

Difference between Quantitative and Qualitative Research Question- PICO vs. SPIDER

Yasir Rehman*

Canadian Academy of Osteopathy, Canada

Email: yasirrehman@canadianosteopathy.ca

Abstract

Purpose: The research question, an empirical component of research, is used for conceptualization, methodology selection, and patient recruitment when aiming to answer a complex phenomenon. PICO (patient, intervention, comparison, and outcome) is a commonly employed/used framework for formulating a research question in quantitative studies. The PICO framework does not capture all the components of a qualitative research question thus, PICO may not be a suitable framework. To describe difference between qualitative and quantitative research questions and what are the main components of these questions.

Methodology: Non-systematic review of qualitative and quantitative studies exploring expectations in preoperative sciatica and or chronic low back pain patients. We compared the research question between qualitative and quantitative studies, using SPIDER and PICO framework.

Findings: We reviewed five qualitative studies, and six quantitative studies that explored expectation in sciatica or chronic low back pain patients undergoing surgical or nonsurgical interventions. Qualitative studies differed from quantitative studies as the former do not test hypotheses, but instead generated them. Qualitative studies are used to explain complex processes such as patients' perceptions, experiences, attitudes, and opinions. The PICO framework did not capture all the components of a qualitative research question thus, SPIDER should be preferred over the PICO framework.

Discussion: Understanding the difference in qualitative and quantitative research questions will be of particular importance to new researchers and students planning to conduct qualitative research.

Key words: Expectations; qualitative studies; quantitative studies; research question; PICO; SPIDER.

* Corresponding author.

1. Introduction

Quantitative and qualitative research are the two common approaches in health research. Both qualitative and quantitative research explore different aspects of a phenomenon and hold varying assumptions. They vary in their reports on ontological and epistemological perspectives, consequently representing dissimilar views[1]. Quantitative studies test hypotheses and measure clinical problems such as the natural course of an illness, the effect of an intervention, or predictive association of exposure variables related to the outcome. On the other hand, qualitative studies do not test hypotheses but rather generate them. Qualitative studies do not quantify the effect of intervention nor causal association of the independent variable with outcomes. The qualitative studies interpret the meaning or perception of a complex problem and provide insight into the lived experience of a disease and a patient’s decision[2, 3]. As qualitative and quantitative studies involve differing methodologies, goals, and outcomes, the research questions, as a result, are also formulated differently. Formulating a research question is a reflective process and an integral part of the research. A research question should clearly articulate the phenomenon[4] and address gaps in the current state of knowledge[5-7]. A well-defined research question is an unambiguous statement which articulates the problem or phenomenon of interest in an interrogative way. To answer a phenomenon of interest in an insightful and coherent manner, we need to employ an appropriate research design[2]. A well-defined research question helps researchers in choosing a suitable study design, setting, participants, and an analysis plan; enabling them to report potential findings with a practical implications[8, 9]. A research question should clearly indicate whether the phenomenon is explored in a quantitative (association) or qualitative (focused on perspective)[10, 11]. An inadequately defined research question leads to an erroneous sample size, biased results, and inaccurate interpretation[12, 13]. An important difference between quantitative and qualitative research questions is that the former type constitutes a linear process, whereas the latter, a cyclical process. In quantitative studies, patient, intervention, comparison, outcomes, timing, and setting (PICO-TS) is a suitable framework[14-19]. Qualitative studies do not explore the causal association of effect and outcome, nor intervention, therefore, a typical PICO-TS framework is not applicable. For qualitative studies, SPIDER (sample, phenomena, design, evaluation, research)[20, 21] and SPICES (Setting, Population, Intervention, Comparison, and Evaluation)[22] have been reported as appropriate frameworks for formulating respective research questions (Table# 1).

Table 1: Comparison of Different frame works

Quantitative research question framework		Qualitative research question framework			
PICO-TS		SPIDER		SPICE	
P	Population	S	Sample	S	Setting
I	Intervention/ exposure	Pi	Phenomena	P	Population
C	Comparison	D	Design	I	Intervention
O	Outcome	E	Evaluation (subquestion)	C	Comparison
T	Timing	R	Research	E	Evaluation
S	Setting				

The aim of this article is to review the main differences between qualitative and quantitative research questions and delineate the important components or structure required to generate an appropriate qualitative research question. For this review, we used “expectation” in low back pain patients or patients undergoing spinal decompression procedures to contrast between qualitative and quantitative research questions.

