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Case study

The Critical Role of Mixed Methods Research in Public Health: Insights from Real-World Case Studies

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ABSTRACT

Mixed methods that combine quantitative and qualitative elements of the approach afford a better capture of the intricacies of health-related issues than any single-method designs. In this review research, we explore the role and importance of mixed methods research in public health by examining how it has been applied in several real-world case studies. The review aims to demonstrate how the mixed methods approach provides an in-depth insight and understanding of public health interventions and their outcomes. Four public health case studies were analyzed to determine the value of mixed methods. The review also goes further to compare the mixed-methods approach with one that is solely quantitative or qualitative. Mixed methods created enormous advantages by putting together statistical rigor with rich contextual insights. Mixed-methods studies can provide a more comprehensive and nuanced view of public health issues than single-method approaches. Mixed methods offered the capacity for in-depth analysis of both measurable outcomes and contextual factors due to their integrative nature with quantitative and qualitative data; hence, we found that complex studies regarding public health could not have been possible without such a method. In addition, the application of mixed methods increased the robustness of public health research by combining empirical data with the community's experiences.

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1. Introduction

Mixed-methods research is a methodology wherein quantitative and qualitative research strategies are conducted conjointly to provide a holistic approach to research questions. It encompasses collecting, analyzing, and interpreting numerical data or words/texts in a single study or multiple studies. This approach enables researchers to study complex phenomena by capitalizing on the strengths of both methods and, in that way, increases the level and breadth of understanding that might not be achieved by either method alone [1].

Mixed-methods research allows scope for the interplay between numeric data and social context, which is considered vital in understanding complex health issues. The approach also allows the study of quantitative issues, for example, the prevalence of a health condition, and then explores the qualitative dimensions, such as patient experiences, cultural beliefs, and social determinants of health. As an example, the integration of statistical analysis and in-depth qualitative insight has played a great role in the formulation of effective public health interventions, in developing those to suit community needs, and in assessing the outcomes of interventions developed [2].

While there has been a growing awareness of the complexities associated with health issues, traditional research methods often rely on purely quantitative or qualitative approaches, thus failing to fully reflect the multifaceted nature of health-related problems. The sole reliance on quantitative approaches undermines contextual variables and personal experiences that influence health behaviors, while qualitative approaches have limited generalizability and the statistical strength required for policy adaptation at broader scales. This gap limits the ability to fully understand and address public health challenges in a way that is both data-driven and contextually relevant [3]. The purpose of this study is to describe the importance of utilizing a mixed-methods approach when working in the field of public health. The integration will provide a

better comprehension of health-related issues on both quantitative and qualitative data, thus enabling the bearing of the same on the setting of public health intervention and policy decisions to further advance the success of health improvement promotions. The aim is to advocate for a broader adoption of mixed-methods research as a standard practice in public health, enabling evidence-based interventions to be tailored to meet the particular needs and contexts of their target population.

1.1 Philosophical Underpinnings

The philosophical underpinnings of mixed methods studies are located in pragmatism, which holds that the choice of research method should be guided by the nature of the research question rather than adherence to a single paradigm. Pragmatism embraces the notion that there are different valuable perspectives and methodologies. In this respect, pragmatism allows an adaptable outcome-oriented approach. This philosophical stance contrasts with positivism, which underpins quantitative research in its emphasis on objectivity and measurable outcomes, and constructivism, guiding qualitative research in the subjective interpretation of social phenomena [4]. Pragmatism, being adaptable, is especially suitable for mixed methods studies where the aim is to provide actionable findings that combine empirical evidence and contextual understanding. A variety of design typologies supports mixed methods research, each tailored for specific research needs.

1.1.1 Convergent parallel design:

In this approach, quantitative and qualitative data are collected side by side but analyzed separately before being compared or merged to provide a comprehensive interpretation of the research problem as seen in Figure 1. This design allows for the cross-validation of findings but may become problematic when the results from quantitative and qualitative analyses do not agree.

