"Quantitative Research and Mixed Method Research – An overview"

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INTRODUCTION

The healthcare is an ever growing sector and with the recent advent of technology the revolution in healthcare sector is like an avalanche. The health professionals need to keep abreast themselves with the changes in the care giving as a result of the technology revolution. Nowadays, the data is generated at every step of our daily life and there are analytics available that analyze these data and interpret them to help the health professionals understand the utility of these data. Health professionals must know the various aspects of data for better care giving.

Quantitative research is defined as the systematic investigation of phenomena by gathering quantifiable data and performing statistical, mathematical or computational techniques. Quantitative research gathers information from existing and potential customers using sampling methods and sending out online surveys, online polls, questionnaires etc., the results of which can be depicted in the form of numerical. After careful understanding of these numbers to predict the future of a product or service and make changes accordingly. Quantitative research is by which objectives are tested to understand the various kinds of interactions between the variables. It is a factor that is studied upon either by manipulation or as it is (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 this is referred to as statistical evidence.

An example of quantitative research is, the survey conducted to understand the amount of time a doctor takes to tend to a patient when the patient walks into the hospital. A patient satisfaction survey template can be administered to ask questions like how much time did a doctor take to see a patient, how often does the patient walk into a hospital and other such questions.

The variables include the Dependent variable which is the variable to be predicted and the independent variable is the variable that influences the dependent variable). 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.

PROCESS OF QUANTITATIVE RESEARCH

The Problem identification

It 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). Ideally four criteria are used in quantitative research namely significance, research ability, feasibility and interest to the investigator" (Moxham 2012 p33).

Review of Literature

"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"

Design of Research

Quantitative research falls into four main designs, namely, Descriptive, Correlational, Experimental and Quasi experimental . The descriptive research explains the present situation and characteristics of sample using statistics to describe and summarize the data. Correlational research explains the relationship between two or more variables without any intervention by the researcher . Experimental Research follows the principle of randomized control trial and comprises of randomization and blinding (Hamer and Collinson 2014 p19)." Quasi experimental research is less powerful than Experimental due to the lower level of control The investigator manipulates an independent variable but subjects cannot be randomised .The choice of design should allow the variable to be measured or manipulated in the study (Burns and Grove 2009). The variables in the study are defined according to the parameters kept for assessment. This is known as operational definition which is different from the conceptual definition."

Designing the instrument

Quantitative instruments may include self reporting tools, questionnaires, observation, and biophysical measures (Broomfield R).The tool chosen for data collection must be pilot tested for reliability and validity of the tool. This is done to ensure the ability of the study to be generalizable on the population.

Sampling

Descriptive research may use probability sampling which includes simple random, stratified sampling, systematic sampling and cluster sampling (Shaughnessy et al 2014). Random sampling is also known as probability sampling which ensures equal chance to every element to be selected. Quasi-experimental research is called 'quasi' because it is part, or almost, experimental. It is less rigorous in design and uses non probability sampling (Polit and Hungler 2013).

Ethical Approval

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.

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). This helps in strengthening the quantitative methodology.

Main Study

The research process depends on the collection of data known more specifically as empirical data (Moxham2012 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 are analyzed and interpreted through various techniques of hypothesis testing (Borbasi and Jackson 2012 p114).

Hypothesis Testing

Hypothesis is tentative assumption made by the researcher before starting the data collection. The hypothesis are of three types. Researcher Hypothesis is the hypothesis made by the researcher of what he wishes to be the outcome of the study. The second is statistical hypothesis which is put to test using various quantitative data analysis techniques. This statistical hypothesis has two types; one is null hypothesis which states that there is no change in the phenomenon and alternative hypothesis which states something happening in the experiment. The third type of hypothesis is substantial hypothesis which is the hypothesis which is true.

Choice of Statistical Test

Hypothesis testing is carried out by various statistical tests. The choice of these tests depends on the level of data which can be nominal, ordinal, interval or ratio. It also depends on what is the objective of the study and whether sample are related or independent in nature.

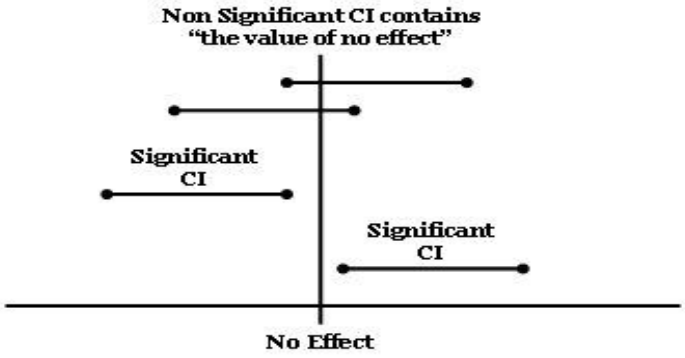
The choice of appropriate test in each level of data is shown in the table 1.