2. Method

For this review, we conducted a non-systematic search for qualitative and quantitative studies that explored “expectations” in chronic low back pain (CLBP) and/or in patients undergoing lumbar decompressive surgery. As our goal was to compare important differences between qualitative and quantitative research questions, we did not need to develop a systematic search strategy. For quantitative studies and qualitative studies, we employed PICO[14-19] and SPIDER[20, 21] frameworks, respectively.

2.1 Conceptual definition of expectation

We choose expectation as the phenomenon to describe the difference between qualitative and quantitative research questions because expectation is a broad term and has both quantitative and qualitative meanings. In literature, “expectation” has various definitions and is explored differently in qualitative and quantitative studies. In literature, expectation is reported either as a predictive association with the outcomes[23] or a desire to seek more information[23].

2.1.1 Quantitatively

We defined “expectation” as a health-related outcome or the independent variable of a predictive association with the outcome such as what an individual believes will occur, as measurable on different expectation scales scale[24] and the visual analogue scale (VAS)[25].

2.1.2 Qualitatively

We defined “expectation” as a desire or hope, an opinion, or perceptions of what an individual wants to transpire and the mechanisms through which expectation may alter musculoskeletal pain[23]. We narratively synthesized differences between quantitative and qualitative studies, exploring expectations in low back pain patients or patients undergoing treatment for their ailment.

3. Results

We identified five studies that explored expectations qualitatively[26-30] and six quantitative studies[31-37]. Summary of the included studies are given in table# 2 and 3, respectively.

Table 2: Research question framework (SPIDER) for qualitative studies

<i>Authors</i>	<i>S (Population)</i>	<i>Pi (Phenomena)</i>	<i>D (Design)</i>	<i>Er (End result)</i>	<i>S (Sub phenomena)</i>
Boote 2015	Sciatica patients	Patient's views and experiences of physiotherapy for sciatica	Thematic analysis, coding framework with constant comparative method	Three major themes with subthemes. i). Impact of sciatica on patients' QOL; ii). Patients' expectations and perceptions of the physiotherapy; iii). Patients' perceptions of the value of physiotherapy as an adjunct to surgery	Most patients in the sample found the physiotherapy valuable, appreciating the individual nature of the approach, the exercises to reduce pain and discomfort, improving functional spinal movement, walking and dynamic posture, and manual therapy and cardiovascular exercise.
Eaves 2015	Low back pain	Change in the expectations with CAM treatment for chronic low back pain	Matrix analysis process	Self-care, empowerment, and lifestyle impacts, as these emerged as central themes in post-treatment interviews	Pre-treatment expectations consisted whether CAM therapy could relieve pain and improve participation in meaningful activities. Expectations tended to shift over the course of treatment, the need for long-term pain management strategies and attention to long-term QOL and wellness and greater acceptance of chronic pain.
Laerum 2006	Chronic LBP	Patient's perceptions of communication with doctors	Observation of consultations, subsequent patient interview and template analysis	The 4 categories were: i). be taken seriously, ii). Patient-centered communication and interaction, iii). Giving test-related explanations and iv). positive feedback and structured consultation''.	Clinical examination had been thorough and satisfactory and emphasized the importance of being given an explanation during the examination, understandable information on the causes of the pain, reassurance, psychosocial issues and discussing what can be done.
Rehman 2019	Preoperative sciatica and spina stenosis patients	Patients preoperative expectation and what information is provided by surgeons	Content analysis	Main themes were: I). patients were overly optimistic for outcomes, which surgeons' thought was not realistic ii). Gap in patients understanding and what surgeons tries to establish	Patients seek information from various sources for self-control and reassurance to make decision to choose surgery
Williams on 2007	Lumbar microdiscectomy	Microdiscectomy insight into patients' experiences of physiotherapy	Phenomenologica l framework	Three major themes; Wish for precise movement boundaries; Limitations of physiotherapy and Fatigue.	A topic guide designed to elicit information relating to pre- and post-operative activity, fears and expectations associated with physiotherapy, barriers to movement and exercise and opportunities associated with return to work.