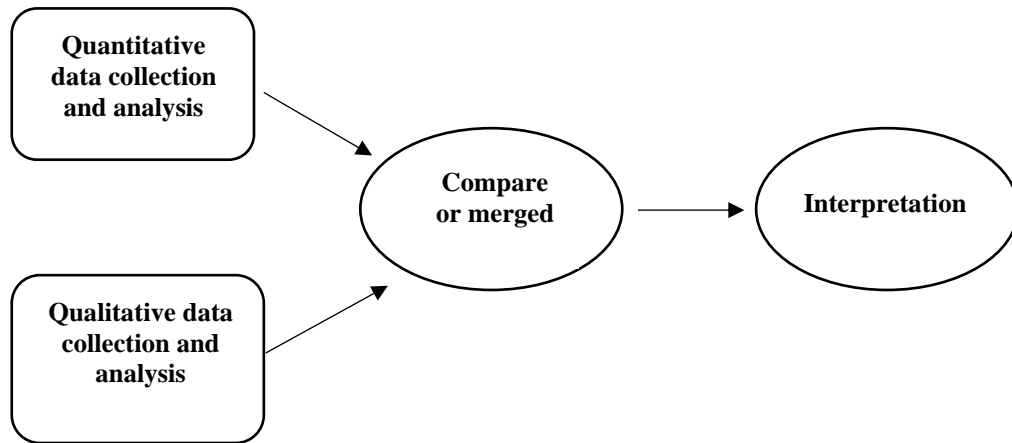


Figure 1. Convergent parallel design

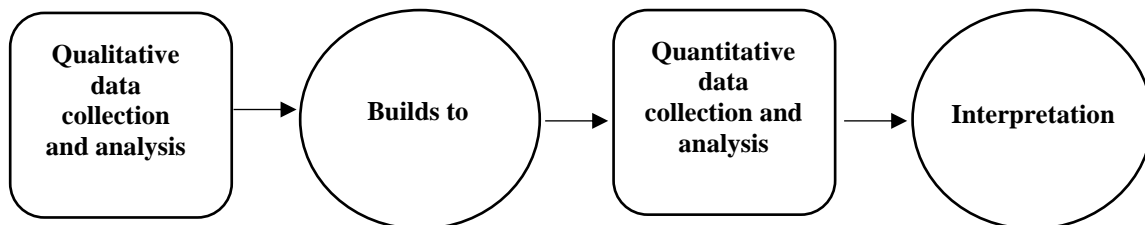


Figure 2. Exploratory sequential design

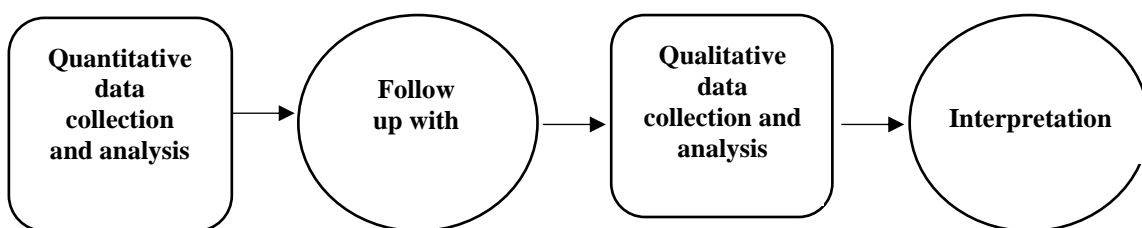


Figure 3. Explanatory Sequential Design

1.1.2 Exploratory Sequential Design:

This method involves gathering qualitative data to investigate a phenomenon first to construct themes from the interviews and build up questions to be tested and generalize the

findings (Figure 2). This design is useful for investigating new or poorly understood disciplines.

1.1.3 Explanatory Sequential Design:

Quantitative data are collected and analyzed to

first find out the trends or relationships, followed by qualitative methods to explain these findings in greater detail (Figure 3). This is useful when initial quantitative results create questions that are best further explored.

