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How to Write a Research Article for the Journal of Genetic Counseling

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The purpose of this paper is to provide guidance to contributors to the Journal of Genetic Counseling about preparing manuscripts that report findings of original research. While variations in reporting formats and standards are acknowledged, the paper aims to assist contributors in recognizing the essential components of research studies and of manuscripts describing such studies. A description of the purpose of each section and guidelines for writing each section are provided. Criteria for assessing the strengths and weaknesses of study design, sampling, measures, procedures, and data analyses are also discussed.

KEY WORDS: genetic counseling; research; manuscript development.

INTRODUCTION

Contributing to the body of scientific knowledge in one's field is no minor undertaking. In addition to planning and conducting high-quality studies, researchers must know how to publish their findings. At times, the task of reporting results from clinical research in a publishable format may seem as overwhelming as the planning and execution of the study itself. Just as the scientific method consists of a series of discrete and logical steps, however, research manuscripts consist of well-defined components. Each component is manageable once authors are familiar with its purpose and format.

This paper presents just one approach that may be useful to researchers looking for guidance in the area of research manuscript preparation. Although this paper primarily focuses on quantitative studies, many of the recommendations

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presented apply to both quantitative and qualitative manuscripts. Qualitative researchers should consult sources that focus on the unique assumptions, procedures, and reporting requirements that apply to qualitative research (Grbich, 1998; Morse and Field, 1995). Additionally, every journal has guidelines for contributors that include specifics on formatting and submission requirements. These guidelines should be carefully followed.

COMPONENTS OF A RESEARCH ARTICLE

Although variation exists in the format and terminology used to present research findings, and although each study has unique features, there are four standard sections that should be included in every research paper. In addition, academic journals require an abstract of the entire manuscript. When you begin to write your study for publication, an outline can help ensure that the critical components are included. An outline may also help you organize your thoughts and get the writing process started.

Overview of Research Article Components

ABSTRACT
1. INTRODUCTION AND/OR LITERATURE REVIEW/BACKGROUND
2. METHODS
    - Study Design
    - Sample (Participants)
    - Procedures (of Data Collection and/or Treatment)
    - Measures
    - Data Analysis
3. RESULTS
4. DISCUSSION
    - Results in Context of Introduction and Literature Review/Background
    - Limitations
    - Implications for Practice
    - Implications for Future Research
    - Conclusion

Abstract

The abstract provides a concise overview of the entire paper. It allows the reader to identify at a glance the topic, variables, methods, major findings, and importance of the study. Many readers examine the abstract to determine if the article is of interest to them. The questions you need to ask yourself as you write the Abstract are

- Does my abstract convey the most essential aspects and findings of my study?
- Will it attract the readers who could benefit the most from its findings?

While abstract components are standard across journals, length and format specifications vary. Authors are instructed by the *Journal of Genetic Counseling* to limit their abstracts to one paragraph and 150 words. The abstract should contain the purpose of the study, the observational and analytical methods used, the primary findings of the study, and the major conclusions. Because of the word count limitation, writing the abstract forces you to identify the core components and conclusions of your study. Although the abstract is typically the first component of a research manuscript to be read, it is frequently the last part to be written. It can sometimes be easier to write a concise summary of the study and the pertinent findings once the rest of the manuscript is written. Abstracts of articles in previous issues of the journal may provide ideas about how best to present your study. After the abstract, list 3–10 keywords related to your manuscript. Use keywords from Medical Subject Headings (MeSH) from *Index Medicus*. If no appropriate MeSH terms are available, use professionally recognized terms.

Introduction

All manuscripts should have an introductory paragraph or section that lets the reader know what issue the study addresses and why it is important. In one desirable format, a section with the heading "Introduction" briefly introduces the nature and scope of the "problem," describes the need for new knowledge related to the problem, and provides a concise overview of the article and its purpose. Of course, the overview and purpose of the article should be clearly related to the problem description and knowledge gap. This introductory section is followed by the heading for the next section, which is the literature review or background section. In another frequently used approach, there is no Introduction or Literature Review/Background heading. The paper simply starts with the problem statement or other introductory material and then proceeds directly into the literature review or background section. The section concludes with the overview of the article and its purpose.