Measurement Scale	One sample case	Two Samples Tests		K samples Test	
		Related Samples	Independent Samples	Related Samples	Independent Samples
Nominal	• Binomial • Chi square one sample test	• McNemar	• Fisher exact test • Chi square two samples test	Cochran Q	Chi square for k samples
Ordinal	• Komolgrovsmirnov one sample test • Runs test	• Signs Test • Wilcoxon Matched Pairs test	• Median test • Mann Whitney • Komolgrovsmirnov	Friedman Two way ANOVA	Kruskal Wallis test
Interval and Ratio	• T test • Z test	Pair t test	• T test • Z test	Repeated measures ANOVA	One way ANOVA

Interpreting the Output

The statistical output gives two values; one is p value and other is confidence interval. (CI) - the range within which the true size of effect (never known exactly) lies, with a given degree of assurance."95% CI " - the interval which includes the true value with 95% certainty. 95% CI represent almost two standard deviations around the mean. *If the 95% or 90% confidence*

intervals crosses 1, the result is NOT statistically significant (this is because a value of 1 means that there is no difference between the interventions).Figure 1 illustrates the significant confidence interval



P value is Probability that the results obtained could have occurred by chance. p = 0.05 means the probability of chance as an explanation for the observed results is 5% in case confidence level is 95%. p = 0.10 in case if CI is 90% .

95% CI gives us information about the whole population than the p-value which gives us information about the sample. ***p value indicates the probability*** **that an outcome this extreme could happen, if the null hypothesis were true.** As it measures the effect of chance; statistically significant does not mean clinically significant.

Advantages of Quantitative Research

There are many advantages of quantitative research. Some of the major advantages why researchers use this method are:

- Collect reliable and accurate data: As data is collected, analyzed and presented in numbers, the results obtained will be extremely reliable. Numbers do not lie. They present an honest picture of the conducted research without discrepancies and is also extremely accurate. In situations where a researcher predicts conflict, quantitative research is conducted.

- Quick data collection: A quantitative research is carried out with a group of respondents who represent a population. A survey or any other quantitative research method applied to these respondents and the involvement of statistics, conducting and analyzing results is quite straightforward and less time-consuming.
- Wider scope of data analysis: Due to the statistics, this research method provides a wide scope of data collection.
- Eliminate bias: This research method offers no scope for personal comments or biasing of results. The results achieved are numerical and are thus, fair in most cases.

Disadvantages of Quantitative Research

- Does not account for people's thoughts or perceptions about what you're evaluating.
- Does not explore the "why" and "how" behind a phenomenon.

MIXED METHODS RESEARCH

A mixed method research is one of the three major research paradigms: quantitative research, qualitative research, and mixed methods research. Mixed methods research combines elements of qualitative and quantitative research approaches for the broad purpose of increasing the breadth and depth of understanding. The definition of mixed methods, from the first issue of the Journal of Mixed Methods Research, is "research in which the investigator collects and analyzes data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or program of inquiry" (Tashakkori& Creswell, 2007, p.4).

Recently, there is an increasing popularity of mixed methods research (O'Cathain, 2009). The four major types of mixed methods designs are triangulation design, embedded design, explanatory design, and exploratory design (Creswell & Plano Clark, 2007).

Growth of mixed methods research in nursing and healthcare has occurred at a time of internationally increasing complexity in healthcare delivery. Mixed methods research draws on potential strengths of both qualitative and quantitative methods, allowing the researcher to explore diverse perspectives and uncover relationships that exist between the intricate layers of our multifaceted research questions. As providers and policy makers strive to ensure quality and safety for patients and families, researchers can use mixed methods to explore contemporary healthcare trends and practices across increasingly diverse practice settings.

What is mixed methods research?

Mixed methods research requires a purposeful mixing of methods in data collection, data analysis and interpretation of the evidence. The key word is 'mixed', as an essential step in the mixed methods approach is data linkage, or integration at an appropriate stage in the research process. The mixed method research helps the researcher to have a panoramic view of the problem. For example, in a randomised controlled trial (RCT) evaluating a decision aid for women making choices about birth after caesarean, quantitative data were collected to assess knowledge change, levels of decisional conflict, birth choices and outcomes. Qualitative data can also be collected to understand what factors influence their choices. (Allison Shorten, 2017)

When to use Mixed Methods Research?