1.2 Data Integration Strategies

Effective integration strategies for data are essential in successful mixed methods research, facilitating the complementarity of quantitative and qualitative results. Prominent strategies encompass data triangulation, pattern matching, and parallel analysis. Such methodologies contribute to the validation of results and offer a more comprehensive understanding of the research question¹.

2. Methodology

The review study adopted a narrative synthesis approach for evaluating the critical contribution of mixed-methods research in public health. Data collection was performed in three major steps involving the selection of case studies, analysis of applications of mixed methods, and hypothetical assessment of single-method scenarios.

2.1 Selection of Case Studies

A purposeful sampling strategy was adopted to select relevant case studies to illustrate the significance of the utilization of mixed methods in public health. Major academic databases were searched using a combination of keywords like "mixed methods," "public health," "health interventions," "disease surveillance," and "evaluation" through PubMed, Scopus, and Google Scholar. Inclusion criteria were limited to mixed-methods case studies published in peer-reviewed journals in the last 10 years. After reviewing the abstracts and full texts of eligible studies, four case studies were selected for in-depth analysis:

Case Study I: Assessing Health Needs in South Los Angeles, California, USA

Case Study II: Evaluating a Community-Based Cancer Prevention Intervention

Case Study III: Cardiovascular Health Promotion Capacity in Youth

Case Study IV: Ebola Outbreak in Sierra Leone

2.2 Analysis of Mixed Methods Applications

All case studies were analyzed in detail to precisely explore what role the application of mixed methods plays in solving public health problems. In applying this analysis, attention was given to:

- The integrated quantitative and qualitative data that result in a more complete understanding of health issues.
 - The added value of mixed methods concerning contextualization, depth of insight, and explanation of complex relationships between health determinants and outcomes.
 - Identifying the respective contribution of each method, qualitative and quantitative, to the overall contribution of the study findings.
- The review considered the extent to which mixed methods allow researchers to:
- Capture both statistical trends (quantitative data) and participant perspectives (qualitative data).
 - Account for cultural and contextual issues not as clearly seen through a single method.
 - Develop more holistic public health strategies and interventions.

2.3 Hypothetical Assessment of Single-Method Scenarios

A series of hypothetical scenario analyses were carried out to further assert the strength of mixed methods. In this stage, each case study was revisited with the assumption that either qualitative or quantitative methods have been adopted exclusively. This review outlined which gaps and limitations might have occurred with a single-method approach. Key aspects considered were:

- Quantitative-only studies lacking depth in context.
- Limited generalizability and statistical power are associated with qualitative-only studies.

- Missed opportunities in data triangulation and cross-validation of findings.

2.4 Synthesis of Findings

A comparative analysis of the key findings from each case study was conducted; in Table 1, a comparative of the key differences and strengths of mixed methods approaches concerning the use of quantitative and qualitative approaches separately was developed. The table showed how integrating quantitative and qualitative data yields more robust and actionable insights than if either method were used in isolation. Synthesis emphasized how mixed methods permitted an exploration of the complexities of public health issues and statistical trends to the constituent human experiences and the underlying human experiences and cultural contexts.

3.Results

The findings of this review highlight the benefits of applying mixed methods research in public health, reflected in the case studies presented. By mixing both quantitative and qualitative approaches, mixed methods can provide a holistic understanding of complex health issues that neither approach can achieve separately. The following discussion explores these benefits in detail, using real-world examples to contextualize the theoretical strengths of mixed methods research. These are discussed in greater detail below, using real examples to illustrate how the theoretical strengths of mixed-methods studies might be realized in actual practice. Accompanied by a comparison table to further illustrate the statistical properties and advantages such as validity, generalizability, depth of understanding across different research designs, statistical power, and reliability that mixed methods provide over purely quantitative or qualitative approaches.

3.1 Health Needs Assessment

The identification and addressing of health priorities within a specified population is

important in health needs assessments. Mixed-methods approaches will be especially useful, whereby quantitative data in the form of health statistics and survey results are combined with qualitative insights through in-depth interviews or focus group discussions. This forms a complex and detailed understanding of the health need, thus explaining not only the "what" of health issues but also the underlying "why" relating to these. This integrative perspective enables public health professionals to formulate more inclusive and culturally sensitive strategies that tackle both the health issues and their underlying factors [5].