The introduction should be closely related to the key points of the rest of the article. It should provide you with organizational and thematic guidance as you write the rest of the article. While it may or may not include a preview of findings, it should establish expectations about what questions, problems, and/or knowledge gaps the study addresses. Don't disappoint your readers by failing to return to your introductory points later in your discussion and conclusion sections!

Example of an Introductory Paragraph

[***Nature and Scope of Problem***] *Fragile X is the leading inheritable cause of mental retardation. It is estimated that approximately 1% of nonsyndromic mental retardation is caused by fragile X. Additionally, girls with fragile X frequently present with learning disabilities. Yet, few student services personnel in schools are aware of the disorder or its presenting characteristics, and almost no referrals to genetic counselors for testing for fragile X among schoolage children originate from school staff.* [***Why it is Important***] *As a result, thousands of American children with fragile X remain undiagnosed and fail to receive the services and resources they need to improve their chances of success at school. In addition, relatives who may be affected or at risk remain unserved.* [***New Knowledge and Overview of Article***] *Effective strategies for increasing referrals from school staff are needed. This article describes a study that was designed to assess the impact on referrals (source and volume) of a school-based intervention to educate school counselors, nurses, and social workers about fragile X. The study has important implications for genetic counselors seeking low-cost strategies for public outreach and education.*

Literature Review/Background

Whether it has a separate heading or is integrated into your introductory text, the Literature Review/Background section is a critical component of your paper. The question you need to ask yourself as you plan and write the Literature Review/Background section is

- Have I provided enough background of existing research and theory related to my topic to convince readers that (a) I am familiar with existing knowledge relevant to my research area, and (b) my study addresses an important gap in the literature?

The literature review should include a discussion of concepts, research, and theory related to your study. Depending on your topic, you will need to select and summarize only the most relevant existing background material from a large body of works, or you will focus in depth on a small number of existing works. The literature review accompanying the sample Introduction presented above, for example, might include background information about fragile X, the individual and societal costs of failure to identify and serve children with fragile X, an empirically based discussion of the potentially important role of school staff as referral sources for fragile X or other disorders (e.g., document their role in making Attention Deficit Hyperactivity Disorder referrals), a review of genetic counselor outreach strategies, and, if available, a review of the characteristics and efficacy of interventions

similar to the one used in the study. The literature review would identify knowledge gaps and limitations of previous research that establish the need and importance of the current study. The discussion and critique of existing knowledge should lead logically to your subsequent description of the strengths and contribution of your study.

Concepts, specialist terminology, and acronyms should be defined when they first appear in the Introduction or Literature Review/Background section. Introduce acronyms parenthetically after the first use of the full terms from which they are derived. Do not assume that every reader is familiar with the specialist terminology you encounter daily or with the genetic condition you are studying. Even familiar terms may have to be clearly defined because they have been defined and measured in multiple ways in past research. Social support, self-concept, and coping skills are examples of terms that have myriad definitions and connotations in the literature and among counselors. Readers interested in the concepts you studied will want to know early on how you defined and/or measured them in order to determine more accurately the potential contribution of your study.

Provide a succinct and relevant critical review of existing research related to your study. Summarize and critique past work and findings, strengths and shortcomings of previous work, and gaps in the existing research. Related research includes studies involving the major constructs examined in your study as well as studies of the population or disorder examined in your study. For example, if you are discussing the effects of social support on the self-esteem of mothers learning that their child has Down syndrome, you will need to review important related aspects of the social support literature, preferably referring to studies that used measures identical or similar to your measures of social support. You will also need to discuss literature related to self-esteem and how it can be affected by learning one's child has a genetic disorder. Review studies that have examined Down syndrome in particular, if they are available. Review studies of self-esteem in other disorders that can be compared and contrasted to Down syndrome, if no studies on Down syndrome have been conducted. General information about Down syndrome might also be relevant to your review.

Good studies include theoretical perspectives, conceptual frameworks, or specific theories that explain the hypothesized relationship among variables in a study. What theories or assumptions guide your practice and research? Why might you hypothesize that the discovery of a genetic heart condition will negatively affect the self-esteem of an athletic 40-year-old male? Why did you posit that an educational video on breast cancer risk would change the behavior of women in a community-wide prevention program? Existing theories of self-concept, health behavior, decision-making, or more generally, of cognitive, social, and behavioral phenomena, guide both the practices and the research studies of genetic counselors. These theories should be presented in the Literature Review/Background section, and referred to again in your discussion of study findings.