Table 3: Research question framework (PICO) for quantitative studies

Author	P	I/ Exposure	C	O	T
McGregor 2013	Spinal surgery for nerve root compression, and/or lumbar disc prolapse	Preoperative expectations (High expectations)	Internal comparison with low expectations	Satisfaction with post-surgical outcome Reduction in leg pain	6 weeks, 6 months, and 1-year post-surgery
Myers 2007	Acute low back pain (LBP)	Preoperative expectations (High expectations) and functional status at baseline	Internal comparison with low expectations	Improvement in functional status	Five and 12 weeks post operatively
Rönnberg 2007	Lumbar Disc Herniation Surgery	Preoperative expectations; visual analog scale leg pain, Zung Depression Scale, and Oswestry Disability Index	Internal comparison with low expectations	Objective Outcome such as work return and realistic expectations on pain and physical recovery	Two years post operatively
Soroceanu 2012	Lumbar and Cervical spine surgery	Effect of expectation	Internal comparison with low expectations	Postoperative functional status: Oswestry Disability Index and SF-36	6 to 12 weeks postoperatively
Toyone 2005	Lumbar spine surgery	Preoperative expectations and fulfillment of expectations	Internal comparison with low expectations	NASS Instrument 4-point scale: relief of leg pain and numbness, relief of low back pain, limitations in walking ability, ADL	Preoperative expectations and fulfillment of expectations
Yee 208	Posterior lumbar spinal surgery for degenerative conditions of the lumbar spine	Expectations for surgery predict patient-reported improvements in functional outcome; and if preoperative functional outcome scores reflected the degree of expectations.	Internal comparison with low expectations	Generic health status measure (SF-36) and a disease-specific questionnaire (Oswestry Disability Index)	Weeks, 3 months, 6 months, and 1 year

In qualitative studies, instead of exploring a cause-and-effect relationship between the independent and dependent variable, the focus was on exploring a phenomenon such as patient experience in consultations, perceptions about the interventions, and expectations of the outcomes. Here, expectations referred to patients' desire for seeking information as well as determining what mechanisms surgeons should adopt in clinical practice to enhance patients' understanding about their condition and possible intervention. Each study proposed a statement of purpose to effectively explore main phenomena with the key theme/concepts supported by subthemes. In qualitative studies, aside from main phenomena, authors explored sub-phenomena in relation to the main phenomena. Boote and his colleagues [26] primarily explored patients' opinion on the impact of physiotherapy and further, patients' perceptions regarding the importance and value of physiotherapy. Eaves and his colleagues [27] explored patients' expectations about the treatment as the main phenomenon and how it affected patient perception about acceptance of pain. Quantitative studies explored cause and effect association

between independent (Intervention/Exposure) and dependent variables, along with covariates. In quantitative studies, expectation was measured as the baseline risk factor used to explore the prognostic association related to musculoskeletal pain or as an outcome. In qualitative studies, objectives were more frequently reported in relation to hypothesis testing and rationale. No sub question was explored. Based on the above comparisons, we summarized the main differences between qualitative and quantitative studies (table# 4).

Table 4: Comparison between qualitative and quantitative research questions

<u>Quantitative Research Questions:</u>	<u>Qualitative Research Questions:</u>
<ol style="list-style-type: none"> 1. Large sample size 2. Sample size was based on power calculation, study design, outcome, and prior knowledge 3. Test hypothesis 4. Contain independent variable, dependent variable, and covariates 5. All variables are quantifiable and measurable with numeral values 6. Cause and effect association are described in a specific direction as good or bad outcome 7. Data is analyzed with descriptive or inferential statistics 8. Often employ questionnaire or validated tools 9. No subquestions 10. Research question is usually a static process 	<ol style="list-style-type: none"> 1. Small Size 2. Patient recruitment till thematic saturation is achieved 3. No hypothesis testing 4. No predictor, variables, covariates, nor outcome variable 5. Analysis is not quantifiable, but included interpretation of meanings and perceptions, and made connections between themes and categories 6. Thematic analysis, constant comparison, or methodology dependent 7. Mostly semi-structured interviews or behavioral observations 8. Central phenomenon or question followed by a specific sub question 9. Research question is not a static process and is modified as research progresses

