (such as the Fisher's exact test, the Wilcoxon rank sum test, and the sign test), multiple regression and discriminant analysis were notably increased.

In this survey there has been an almost twofold increase in the use of statistical techniques in 5 dental journals, from 26% in 1975 to 46% in 1986. From 1980 multiple comparision and nonparametric test increased. However, statistical education did not cover these statistical analysis. Two statistic textbooks which are employed on master-course at college of Dentistry in Korea did not contain statistical procedures such as multiple regression, multiple comparision, nonparametric correlation, and multivariate analysis.

Summary

The purposes of this survey were to (1) describe the statistical techniques and its frequency with which were reported in dental journals, (2) investigate statistical trend, and (3) determine if statistical education covers these statistical procedures. The journals under review consisted of five general dental journals published during 1975, 1980, and 1986. Two textbooks of statistics, which are employed on master-course at College of Dentistry in Korea, were chosen to see which statistical procedures teach educators.

The following results were shown:

1. There has been an almost twofold increase in the use of statistical procedures in the articles appearing in the dental journals. (from 26% in 1975 to 46% in 1986)
2. T-test, analysis of variance, and descriptive statistics were most frequently used in the dental journals. These procedures occupied 57.5%.
3. There was a trend that multiple comparision, nonparametric test, and multiple factor analysis increased.
4. Two statistic textbooks did not contain statistical procedures such as multiple regression, multiple comparision, nonparametric correlation, MANOVA, Discrimin ant, Factor, cluster analysis.
5. The proportion of articles that the content in two statistic textbooks did not cover the statistical procedures used in 5 dental journals increased from 8% in 1975 to 16.4% in 1986.

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