It is rarely acceptable to claim that there is no existing research, theory, or knowledge related to your topic. If, for example, there were truly no existing literature on the self-esteem of parents of children with neurofibromatosis, you would review the literature on self-esteem of parents of children with another related disorder. If you could accurately claim there was no literature on related disorders, you would review the literature on parental self-esteem and *unrelated* disorders. In this review you would discuss why or how you expect parental self-esteem to respond in similar or different ways to the characteristics of the disorder you are interested in. If you could accurately claim that there was no literature on parental self-esteem and any disorder of children, you might discuss the literature on parental self-esteem when confronted with disability or disfigurement that resulted from a child's accident or some other analogous situation. There is always some reference point or context for your study. Not only does your discussion of this context demonstrate that you are knowledgeable and your study is grounded, but it provides you with the opportunity to justify your study. If parental self-esteem is affected by the discovery of *any* kind of disorder, injury, or impairment in a child, for example, you are in a better position to argue that it is important to understand the self-esteem of parents of children with the disorder of interest in your study.

Headings are a gift you give to your readers to help them navigate their way through your paper. You really should have headings related to the four major components of a research article—Introduction or Literature/Background (see caveat discussed above), Methods, Results, and Discussion. Subheadings within sections clarify the organization and main points of those sections. Any section that is long or complex or contains several multiple-paragraph topics would benefit from subheadings. Because of the number of different topics that need to be covered in the Methods sections, for example, it is almost always advisable to use subheadings.

Methods

The Methods section describes all aspects of how the study was carried out. The Methods sections should contain information about the following aspects of the study:

Study Design
Sample (Participants)
Procedures (of Data Collection and/or Treatment)
Measures
Data Analysis

The order in which these components are discussed may vary. Subheadings will make it easier for readers to follow your study description. The terminology for the study components may vary, and other subtopics may apply to specific studies. As you plan and write the Methods section, keep in mind the following two questions:

- Have I described the study well enough that the reader can replicate my procedures?
- Does the reader have enough information to come to his/her own conclusions about the strengths and limitations of the findings?

Study Design

Study Design refers to when data collection occurred and whether sample members were grouped for comparison. Common descriptors referring to the timing of data collections are cross-sectional, repeated measures, and longitudinal. Common descriptors referring to the relationship among groups studied are experimental, quasi-experimental, and non- or preexperimental. There is no one right or wrong study design. In evaluating study design, readers take into account the purpose of a study. When the purpose of a study is to describe or explore some phenomenon, for example, genetic counseling practices in one state at one point in time, a one-group, cross-sectional design may be adequate and appropriate. When the purpose is to do a one-time comparison of counseling practices in two different states, a two-group, cross-sectional design may be adequate and appropriate. Such studies do not aim to determine causal relationships among variables, so their simple cross-sectional design is adequate. In contrast, when the purpose of a study is to demonstrate that a treatment or procedure *causes* a desired outcome, more complicated designs are necessary.

Researchers conducting clinical trials to examine the effects of a treatment or procedure (independent variable) on the physical or emotional well-being or behavior of a client/patient (dependent variable) must demonstrate to readers that their study design permits causal claims. This issue is also referred to as the internal validity of a study. Serious design flaws, or threats to internal validity, in studies testing treatment effects may make reviewers reluctant to endorse publication; therefore, we devote some attention to this topic.

Three conditions must exist before a researcher can claim that his/her treatment (independent variable) *caused* an effect on the outcomes (dependent variable) of subjects (Rubin and Babbie, 1997). First, there must be a statistical relationship between the independent and dependent variable. Second, the independent variable must precede the dependent variable temporally. And third, the relationship between the two variables must not be attributable to some other factor.

We will use an example of a fictional study that examined the effects of a support group on the coping skills of women newly diagnosed with a genetic disorder. Two groups took part in the study—one group that took part in the support group and one group that received no services after diagnosis. To demonstrate that the support group *caused* an improvement in coping skills and is therefore a valuable intervention, the researcher must first demonstrate that the coping skills of the women in the support group differed (e.g., were superior) at the end of

the study from the coping skills of women in the control group. If support group participation was not associated with superior coping skills relative to no treatment, the researcher cannot claim it *caused* better coping skills. Second, if the group receiving social support services did have better coping skills at the end of the study, the researcher would also have to demonstrate that the group did not have better coping skills before the intervention started. In other words, he/she must demonstrate that participation in the support group (the independent variable) preceded the superior coping skills (dependent variable). Note that the required temporal ordering of cause and effect necessitates the use of a repeated measures or longitudinal design in studies testing treatment effects. Third, the researcher would have to demonstrate that improved coping skills in the treatment group were not due to some phenomenon besides the support group.

