

A nurses' guide to Quantitative Research

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ABSTRACT

Objective

This article provides a breakdown of the components of quantitative research methodology. Its intention is to simplify the terminology and process of quantitative research to enable novice readers of research to better understand the concepts involved (Benner 1984).

Primary Argument

Globally, evidence-based practice (EBP) has become a major preoccupation of investigators and practitioners involved in the delivery of health care (Liamputtong 2013 pxi). Working within the health sector requires the nurse to be familiar with research in a way that informs practice, especially if working towards a degree (**Wright-St Clair et al 2014). Nurses may benefit from a discussion that helps them understand the sequence of a research paper (Moxham 2012) that uses quantitative methodology.

Conclusion

The content of a typical quantitative research paper will be discussed in a systematic, logical order. A quantitative grid is provided at the end of the paper. Its intention is to aid the nurse to better understand the differing components of the four main quantitative research methods.

INTRODUCTION

There is an increased emphasis on EBP to substantiate clinical decision-making. EBP is defined as the conscientious integration of best research evidence with clinical expertise, patient values and needs in the delivery of high-quality, cost effective health care (**Wright-St Clair et al 2014; Burns and Grove 2009 p17). Health clinicians use tools, such as pain or depression scales, frequently in clinical practice and during research (Imms and Greaves 2013). In this paper only quantitative research will be discussed as one paradigm for researching health.

THE QUANTITATIVE RESEARCH PAPER

Definition and meaning of Quantitative research

Quantitative research is a means for testing objective theories by examining the relationship among variables (Polit and Hungler 2013; Moxham 2012). A variable is a factor that can be controlled or changed in an experiment (Wong 2014 p125). The word quantitative implies quantity or amounts. Information collected in the course of the study is in a quantified or numeric form (White and Millar 2014). This is referred to as statistical evidence (White and Millar 2014).

The variables include the Dependent variable (the variable which is hypothesised to depend on or be caused by another variable) or Independent variable (the variable that is believed to be the cause or influence) (Wong 2014; Polit and Hungler 2013). There may also be Extraneous variables (Polit and Hungler 2013), also known as Confounding variables (White and Millar 2014 p47), which confuse or confound the relationship between the Dependent and Independent variables. An example would be as follows: wound healing (Dependent variable) and type of dressing (Independent variable). Patient age and presence of Diabetes Mellitus would be Extraneous/Confounding variables.

Quantitative research falls within the philosophical underpinning of Positivism. A Positivist researcher believes in the concepts of objective reality (Jirojwong et al 2014 p362). Quantitative research attempts to establish statistically significant relationships, addresses questions by measuring and describing, is based on objective measurement and observation, and is concerned with correlation and causation (Hamer and Collinson 2014). A specific example of positivism is where there is generally consensual agreement on foundational aspects of human body structures (*Wright-St Clair 2014 p18).

Abstract/Summary

An abstract or summary should clearly outline the hypothesis or research question/s, aims and objectives of the study (Polit and Hungler 2013; Nieswiadomy 2012). A hypothesis is a statement of a predicted relationship between the variables under study (Polit and Hungler 2013). The research may state a Null hypothesis which predicts no relationship between the variables (White and Millar 2014 p43; **Wright-St Clair et al 2014, p.456). It should also cite the quantitative methods used to collect the data, the results, conclusions and recommendations for practice (Nieswiadomy 2012). Abstract length is generally less than 200 words (Borbasi and Jackson 2012 p178). The abstract may also include some of the limitations of the study.

Identifying the problem

The problem should clearly describe what is to be studied. The hypothesis, aims and/or objectives should be clearly and unambiguously stated. Ideally the topic is narrowed down to a specific one sentence statement of the problem (Nieswiadomy 2012). A useful strategy for formulating EBP question is the acronym PICO/s (patient, population or problem, intervention or interest, comparison, outcome and study design) (Hoffmann et al 2013 p22; **Wright-St Clair et al 2014 p457; Burns and Grove 2009 p474). Ideally four criteria are used in quantitative research namely significance, researchability, feasibility and interest to the investigator (Moxham 2012 p33).

Literature Search

The literature review is generally in the introductory section (Polit and Hungler 2013). The investigator needs to determine what is known and not known about the problem, identify gaps in knowledge, establish the significance of the study and situate the study within the current body of knowledge (Hoffmann et al 2013; Polit and Hungler 2013; Burns and Grove 2009). The literature search should consider how the major variables were explored by critiquing the strengths and limitations of the methods previously used. The investigator may also acquire information about other techniques, instruments and methods of data analysis as well as also identify potential problems that can be avoided in a new research (Polit and Hungler 2013).