4. Discussion

In this article we compared research question formulation between qualitative and quantitative studies. We focused on the main components used to formulate a research

questions in qualitative studies. A research question is not always explicitly stated in qualitative studies but is often embedded or stated in the purpose statement in the introduction[38]. In quantitative studies, a research question is crucial for testing a hypothesis, reporting predictive association with the outcomes, and are required to specify the direction of the relationship between the variables[39]. For example, in McGregor[31] and Toyone[35] preoperative expectation was measured with the visual analogue scale (VAS) on a 0-100 mm scale, with higher score indicating higher expectation about the outcome. The main hypothesis or objective was that patients with higher expectation experienced better outcomes. In contrast to quantitative studies, hypotheses were not tested in qualitative studies as they instead facilitated hypothesis generation. Qualitative studies reported idiographic relationships rather than cause and effect association. Qualitative studies were primarily predominantly involved in constructing making relations between themes, and interpreting meanings from patients' experiences, or perceptions[40]. Qualitative studies did not report whether patients were satisfied with the treatment or not, but reported why a patient was satisfied, their behavior, experiences, perceptions, and feelings in a meaningful manner. For example, Boote and his colleagues [26] reported on the main themes concerning patients' perception, how sciatica had affected patients' quality of life (QOL), and patients' expectation regarding the effect physiotherapy will have on their pain and QOL In qualitative studies, direction of the association or outcome was not specified and often focused on "understanding", "identifying", or "generating" meanings of the central phenomena. This did not require measuring patients' expectations or testing a hypothesis, rather authors made interpretations about the meaning and connection between those meanings and certain behaviors such as exploring attitudes, opinions and perspectives[41]. Qualitatively, it is vital to determine meaningful research phenomena, gaps in existing knowledge, an appropriate analytic approach which can be implemented in a feasible manner,[2, 42, 43] and provide information on participants' contexts, behaviors, experiences, perceptions, and feelings[12]. Qualitative research is a flexible process in which researchers can adapt their approach based on what participants say, and alter the question depending upon the participants' responses,[12, 41, 44, 45] to provide further insight into the overarching research question. In qualitative studies, phrasing of the research question depends on the specific qualitative approach used. In qualitative studies, research questions should specify who the participants are, ii) what information will be collected, and offer an explanation as to "what is explored", "how a process is accomplished", or "what is described"[46]. Qualitative research questions have one final feature that distinguish them from quantitative research questions. In qualitative studies, research questions were open-ended and broad but focused on a narrow sub question. The sub question is a component of the main statement and adds more specific meaning to the central statement[46]. Rehman and his colleagues [29] had a broad research question, such as what expectations of preoperative patients are undergoing lumbar decompressive surgery but studied it in relation to decision-making. In Rehman and his colleagues [29], authors explored discrepancies between patients' understanding and what surgeons attempted to establish with patients. In essence, they noted the differences in what surgeons thought the patients might be interested in knowing in the preoperative surgical consultation versus what patients wanted to know[29]. In Rehman and his colleagues [29], authors further interpreted how the information given in the presurgical consultation may influence a patient's decision to choose surgery. As in qualitative studies, the authors explored a sub-phenomenon in relation to main phenomena of interest. Based on the above comparison, research questions for qualitative and quantitative research required different frameworks to formulate a meaningful question. For quantitative studies, a common framework is population, intervention, comparison and outcome [PICO][39], whereas for qualitative studies, the SPIDER

framework is more suitable. A potential limitation of this review was a non-systematic search of the literature. Only relevant articles were included to provide the overview of the PICO and SPIDER approach. Important comparison between vital components of qualitative and quantitative research questions were made.

5. Conclusions

This paper describes in detail the difference between qualitative and quantitative research questions using expectation as an example. As a research question is an integral part of the research design[47], having a thorough understanding of what it entails in qualitative research is vital, especially for those who are new to this branch of research. A researcher should have a clear and well-defined research question prior to starting a research project. A well-framed research question is crucial for a constructive communication between researchers, clinicians, and patients. A well-articulated research question is more than just a phrase as it signifies meaning and processing of information to effectively eliminate misinterpretation. Not all components of a qualitative research question are framed in PICO therefore, a more suitable framework is SPIDER. A research question should be feasible, interesting, novel, ethical and relevant[48, 49]. Feasibility implies the pertinence of the study design to explain a phenomenon. A research question should also indicate the target population and who it will help, context, and what the benefits are of studying a particular phenomenon[4, 50]. Further, in a qualitative study, focus should be on a narrow phenomenon, for example, “what are the expectations of pre-operative patients?” is too broad but, “what are the expectations of a preoperative –sciatica patients and how will it facilitate decision-making?” is more specific. In qualitative studies, the research question should align with the context and methodology, in order to soundly gather information during patients' interviews and observations[38].

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