The third criterion for causality is the most difficult to meet and to demonstrate. The use of an experimental design—which implies that subjects are randomly assigned to control and treatment groups—is the first critical step toward meeting the third criteria for causality. The assumption of random assignment is that preexisting differences in subjects will be distributed evenly across groups or will counteract each other. The goal of random assignment is group equivalence, so that intervention effects can be isolated for testing. Random assignment does not guarantee that the groups will be equivalent, but it increases the likelihood that they will be similar before the study begins. If random assignment results in groups that look similar at the beginning of the study in terms of demographics, the dependent variable, and other characteristics that may be relevant to the study, then the researcher can be more confident in claiming that group differences at the end of the study were *caused* by the treatment.

Ethical concerns and feasibility may preclude the use of random assignment in clinical studies. The next best thing may be a quasi-experimental design, in which a nonrandom comparison group is used. A quasi-experimental design may be considered adequate if a researcher can demonstrate that a study's comparison group is similar to the treatment group on most relevant variables. Nonequivalence of control and treatment groups and numerous other threats to validity are discussed in introductory research texts such as Rubin and Babbie (1997).

It should be obvious why it is critical to provide readers with a clear description of your study design. In the context of the study's purpose, study design features help readers evaluate the validity of a study and utility of its findings.

Sample

It must be clear to readers (a) how you chose your sample, and (b) how your sample relates to the population of interest. These two related pieces of information are essential for determining the contribution of your study to the existing knowledge base. Sample limitations exist for virtually all studies; few

researchers are able to obtain samples that are representative of the global, national, state, or even local population of individuals with the genetic condition they are studying. Studies of samples that are not representative of the national population of individuals with a particular genetic condition still make valuable contributions to the literature as long as sample limitations are explicit. Sampling procedures and the samples they generate are evaluated in terms of the purpose and claims of the study. A convenience sample, for example, may be quite adequate for a study designed to explore the range of emotional responses to a genetic counseling approach. An ambitious but flawed national probabilistic sampling strategy, however, may bring reviewer criticism if researchers claim the study results apply nationally. While writing the Sample subsection of the Methods section, keep in mind the following questions:

- Can a reader reconstruct the steps I used to obtain my sample?
- Is it clear from the description of my sample, to whom my study findings can be generalized?

The Sample section of your paper is also the logical location for the brief description required by the *Journal of Genetic Counseling* and most other journals of your consent procedures and human subjects review procedures.

How You Obtained Your Sample. From the start, you made decisions about who was and was not approached to be in your study. You chose, for example, to start with a list of clients currently receiving services at your clinic, or patients walking in for services between specified dates, or an official list of members of your professional organization. This "list," which is often an actual physical list of names at the time you start your study, is called your sampling frame. How you choose names from the sampling frame is your sampling strategy. Did you ask everybody on the list to participate? Did you randomly select names? Did you define exclusionary criteria, such as age, comorbid conditions, symptom severity, date of contact with your facility? All of these decisions must be described and explained. The reader should be able to reconstruct your sampling steps and understand the decision-making at each step.

During the recruitment of subjects, some individuals in your sampling frame agree to participate and others decline to participate. You must discuss this phenomenon in your paper. Provide any information available about why some potential participants declined. Describe how those who declined to participate differed from those who agreed to participate. If possible, statistical comparisons should be provided. In addition, during the course of a study, participants are often "lost" due to withdrawal from the study or services, incomplete data, or other reasons. Describe and explain any differences between your original sample and the sample that was actually available for analyses. If you collected data for your study with surveys or questionnaires, you should obtain a 50% or greater response rate. For example, if after you mailed out surveys to 200 genetic counselors and fewer than

100 completed surveys were returned to you, your response rate is likely to be considered inadequate for publication.

