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Jakobsson, Ulf

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Ulf Jakobsson PhD RN

Department of Nursing, Faculty of Medicine, Lund University, Lund, Sweden

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Objectives: The aim of this study was to review the presentation and analysis of ordinal data in three international nursing journals in 2003.

Method: In total, 166 full-length articles from the 2003 editions of *Cancer Nursing*, *Scandinavian Journal of Caring Sciences* and *Nursing Research* were reviewed for their use of ordinal data.

Results: This review showed that ordinal scales were used in about a third of the articles. However, only about half of the articles that used ordinal data had appropriate data presentation and only about half of the analyses of the ordinal data were performed properly.

Conclusions: Ordinal data are rather common in nursing research, but a large share of the studies do not present/analyse the result properly. Incorrect presentation and analysis of the data may lead to bias and reduced ability to detect statistical differences or effects, resulting in misleading information. This highlights the importance of knowledge about data level, and underlying assumptions for the statistical tests must be considered to ensure correct presentation and analyses of data.

Keywords: ordinal data, statistics, nursing, research, nursing research.

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Introduction

Ordinal data are commonly used in medical science (1–3) and perhaps even more in nursing science. The reason for the frequent use of such data in nursing science may be that the phenomenon to be measured most often only can be measured by nominal or ordinal scales (e.g. quality of life, various symptoms). This type of data is commonly used in questionnaire responses. An adequate presentation and analysis of the data is essential to eliminate several problems and errors as well as to draw correct conclusions.

A variable could be divided into nominal, ordinal, interval, and ratio data (4, 5). Nominal data is the 'lowest level of data' and this type of data can be categorized and frequencies calculated in each category. Examples of nominal data are gender, blood type and marital status. Ordinal data are generated when observations are placed into ordered categories. This type of data is assessment of subjective data of something that cannot be measured, for example degree of pain. The distance between each scale step is not important, only that there is an order between them such as very bad, bad, good and very good. Interval and ratio data are numerical data with consistent spacing. An example of interval data is body temperature, and examples of ratio scales are age and blood pressure. It should be noticed that interval and ratio data are numeric if they are originally numeric values. Hence re-coded nominal and ordinal data are not numeric and should not be analysed as numeric values. Descriptive statistical presentation of continuous data, such as mean and standard deviation as well as parametric tests should not be used for nominal and ordinal data because these methods make several underlying assumptions such as consistent spacing and normal distribution of the data (4, 5). When presenting and analysing ordinal data median, quartiles (or range), and nonparametric tests are preferable (4, 5).

Previous studies have found that statistical data, especially ordinal data, used in medical research are often presented or analysed in ways which are not in accordance with the structure of the data (2, 3, 6). This incorrect

Correspondence to:
Ulf Jakobsson, Department of Nursing, Faculty of Medicine, Lund University, PO Box 157, SE-221 00 Lund, Sweden.
E-mail: ulf.jakobsson@omv.lu.se

presentation as well as incorrect analysis of the data may lead to bias and may reduce the ability to detect statistical differences or effects. Incorrect presentation of the data can above all result in misleading information.

Ordinal data are often used in nursing research but it is uncertain to what extent or how this type of data is handled. Previous research reviewing the medical literature found that this type of data is incorrectly handled, and this may be the case in nursing literature as well. A study that surveys the use of this type of data could identify the extent and related problems.

Aim

The aim of this study was to review the presentation and analysis of ordinal data in three international (peer-reviewed) nursing journals in 2003.

Method

A review of the use of statistics for ordinal data was undertaken in *Cancer Nursing*, *Scandinavian Journal of Caring Sciences* and *Nursing Research*. Only full-length articles were reviewed, hence letters, editorials, debates and review articles were excluded. The review was performed for all issues published in 2003. The data in the articles were classified as nominal, ordinal or interval/ratio according the criteria of Siegel and Castellan (4). The appropriate or inappropriate use of statistical methods, presentation, and analyses in the articles was evaluated based on Siegel and Castellan (4) and Altman (5). Descriptive data were evaluated to identify what type of descriptive data was used, and the presentation of ordinal data. The use of mean and standard deviation was not considered adequate if it was never stated in the article that normality had been assessed or if it was not obvious (e.g. according to the central limit theorem) that the variable was normally distributed. Inferential statistics were evaluated to identify what type of methods were used and the use of statistical tests (also including the use of post hoc test and corrections for multiple comparisons). Further, the description of the methods used, in the method section of the article, was reviewed and judged as sufficient or not. The application of statistical tests was only counted once even if the tests were used several times in each article. If both appropriate and inappropriate presentations of data were identified in an article, the article (as a whole) was judged as appropriate if more than 50% of the presentations were judged as appropriate. Likewise the methods used in an article were appraised. Studies including previously developed instruments where ordinal scales were used in various ways (e.g. summary scores, calculation of mean scores) were classified as 'quantitative articles without ordinal scales' (Table 1). If the aim of the study was to develop an instrument with ordinal scales, the article was classified as 'quantitative articles with ordinal scales' (Table 1).