METHODOLOGY

Designs

Quantitative research falls into four main designs, namely, Descriptive, Correlational, Experimental and Quasi-experimental (Borbasi and Jackson 2012; Burns and Grove 2009). The main aim of Descriptive Research is the accurate portrayal of the characteristics of individuals, situations, or groups and the frequency with which certain phenomena occur using statistics to describe and summarise the data (Polit and Hungler 2013). Correlational research explores the interrelationship amongst variables of interest without any active intervention on the part of the researcher (Polit and Hungler 2013). Experimental research is systematic and objective, particularly in medication trials, known as a Random Controlled Trials or RCT's. They are considered as the 'gold standard' in research evidence (Hamer and Collinson 2014 p19). In Experimental research the investigator controls the independent variable and randomly assigns subjects to different conditions. Quasi-experimental research is less powerful than Experimental due to the lower level of control (Burns and Grove 2009). The investigator manipulates an independent variable but subjects cannot be randomised (Polit and Hungler 2013). The choice of design should allow the variable to be measured or manipulated in the study (Burns and Grove 2009). Before a study can progress, the investigator will usually clarify and define the variables under investigation and specify how the variable will be observed and measured in the actual research situation (Polit and Hungler 2013). This is known as an operational definition (Polit and Hungler 2013; Nieswiadomy 2012). These four designs, discussed above, are compared in the grid at the end of this paper to highlight similarities and differences in style.

Instrument

Quantitative instruments may include self-reporting tools, questionnaires, observation, and biophysical measures (Polit and Hungler 2013). Commonly used methods in nursing research also include focus groups and interviews that are qualitative in nature (Moxham 2012). Using both styles is referred to as mixed or multi-method research (Polit and Hungler 2013). Scales may be used to quantify specific information such as a Likert scale gives specific choices for example, strongly agree, agree, not sure, disagree, strongly disagree (Polit and Hungler 2013). Whatever instrument is used the reliability and validity of the instrument is essential. Reliability refers to the degree of consistency or accuracy with which an instrument measures the attribute it has been designed to measure (Polit and Hungler 2013). Data retrieved may look authoritative but it could be incomplete or inaccurate or may not be sufficiently reliable to be of value in generalising to the larger population. Concurrently, validity refers to the degree to which the instrument measures the phenomena in the first place or reflects the abstract construct being examined (Burns and Grove 2009 p479).

Sample

Descriptive research may use probability sampling which includes simple random, stratified sampling, proportionate stratified sampling and cluster sampling (Shaughnessy et al 2014). Random sampling is also known as probability sampling, rather than non-probability sampling, which ensures every element is

likely to be included in the sample (Shaughnessy et al 2014). Correlational and Experimental research use random sampling. Random sampling gives every member of a population an equal chance/probability of being included (Polit and Hungler 2013). Quasi-experimental research is called 'quasi' because it is part, or almost, experimental. The component that makes it quasi is the use of a convenience or accidental sample which does not give the population equal probability of being included and therefore, less rigorous in design (Polit and Hungler 2013).

Ethics

The investigator is obliged to consider the implications of the proposed research for the participating subjects, their families and society (Burns and Grove 2009). Most nursing research usually requires the permission of an appropriate ethics committee (Elliott et al 2012 p93; Jirojwong et al 2011 pp63-66). Ethical guidelines outline a set of standards for conducting research. Within their practice nurses have a moral and legal obligation to protect the privacy of an individual (Nursing and Midwifery Board of Australia 2012, Conduct Statement 5) and this holds true within nursing research. Equally important is the premise to protect individuals from the risk of significant harm (Nursing and Midwifery Board of Australia 2012, Conduct Statement 8). It is important that consent is obtained after full explanation of the study's intent (Borbasi and Jackson, 2012). Participants are entitled to withdraw from the study at any point without penalty (Jirojwong et al 2014 p70).

Pilot Study

A pilot study is a trial run of the research (Nieswiadomy 2012). It is conducted on a small number of participants to assess the adequacy and feasibility of the intended research (Moxham 2012 p35). By doing so the pilot study can identify problems and strengthen the quantitative methodology.

Main Study

The research process depends on the collection of data known more specifically as empirical data (Moxham 2012 p35) which is rooted in objectivity or a scientific approach (Polit and Hungler 2013). It is at this point that the researcher puts the design into action and ensures that the data is collected and recorded. The findings need to be analysed, and in the case of quantitative research, statistical analysis and interpretation is an essential part of answering the hypothesis or research questions (Borbasi and Jackson 2012 p114).