Generalizability of Findings in Your Sample. Samples are derived from populations, which may be well-defined or hypothetical entities. The relationship between your sample and the population to which you would like your results to be generalized must be explicitly addressed in your manuscript. We should start by acknowledging that "population" is a problematic term. If you are interested in fragile X, for example, there exists a real, but unidentified, global "population" of individuals with the hereditary condition. It would be difficult for any researcher to claim that his/her sample represented this "population" because its characteristics are not known. A seemingly more accessible fragile X "population" may consist of all individuals identified as having the condition by staff of public and private health and mental health facilities in the United States. But, if no centralized data are available on this group, it too may be of little use for comparison to your sample. The "population" that may actually be available to researchers of fragile X or other conditions for putting their samples into context are likely to be more restricted databases compiled by the federal government, professional organizations, or private foundations. In other cases, the only population with the condition of interest that is available to you is the group of individuals from which your sampling frame was derived—visitors to your facility, or to facilities like yours in a specific region or state.

In spite of the difficulties inherent in defining populations, your job in this section of the research manuscript is to describe a population that is meaningful to the reader, and then explain how your sample relates to that population. Creating a table with comparative information on the population, the study's sampling frame (if different), and your actual analyzed sample is recommended. Readers should be cautioned about generalizing your findings to the population if your analyzed sample differs significantly from the population on certain characteristics. Later, in your discussion/limitations section, potential implications of significant differences should be presented in more detail. You are in a better position than most of your readers, for example, to evaluate the potential implications of the fact that your sample has a higher proportion of European Americans and fewer African Americans than the state population of individuals with fragile X.

Procedures

The procedures of your data collection and treatment, if applicable, must be described in your research manuscript. The question to keep in mind while preparing the Procedures subsection of the Methods section is

- Can an interested reader replicate the steps I took to implement my study, including my data collection procedures and my treatment protocol?

The Procedures section for studies in which data were collected but no treatment was provided focuses on how data were collected from the sample. Because the sample recruitment has already been addressed in the Sample section, the Procedures section does not have to include a discussion of this topic. All other aspects of the data collection should be discussed, such as training of data collectors, timing of data collection, where and how data were collected, and how data were handled subsequent to collection (for example, how audio or video tapes were transcribed and coded).

Studies involving treatments or other interventions require a description of how the treatment was implemented in the study. Ideally, other researchers should be able to replicate your intervention based on the description provided. Realistically, space requirements in journals preclude such detailed accounts of procedures. You will need to balance space limitations with the need for readers to have a clear idea of what the treatment entailed. Providing references to treatment manuals or other documents and materials, if available, is a good way to supplement your treatment description.

Measures

The Measures subsection of the Methods section should describe all of the variables that were used in the data analyses for your research manuscript. Some authors discuss their independent, dependent, and control variables separately, which is a reader-friendly organizational strategy. Provide information about the response options of your variables and their measurement level. For example, if race/ethnicity was a control variable in your analyses, indicate the race/ethnic categories that were available as response options. If "age" was a variable, was it a continuous variable (respondents could write in their actual age), or was it an ordinal variable with age range options (e.g., 18–24, 25–30, etc.). Many survey variables have ordinal response options, such as "disagree strongly," "disagree," "no opinion," "agree," and "agree strongly." These responses do not have intrinsic numerical meaning, but they can be ranked in order.

Many studies employ "scales," or composites that are variables based on two or more other variables. For example, self-esteem might be assessed with 10 questions. The measure of self-esteem is actually a new variable that was created by combining the responses to the 10 questions in some way. Many researchers use preexisting scale or composite measures for their constructs. Generally, the use of standardized, existing scales is considered a study strength because it facilitates comparisons of findings among studies and because standardized scales may have better psychometric properties than home-made scales. On the other hand, researchers often identify a need for new and better measures and create them themselves.

Whether you use standardized or original measures in your study, certain information about the scales should be provided. Do not assume all readers are familiar with the standardized measures you used. First, describe the items used in the scale. How many items are included, what kinds of questions are asked (provide examples or summaries), and what are the response options for items on the scale? Second, explain how multiple items were combined to generate the scale score. Were they summed, averaged, or combined in some other way? Did you use factor analysis to determine which items worked well together empirically? Third, provide information on the psychometric qualities of the new measure. Internal consistency or reliability of scales is the most consistently used standard (e.g., "Cronbach's alpha"). Factor loadings and validity assessments may also be provided. Reliability coefficients from the literature on existing scales can be reported. Or, with adequate sample sizes, reliability coefficients for existing or original scales can be generated with the data from your study. A commonly accepted cutoff for reliability is 0.70 (DeVellis, 1991). Higher numbers are desirable. They indicate that the items work well together and there is little error in the measurement of the construct. If you have created your own scales, provide some description of the development process and rationale for your choice of items in addition to the above information.