Case Study: Assessing Health Needs in South Los Angeles

A mixed-methods study was conducted to assess the health needs of residents living in South Los Angeles. Quantitative findings from health questionnaires indicated high rates of obesity and diabetes. However, the qualitative component, including focus groups and interviews, uncovered deeper contextual issues, such as limited availability of fresh food, financial barriers to healthcare access, and cultural tendencies toward traditional food choices. This integration of evidence-based, targeted interventions encompasses efforts to increase access to healthy affordable foods, and the provision of culturally competent nutrition education programs [6].

3.2 Intervention Evaluation

Mixed methods research is an integral part of the comprehensive assessment of public health interventions, allowing investigators to examine both quantifiable results and contextual elements that determine whether an intervention works or does not. By integrating the quantitative data, emphasizing efficacy and statistical significance, with qualitative data aimed at examining the lived experiences and perceptions of participants, mixed methods evaluations yield a deeper understanding of how interventions function in the real world.

Mixed-methods evaluation provides an expansive approach in the evaluation of public health interventions since they provide

Table 1. Comparison of Statistical Properties and Research Outcomes: Mixed Methods vs. Quantitative and Qualitative Approaches

ELEMENT	QUANTITATIVE METHODS	QUALITATIVE METHODS	MIXED METHODS	EXAMPLE FROM CASE STUDIES
VALIDITY	Provides statistical validity through numerical data (e.g., p-values, confidence intervals) but can miss context.	Offers contextual validity, explaining the 'why' behind phenomena, but lacks statistical rigor.	Combines statistical validity with contextual relevance, ensuring more robust and meaningful findings.	In the South Los Angeles study, high obesity rates (quantitative) were complemented by understanding cultural food preferences (qualitative).
GENERALIZABILITY	High generalizability due to large sample sizes and statistical analysis.	Low generalizability due to small, context-specific samples.	Balanced generalizability, where statistical findings are informed by real-world contexts and specific cases.	The cancer prevention intervention study showed broader statistical trends, while focus groups revealed issues with training and implementation that were not generalizable.
DEPTH OF UNDERSTANDING	Provides breadth of data but can overlook underlying causes.	In-depth exploration of themes, but lacks statistical metrics.	Offers both breadth and depth, ensuring comprehensive understanding supported by data.	The South Los Angeles study captured health statistics (quantitative) and paired them with insights about access to healthy food (qualitative), offering both the “what” and the “why” of health outcomes.
RELIABILITY	Ensures reliability through replicable statistical procedures.	Reliability depends on researcher skill and interpretation.	Increases reliability through quantitative verification of qualitative insights, reducing subjective errors.	In the cardiovascular health promotion study, statistical surveys (quantitative) were supported by consistent themes from focus group discussions (qualitative), enhancing reliability.
STATISTICAL POWER	Strong, especially with large datasets, but limited to predefined hypotheses and variables.	No statistical power; relies on non-numerical exploration.	Increases statistical power by combining the strengths of both numerical data and qualitative depth.	In the cancer prevention study, the statistical relationship between high-quality program implementation and outcomes was strengthened by qualitative insights explaining the reasons behind program failures.

empirical evidence of the efficacy, while at the same time, outlining the nuanced comprehension of contextual elements that influence this process. This integrative approach guarantees that public health initiatives are effective not only in principle but also practical, viable, and adaptable to the

needs and circumstances of the population they target to serve [7].

Case Study: Evaluating a Community-Based Cancer Prevention Intervention

The study tested how a community-based cancer prevention program was being

implemented and how the quality of its implementation was affecting participants' outcomes. The authors combined qualitative and quantitative strategies to assess multiple facets of program success with use of the Consolidated Framework for Implementation Research. Such a combination allowed a thorough and detailed assessment of both kinds of data. The quantitative findings showed the clear relationship of high-quality program implementation to better participant outcomes, such as increased physical activity and healthier lifestyle intentions. Qualitative data explain why the effective implementation was not realized in this study—that is, training, program design, and leadership were particularly problematic. These insights were critical in identifying ways for improvement that might not have been captured as clearly in quantitative measures alone. The study has stressed the importance of using mixed methods in assessing public health interventions, as only a combination of quantitative data and in-depth qualitative information can lead to a more comprehensive understanding of the factors behind the success or failure of programs [8].