Four broad types of research situations have been reported as benefiting particularly from mixed methods research. The first situation is when concepts are new and not well understood. Thus, there is a need for qualitative exploration before quantitative methods can be used. The second situation is when findings from one approach can be better understood with a second source of data. The third situation is when neither a qualitative nor a quantitative approach, by itself, is adequate to understanding the concept being studied. Lastly, the fourth situation is when the quantitative results are difficult to interpret, and qualitative data can assist with understanding the results (Creswell & Plano Clark, 2007).

What are the strengths and challenges in using mixed methods?

A mixed methods design is appropriate for answering research questions that neither quantitative nor qualitative methods could answer alone. Mixed methods can be used to gain a better understanding of connections or contradictions between qualitative and quantitative data; they can provide opportunities for participants to have a strong voice and share their experiences across the research process, and they can facilitate different avenues of exploration that enrich the evidence and enable questions to be answered more deeply. Mixed methods can facilitate greater scholarly interaction and enrich the experiences of researchers as different perspectives illuminate the issues being studied.

The process of mixing methods within one study, however, can add to the complexity of conducting research. It often requires more resources (time and personnel) and additional research training, as multidisciplinary research teams need to become conversant with alternative research paradigms and different approaches to sample selection, data collection, data analysis and data synthesis or integration. (Allison Shorten, 2017)

Types of Mixed Methods Research

The first type is explanatory sequential mixed method research. In this research, Quantitative data are collected and analysed first, then qualitative data are collected and analyzed to help explain quantitative data.

The second type is exploratory sequential in which Qualitative data are collected and analyzed first, then quantitative data are collected and used to test findings empirically.

The third type of mixed method research is parallel forms where in the Qualitative and quantitative data collected and analyzed concurrently

The nested type of mixed method research is which can be either qualitative or quantitative or mainly quantitative within which the alternative paradigm is embedded to answer a complementary question.

Using Mixed Methods to Overcome Barriers to Research

Barriers to effective research into chronic pain management among American Indians include the relatively small number of American Indian patients in any circumscribed area or tribe, the limitations of individual databases, and widespread racial misclassification. A mixed methods research approach is needed to understand the complex experience, epidemiology, and management of chronic pain among American Indians and to address the strengths and weaknesses of quantitative methodologies (large sample size, trends, generalizable) with those of qualitative methodologies (small sample size, details, in-depth).

Role of quantitative data

Previous examination of U.S. national databases has reported a higher prevalence of lower back pain in American Indians than in the general population (35% compared to 26% ;Deyo, Mirza, & Martin, 2002). Thus, at level 1, quantitative administrative data sets representing health care received by American Indians, both across the United States and in broad regions, will be used to evaluate macro-level trends in utilization of health care and in basic outcomes, such as opioid-related deaths.

At level 2, more detailed quantitative Washington state tribal clinic data will be used to identify American Indian populations, evaluate breakdowns in the delivery of care, and identify processes that lead to unsuccessful outcomes. For example, in a study conducted with community health practitioners in Alaska, participants reported low levels of knowledge and comfort around discussing cancer pain (Cueva, Lanier, Dignan, Kuhnley, & Jenkins, 2005).

Role of qualitative data

At level 3, qualitative research through focus groups and key informant interviews will provide even more refined information about perceptions of recommended and received care. These interviews will provide insight into selected immediate and proximal factors. These factors include patients' choice and use of services; attitudes, motivations, and perceptions that influence their decisions; interpersonal factors, such as social support; and perceived discrimination. This qualitative data will shed light on potential barriers to care that are not easily recognized in administrative or clinical records, and thereby will provide greater detail about patient views of chronic pain care.

Conclusion

Mixed methods are increasingly being used in nursing research. Each type of data can be collected and analyzed separately and independently, using the techniques traditionally associated with each data type. Both simultaneous and sequential data collection lend them to team research, in which the team includes researchers with both quantitative and qualitative expertise.

Challenges include the effort and expertise required due to the simultaneous data collection, and the fact that equal weight is usually given to each data type. Thus this research requires a team, or extensive training in both quantitative and qualitative methodologies, and careful adherence to the methodological rigor required for both methodologies. Nursing researchers may face the possibility of inconsistency in research findings arising from the objectivity of quantitative methods and the subjectivity of qualitative methods. In these cases, additional data collection may be required.

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