Data Analysis

Depending on the complexity of your data analyses, this section may be short or lengthy. Take some time to plan carefully the organization of this section, because you should follow the same order in the Results and Discussion sections. Ideally, the data analysis subsection of the manuscript will include the research question or hypothesis guiding each analysis, the variables included in the analysis, the statistical procedure to be used, and the *p* value or other statistical criteria (e.g., goodness of fit values) that will be used to identify significant findings. Other relevant information that makes it clear how data were manipulated and analyzed should be included. This information will vary depending on how complex or uncommon your procedures were. Common statistical procedures, such as ANOVAs, *t* tests, regressions, and chi-squares need little explanation or justification. You may need to briefly explain less common statistical procedures and indicate why they were the best choice for your study. Provide the name and version number of the statistical program used.

Even experienced researchers obtain consultation from statisticians. Different procedures are appropriate for different research questions, sample sizes, and data characteristics. This volume of information is beyond the scope of this article. Numerous sources are available (e.g., DeVellis, 1991; Pagano, 1994; Pedhazur, 1997; Rosenthal, 2001; Tabachnick and Fidell, 1996).

Power Analysis. Clinical studies in genetic counseling often have small sample sizes. Small sample sizes have implications for the types of statistical analyses used and the "power" of your study to detect the effects of your independent variable(s) on your dependent variable(s). A small-sample study can make a valuable contribution to the literature, depending on its purpose and the appropriateness of its analysis procedures. If your study includes statistical analyses, however, a discussion of power must be included in your manuscript. The classic source on power is Jacob Cohen's *Statistical Power Analysis for the Behavioral Sciences* (Cohen, 1988). Because of its importance, we devote some attention to a discussion of power below. As with data analysis in general, authors are encouraged to obtain consultation on this topic before submitting manuscripts to the journal.

"Power" in the context of statistical analyses refers to the ability of the researcher to detect true relationships among variables given (a) the number of subjects in the study, (b) the strength of the existing relationship (effect size), and (c) the level of significance that has been prespecified (usually 0.05). (Other factors may also affect power, and sophisticated statistical procedures require different calculations, but these topics are beyond the scope of this article.) Although each of these three elements affects power, sample size is most often viewed as the "problem" in underpowered study because it can be manipulated more readily than the other two. Below we explain the components of power and why it must be addressed in research studies involving statistical analyses.

Imagine that a colleague invites you to play a game of chance. He says that he will flip a coin. Each time it comes up heads you will pay him a dollar. Each time it comes up tails he will pay you a dollar. You agree and he flips the coin. The first coin toss comes up heads. You pay him a dollar. The second coin toss comes up heads. You pay him another dollar. When the third toss comes up heads, you start to feel a little annoyed as you pay him a third dollar. How many coin tosses would you have to observe before you were convinced you were being cheated? If your colleague decided to end the game after winning 4 tosses, you might think he was unusually lucky, but not feel justified in accusing him of cheating. What if he continued tossing the coin 25 times and each time it came up heads? You would probably become quite sure that the coin was unfair, i.e., that some characteristic of the coin was having an *effect* on the outcome of the tosses. The difference between your conclusions after 4 tosses and after 25 tosses is analogous to a researcher's ability to conclude that a treatment is having an effect on outcomes in a study with too few subjects versus an adequate number of subjects. An unfair coin is unfair whether it is tossed 4 times or 25, but after only 4 tosses you cannot claim with confidence that it is unfair because, while it is unlikely, it is possible for a *fair* coin to come up heads 4 times in a row. Similarly, if you are testing an intervention with too small a sample, your statistics may not identify its effects as significant, even though it truly is an effective intervention.