Results

Data analysis may involve descriptive or inferential statistics (Moxham 2012). Descriptive statistics describe and synthesise data and show patterns and trends (Moxham 2012) whereas inferential statistics permit the investigator to infer whether relationships noted in a sample might occur in a larger population (Polit and Hungler 2013). Numerical data may be presented in two forms, firstly as raw figures and percentages and secondly, more visually, as line graphs, tables or histograms (Burns and Grove 2009). To analyse variables statistically they have to be in a measurable form that means using numbers or scores (Borbasi and Jackson 2012).

Measures of central tendency, known as the average, identify how near the usual response a particular variable lies (Burns and Grove 2009). These averages are expressed as mean, median and mode (Burns and Grove 2009). The mean is the average, for example, all scores are added up and divided by the number of subjects. The median represents the exact middle score or value in a distribution of scores. The mode is the value that occurs most frequently in a distribution of scores (Polit and Hungler 2013; Burns and Grove 2009).

Probability refers to the likelihood of a particular outcome (White and Millar 2014 p43). Statisticians use p-values to measure probability (White and Millar 2014 p43). A simple example of probability is flipping a coin ten times. It will most likely fall five times as heads and five times as tails. To determine a significant result the statistics have to have levels of significance. Figures may be expressed as $p > 0.05$ or $p < 0.05$ (Burns and

Grove 2009 p37). If a probability result is statistically significant ($p < 0.05$) the result had a less than 5% possibility of being caused by chance and therefore becomes significant and important (Polit and Hungler 2013). Even when a result is claimed to be statistically significant it is important to remember the results may still tell us nothing that matters whilst relationships that do not achieve conventional levels of statistical significance can be important (Lempert 2008).

Another term used in quantitative research is the Confidence Interval (CI). Whenever a mean is calculated using a sample there is always the possibility of error. The investigator will calculate the CI. If they arrive at a CI of 95% it means that the investigator is satisfied that 95% of the true population lies between two values (Liamputtong 2013 p413) for example, the investigator may find average height of humans falls between 1.4m and 1.8m. Essentially the CI represents how true the estimate is (Hoffmann et al 2013 p80). A CI is an important reminder regarding the limitations of estimates. The greater the sample size the more precise the CI (Liamputtong 2013 p297).

Standard Deviation (SD) is the spread of data from a mean value (White and Millar 2014 p41). Using the example of human height, if normal standard height falls between 1.4m and 1.8m then heights outside those ranges deviate from the norm. The mean and standard deviation are two statistics that help determine differences and similarities in groups that are being researched (White and Millar 2014 p41).

Discussion/Recommendations

The discussion of findings allows the investigators to make interpretations (Nieswiadomy 2012) that need to be analysed in an objective and critical manner before drawing conclusions. Recommendations could be implemented in practice readily or cautiously taken up and piloted over a period of time. Alternatively the results may not be considered unless modifications are made. An important point to remember is that the research does not necessarily prove a point and may only suggest a relationship or highlight an issue needing further investigation. A body of evidence, to support clinical practice, particularly in RCT's, is the most reliable source of evidence (Borbasi and Jackson 2012 p195). Limitations of the research should be acknowledged.

Conclusions

All major findings related to the original aims of the study are discussed in relation to whether the data supports or negates the hypothesis or research question/s (Nieswiadomy 2012).

Reference List

Research papers conclude with a list including books, reports and other journal articles used to support the concepts outlined. For those interested in pursuing additional reading on the topic, the reference list provides an excellent starting place (Polit and Hungler 2013).

ARTICLE CONCLUSION

This paper has discussed quantitative research logically and systematically. Whilst this paper is deliberately simplified it still allows for the main components of the quantitative research process to be identified for the novice researcher in nursing (Benner 1984).

The Grid: An overview of the four styles of Quantitative Research

Content	Descriptive	Correlational	Experimental	Quasi-experimental
Sample	Simple random, Stratified Sampling, Proportionate Stratified Sampling and Cluster Sampling	Random	Random	Convenience or accidental
Example of types of instruments/tools used	Can use both quantitative and qualitative methods. Relies on instrumentation to measure and observe. May use microscopes, computer models, survey method, as well as observational and measurement tools. Others may include case studies and archival research projects.	Survey method may be used to determine correlations, for example, when wattle flowers in Spring more people buy antihistamines. This type of research may be purely based on observation (also known as naturalistic research) where subjects are observed in their habitat looking for behavioural correlations.	A RCT is purely quantitative and a good example where one group is the experimental group (for example, consented patients receiving new drug) and one group which is random (patients receiving either an old tested drug or placebo). Post-test only.	Pre and post testing knowledge and skills using observation and questionnaire
Ethics permission	Essential	Essential	Essential	Essential

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