Results

A total of 166 full-length articles from the 2003 editions of three nursing journals were reviewed for the use of ordinal data (Table 1). The content of the journals was mainly articles that did not use ordinal data (29% were quantitative articles without ordinal data, 23% qualitative articles and 17% other articles). Ordinal data were identified in 51 (31%) of the 166 articles. Only 49% had appropriate data presentation and 57% had appropriate data analysis (Table 2). The most commonly used ordinal scale was the Likert scale. Visual Analogue Scales (VAS) were also common and were in most cases treated as interval/ratio scales. Even if the VAS is converted to millimetres or centimetres, the scale has no true unit of measurement and hence is an ordinal scale.

Table 2 Presentation of ordinal data in the articles

Journal	*n*	*Appropriate presentation (%)*	*Appropriate analysis (%)*
Cancer Nurs	17	53	38
Scand J Caring Sci	16	69	93
Nurs Res	18	28	38
Total	51	49	57

Table 1 Articles reviewed in each journal

Journal	*Number of articles (total)*	*Number of quantitative articles with ordinal scales*	*Number of quantitative articles without ordinal scales*	*Number of qualitative articles*	*Number of other (reviews, etc.) articles*
Cancer Nurs	58	17	16	16	9
Scand J Caring Sci	51	16	14	21	0
Nurs Res	57	18	18	2	19
Total	166	51	48	39	28

The 25 articles that did not present data properly all used mean and standard deviation, instead of percentages or median and inter-quartile range. The 29 articles without appropriate analysis used statistical methods that require normally distributed data, interval/ratio data. These types of methods were Student's *t*-test, ANOVA and Pearson's product-moment correlation. Examples of methods (non-parametric) properly used for ordinal data were Mann–Whitney *U*-test, Kruskal–Wallis test, Wilcoxon's signed rank test and Spearman's rank correlation.

Discussion

Ordinal scales were commonly used in studies in the nursing journals. About 31% of the total number of articles used (presented/analysed) some kind of ordinal scales. However, a large part of the studies that used ordinal scales did not present or analyse the results of the scales properly. The number of articles incorrectly handling this type of data will increase greatly if studies using standardized instruments with ordinal scales are also included.

Mean and standard deviation are invalid parameters for descriptive statistics whenever data are on ordinal scales. Consequently, parametric methods with calculations based on mean and standard deviations would also be invalid for analysing ordinal data. It is sometimes stated that the significant level for tests designed for continuous data is approximately 'correct' when used on ordinal data. However, both parametric and nonparametric tests exist, and which tests to use depends on what kind of data is to be analysed and the underlying assumptions of the test. A parametric test is designed for continuous, normally distributed data (with equal variance), and a nonparametric test is based on ranks. One strength of nonparametric statistics is that it is not sensitive for outliers, but the effectiveness is about 95% (i.e. you need 5% more observations to detect statistically significant differences) compared with parametric methods. However, this higher efficiency for parametric methods is only for interval/ratio scales, for example when skewed, and not for ordinal data. The fact that sample size often is too small might be another explanation as to why researchers treat ordinal data as they were interval data. Hence it is important that researchers are aware of the underlying assumptions for each test that is used and choose the most proper one (based on scale, number of observations, etc.).

The presentation of the statistical methods used was sometimes weak in the studies and it was above all the designation of the statistical methods that was vague, but it was also often unclear what kind of data the analyses were performed on. For example, the type of correlation that had been chosen was often not stated, and instead phrases like '… X was correlated to Y …' were used. Another example is '… Wilcoxon's method was used…', but which one was chosen is not stated. This highlights the importance of clear and concise descriptions of the methodology to avoid misconceptions, and it makes it easier to evaluate the study.

The VAS scale is frequently used for measuring pain (and other complaints), and the scale is often considered as an interval/ratio scale, and hence is analysed with parametric tests. This is a common misunderstanding; the assessment is highly subjective and the result cannot be interpreted as numerical. Furthermore, the scale cannot be considered as having consistent spacing between each 'scale step'. Thus, the VAS scale should be treated as an ordinal scale and analysed with nonparametric methods.

Another example of unacceptable use of ordinal scales was that the ordinal scales were often summarized and a mean value (with accompanying standard deviation) was computed and hence the scale was treated as an interval/ratio scale. This type of 'manipulation of the data' is very common, but is not a correct way to handle ordinal data. Remember that interval and ratio data are only numeric if they are originally numeric values, and re-coding of ordinal data does not give numeric variables. It may be hard to find acceptable alternatives when you wish to create a summary score from ordinal data. A solution to the problem may be to consult a statistician and discuss different possibilities from case to case. A 'statistically acceptable' solution may not always be achieved but the discussions/consultation may ease the writing of the method section (i.e. to justify the handling of data).

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