Another factor to keep in mind is that the magnitude of the relationship between variables being tested, or the "effect size" mentioned above, influences power too. The power of your study is higher when you are testing a strong intervention, that is, one with a large effect size. If your friend's coin had been engineered so that it came up heads 100% of the time, you would detect its unfairness after far fewer tosses (i.e., with a smaller sample) than if it had been engineered to come up heads 60% of the time instead of the expected 50%.

The third commonly mentioned component of power is the level of significance chosen by the researcher. Level of significance refers to the probability that observed effects are due to chance and therefore are not due to an intervention or a true relationship between independent and dependent variables. For example, there is a very small probability that a fair coin will come up heads 10 times in a row. The most common level of significance used in studies is 0.05, although some studies use a 0.01 level of significance. By setting an alpha of 0.05 level, researchers indicate that they will not claim their observed intervention effects are real unless there is only a 5% or smaller chance that the findings are due to statistical chance—i.e., they are 95% sure that the effects are due to their intervention. A lower alpha reduces the power of a study, with a concomitant increase in the sample size requirement.

Concluding that an intervention is not effective based on a study that did not have the power to detect the intervention's effects is detrimental to the knowledge-building process. Low power can also undermine nonexperimental studies. A researcher looking for family variables associated with self-regulation among children with Down syndrome, for example, might claim that none of the variables examined were related to behavior, when in fact, the study did not have the power to detect such relationships even if they existed.

Power analyses must be conducted for each study because the power of each study depends on various characteristics of the study and data. Still, we suspect that potential authors would welcome some further specificity about power and sample size. What is a "small" sample size? How many subjects might I need before I can hope to have adequate power for my analyses? Rosenthal (2001, p. 308) provides a "A Rough Guide" on this topic. Please note, he cautions that the guidelines are an oversimplification; any number of study features can affect power and invalidate his estimates. According to Rosenthal, if there are fewer than 50 subjects in your sample as a whole, you are unlikely to have adequate power to detect relationships among variables or group differences unless they are very strong or large. With sample sizes of 201–500, you are likely to have adequate power to detect all but the weakest relationships or smallest group differences. With samples of over 500 you are in a excellent position to test hypotheses. Rosenthal's guidelines suggest that in samples ranging from 51 to 200, adequate power *may* or *may not* be present. This range contains the sample sizes that many clinical researchers who are hoping to do statistical analyses are likely to encounter. Hence, it is critical that potential authors calculate and report the power of their particular studies.

Results

The Results section is one of the easier ones to write because you have already dictated the order of presentation of the findings in the Data Analysis section, and because you have permission—in fact you are instructed—to avoid attention-grabbing commentary and clever interpretation. Avoid the temptation to interpret your findings in the Results section; interpretation belongs in the Discussion section.

The Results section of your research manuscript is a succinct, factual presentation of the findings from the statistical analyses you listed in the Data Analysis section. Results should be presented in a user-friendly manner and in the order of the analyses described in the Data Analysis section. If your study was guided by research questions or hypotheses, then the Results section, like the Data Analysis section, should be presented and ordered by these questions or hypotheses. Do not present results of analyses you did not describe in the Data Analysis section. Because the Results section parallels the previous section, you do not need to repeat information about the data analysis procedures; the reader can refer back to the previous section if necessary.

Use tables, graphs, and other visual tools whenever they enhance, clarify, or simplify your statistical information. Do not repeat the information in tables in your narrative, but do refer to each table in the text, explain what the table presents, and point out the findings you believe are most important. Different statistical procedures require different reporting content and formats. Consult a statistician, other researchers, or journal articles to determine the information that should be included in your tables. At the end of the presentation of each set of results, provide a brief summation of whether the analyses supported or failed to support the hypotheses they were testing, or a summation of the "answer" to the research question they addressed.

Discussion

The Discussion section provides systematic and thoughtful interpretation of the findings, and an informative and useful discussion of implications of the findings. The Discussion section should follow the order of the Data Analysis and Results sections. It builds substantially on the Results section by interpreting the findings and discussing their implications for theory, future research, and practice.

The Discussion section commonly includes the following subsections:

Discussion of Results in Context of Introduction and Literature Review/ Background
Limitations of the Study
Implications for Practice

Implications for Future Research
Conclusion

The questions to keep in mind while writing the Discussion section are

- Have I returned to the major points and promises of my Introduction and Literature Review?
- Have I devoted attention to each of the major findings detailed in the Results section?
- Have I adequately tempered my claims with a fair summation of the limitations of the study?
- Have I seriously considered the range of implications of my study?

