Original Investigation

Survey Research: A Primer for the Academic Radiologist

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Survey research is appealing to many clinical researchers, including radiologists. Emerging interest in patient preferences and patient-centered outcomes related to imaging likely will stimulate additional use of questionnaires in our field. However, like other quantitative methods, survey-based research requires meticulous planning, execution, and analysis to generate reliable results and support meaningful conclusions. The purpose of this review is to provide a guideline for radiologists embarking on this type of research, with attention to questionnaire design, sampling, survey administration, and analysis.

Key Words: Survey research; research methods; survey; questionnaire; research design.

INTRODUCTION

Survey research appeals to many academic radiologists. On the surface, these projects seem quick, inexpensive, and relatively simple. In the age of e-mail, social media, and smartphones, the broad potential reach and clickable immediacy of a questionnaire are attractive. However, the perception that "anyone can do it" and the rush to push "send" may contribute to flawed data and inappropriate conclusions (1–3).

Survey research should be approached with the same rigor and planning as other quantitative research methods (1,4). In fact, survey research is itself an entire academic discipline within social science. Although abundant throughout the medical literature, most medical professionals lack formal training in this area (5).

A point about terminology: a survey, in its pure sense, is a sampling of any value from a larger population, whereas a questionnaire is a tool often used in survey research that consists of a series of written or verbal questions. Therefore, although "survey" and "questionnaire" often are interchangeably used, they are not synonymous. Examples of survey research that do not include a questionnaire might include samples of blood pressure values, heights, or test scores. For the purposes of this manuscript, we will be focusing on questionnaire-based survey research.

Reliable survey research requires substantial forethought to refine the scientific question, design the survey instrument, select and engage the appropriate population, and analyze the data. This review outlines the steps in designing and implementing a questionnaire-based study. The process is broken down into its key components in Figure 1. The purpose of this review is to provide a stepwise guideline for radiologists embarking on this type of research.

A STEPWISE APPROACH TO QUESTIONNAIRE-BASED RESEARCH

The "Survey Construct": What Do I Want to Measure, or Why Am I Doing This?

The *construct* is the first piece of information that an investigator needs to define when beginning the journey toward survey design; it is the specific question or kernel of information that the survey aims to answer or measure (6–8). In simplest terms, defining the construct is answering the question: "What do I want to measure?" If the answer to this question is vague or general, such as "I just want to see what people think," the results are likely to be similarly unfocused (ie, difficult to analyze and publish). It is worth taking time at this point in the process to refine this statement and clarify the purpose of the study as much as possible before moving forward.

In research design, constructs may be direct or indirect (8). Direct constructs, such as height (in meters), weight (in kg), and distance (in meters), refer to variables that can be explicitly quantified. In social science and survey research, indirect constructs are more often of interest. Examples of indirect constructs include patient satisfaction, testing experiences, and health-related quality of life (8–10). These concepts can be numerically expressed, but the values usually are obtained by inference from carefully engineered combinations of survey items rather than by direct measurement. A thorough review of the literature at this phase is crucial in understanding any

Acad Radiol 2018; ■:■■–■■

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https://doi.org/10.1016/j.acra.2018.02.003

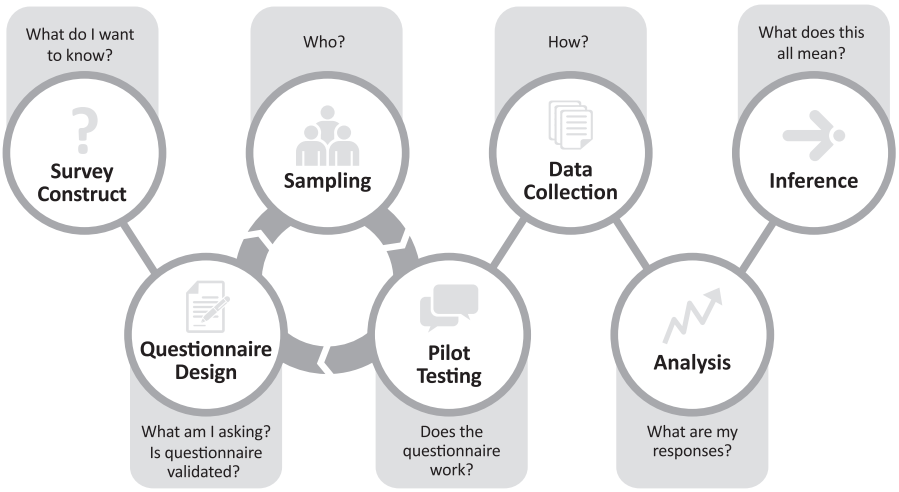

Figure 1. Schematic of the process of conducting a survey-based research study.

relevant work that already has been done, to help refine the potentially abstract construct of interest, and to identify any existing validated surveys that may be helpful during questionnaire design.

It is during this initial step that the investigator should think ahead toward his or her intended conclusions: is the survey being performed for simple descriptive purposes, or does the investigator have a specific analysis or hypothesis test in mind (4)? A descriptive survey is conducted for the purpose of understanding opinions or views of a sampled population. Examples include a survey assessing patient preferences related to oral contrast material consumption, an exploration of patients' baseline knowledge of imaging tests, or an overview of participants' experiences in a professional development program for women radiologists (11–13). These descriptive surveys illustrate the current clinical landscape and often serve as preliminary data for further investigation or intervention.

Alternatively, in an analytic survey, the goal of the investigation is to derive an association between a direct or indirect outcome and specific respondent characteristics, or to test a hypothesis. This kind of analysis might involve surveying the same respondents at multiple time points, or comparing responses between subsets of the population who differ in a specific way. Examples include surveys of residents regarding a curriculum change, a patient survey incorporated into a longitudinal clinical trial (14–16), or a comparison of patient-reported outcomes stratified by race, gender, or cancer type. If the research question requires representation by certain respondent types in the final population, this will be essential to keep in mind during consideration of the third step, which involves sampling method.

Questionnaire Design: What Questions Am I Asking and Are These the Right Ones?

When seeking to measure a direct construct such as length, a researcher probably would not spend time creating a brand new ruler. Likewise, the use of validated survey instruments to measure indirect constructs may be more efficient, accurate, and generalizable than a new homegrown questionnaire (1). Validated questionnaires have undergone rigorous testing, including internal consistency (6), test-retest reliability, and construct validity (17), as well as comparison and calibration with existing metrics to assess external consistency. Validated questionnaires may have been accepted in a given discipline as a means for measurement of particular domains, and may be used very broadly by other investigators. Therefore, using previously published instruments also enables investigators to compare their results to published norms in various populations, providing valuable context for their conclusions.

A questionnaire may combine one or more validated components with any number of specific new questions (items) that provide additional information of interest to investigators. For example, in addition to exploring the major outcome of the survey, the questionnaire might also contain items to capture respondent covariates that may be of interest (eg, age, gender, or political affiliation).

Simplicity and clarity are key principles of item construction. Table 1 enumerates a variety of pitfalls to avoid. Answer options should not overlap and should be mutually exclusive. In general, questionnaires should be constructed at an eighth grade reading level. Reading level and questionnaire length should reflect the education and attention span of the population (18). A population of physician respondents may tolerate a higher level of syntactic complexity, but similar to the general population, they usually will quit after one to two pages of a questionnaire. Items should be constructed in the context of the intended method of survey administration. For example, a schematic diagram may be an elegant way of asking a complex question in an online survey, but if the same schematic is incorporated into a phone survey, the meaning could be lost.

Beyond individual items, the entire survey should be a comprehensive tool with appropriate internal and external validation. Internal validation is a process to ensure that the question-