The Discussion section is one of the harder sections to write because it requires a lot of cognitive effort. It is also the most satisfying, because it is where you have the opportunity to interpret your results for the reader, drive home your points, and demonstrate how and why your study is valuable and noteworthy.

Writing the first subsection of the Discussion section is facilitated by the fact that the Introduction, Literature Review/Background, and Results sections provide the topics to be covered and suggest the order in which to cover them. Start with a short paragraph that describes the major features of your study and highlights your most important findings. Then systematically place the results presented earlier in the context of the points made in the literature review and the hypotheses or research questions of interest. Typically, you should avoid repeating technical details of the results. Synthesize and translate the statistical findings into the language of genetic counselors. Those who enjoy statistical detail can refer back to the Results section to validate your summaries and interpretations. No new results or previously unannounced data analyses should be presented in this section.

The Limitations subsection describes limitations related to sampling, design, measures, procedures, and statistical analyses *and* helps the reader understand the implications of the limitations. Writing the subsection on limitations is facilitated by referring back to what you wrote earlier in the Methods section about the study's features. Address the limitations and shortcomings of each aspect of the study. Thoughtfully address the possible implications of the limitations. What does it mean that your control group, in spite of random assignment, contained individuals who had significantly more severe symptoms? How does your cross-sectional design constrain your ability to assert that low self-esteem in your sample members was *caused* by inadequate social support networks?

The Discussion section also includes a subsection on the implications of your findings for practice. Many readers will want to know what your study means for their clients and their interactions with clients. Provide a useful and informative discussion of implications of the findings for genetic counseling practice.

After discussing your findings, study limitations, and implications for practice, you should have ideas about what your study has contributed to the genetic counseling knowledge base, and what more you wish it had contributed. Your thoughts on these topics can be presented as implications for future research. Provide readers with your thoughts about how future research can substantiate, address flaws in, and build on your findings.

A Conclusion subsection may be useful to summarize, highlight, or tie together the major points you have made in your Discussion section. If your Implications sections have achieved this goal, a Conclusion section may not be necessary. The length of your concluding comments may vary depending on the complexity of your study and its findings. This statement should be consistent with your Abstract's assessment of the importance of your study.

FINAL THOUGHTS ON MANUSCRIPT PREPARATION

The careful development of your manuscript following the guidelines presented in this paper will increase its chances of being reviewed and accepted. The revision process will also be shortened and simplified. A well-developed manuscript allows manuscript reviewers to focus their attention on the value and implications of a study rather than the presentation flaws of the manuscript. Manuscript reviewers are carefully selected for their particular expertise. If reviewers are unable to follow the organizational strategy of your paper or to find information about critical components of your study, you may lose the opportunity to receive their constructive feedback on your study and insights on findings. You may also lose the opportunity to resubmit your paper. A well-presented manuscript makes a lasting positive impression on the reviewers and editor. They will enjoy reading your study and, like you, look forward to seeing it in print. Writing a research manuscript for publication is hard work. It is also incredibly satisfying to see your research published.

REFERENCES

Cohen J (1988) *Statistical Power Analysis for the Behavioral Sciences*, 2nd edn. Hillsdale, NJ: Erlbaum.
DeVellis RF (1991) *Scale Development: Theory and Applications.* Newbury Park, CA: Sage.
Grbich C (1998) *Qualitative Research in Health*. Thousand Oaks, CA: Sage.
Morse JM, Field PA (1995) *Qualitative Research Methods for Health Professionals*. Thousand Oaks, CA: Sage.
Pagano RR (1994) *Understanding Statistics in the Behavioral Sciences*, 4th edn. New York: West Publishing.
Pedhazur EJ (1997) *Multiple Regression in Behavioral Research: Explanation and Prediction*, 3rd edn. New York: Harcourt Brace College Publishers.
Rosenthal JA (2001) *Statistics and Data Interpretation for the Helping Professions*. Belmont, CA: Brooks/Cole.
Rubin A, Babbie E (1997) *Research Methods for Social Work*, 3rd edn. Pacific Grove, CA: Brooks/Cole.
Tabachnick BG, Fidell LS (1996) *Using Multivariate Statistics*, 3rd edn. New York: Harper Collins.