3.3 Health Promotion Programs

The development and evaluation of health promotion programs benefit from the mixed-methods research. Such an approach allows program developers to adapt their interventions through iterations in real-world settings where they are implemented. Mixed methods approach ensure that participants feel empowered, and their experiences are considered when designing the program through integrating both quantitative and qualitative data. This translates to improved public health results as well as enhanced community involvement [1; 5]

Case Study: Cardiovascular Health Promotion Capacity in Youth

An article entitled "Building School-based Cardiovascular health promotion capacity in youth: A mixed methods study" is an exemplary use of mixed methods in evaluating

health promotion programs. The research focused on a school-based intervention aimed at empowering students to promote cardiovascular health. The study assessed how such intervention impacts students' decisions as well as their understanding of what it means to have a healthy heart by using qualitative data (focus groups and journals) along with quantitative measures (surveys.). This design provided insights into both the process and outcomes, demonstrating how mixed methods can offer a holistic evaluation of health interventions [9].

3.4 Disease Surveillance and Outbreak Investigation

A mixed methods approach considerably improves disease surveillance and outbreak investigation by synthesizing the advantages of quantitative and qualitative methodologies. For instance, quantitative data like disease incidence metrics, death rates as well as infection rates provide basic information regarding the magnitude and evolution of an epidemic. However, these statistics do not provide enough context to comprehend the underlying behavioral, social and cultural determinants that induce disease transmission on their own. Community behaviors, public perception and risk factors which can influence disease dynamics need to be properly understood through qualitative techniques for example interviewing people focusing groups or ethnographic studies.

Case Study: Ebola Outbreak in Sierra Leone

A research was conducted during the Ebola outbreak in Sierra Leone used a mixed methods approach in disease surveillance and outbreak investigation. It evaluated infection prevention and control (IPC) measures in primary healthcare settings using both quantitative and qualitative methods. In addition to analyzing IPC compliance and changes in practice over time, it included interviews with healthcare workers (HCWs) and community members to understand psychosocial impacts. This

combination of approaches ensured that both the technical and human aspects of disease control during the Ebola outbreak were fully understood, enabling adjustments to IPC policies according to the exigencies of a health crisis¹⁰.

4. Discussion

4.1 Health Needs Assessments in South Los Angeles

If only quantitative methods had been used in this health needs assessment, researchers would have identified the high rates of obesity and diabetes in the population, but they would lack the understanding of the deeper, context-specific issues contributing to these trends. Factors such as access to fresh food, financial barriers to healthcare, and cultural practices related to diet would not be uncovered. This could lead to interventions focused only on reducing obesity or diabetes through generalized programs that might not address the real, underlying causes of these health problems. Without the qualitative insights from interviews and focus groups, public health professionals might implement programs that are poorly suited to the community's actual needs and are less likely to be effective.

4.2 Evaluating a Community-Based Cancer Prevention Intervention:

In the case of the cancer prevention intervention studied here, a purely quantitative approach would most likely result in the statistical processing of the effective running of the program in terms of quantitative outcomes, such as family physical activity levels or behavioral intentions to change to healthier alternatives. While this is important information, by itself it would not provide insight into the issues of implementation that might have occurred, such as problems with training, leadership, and design of the program. Researchers and program developers would not know through qualitative data why certain parts of the program did not work and how those parts could be improved. Without qualitative data, researchers and program developers would miss out on understanding why certain

aspects of the program were not effective and how they could be improved. The lack of mixed methods might result in future interventions replicating the same problems without addressing critical program delivery issues, leading to lower participant engagement and suboptimal outcomes.

4.3 Cardiovascular Health Promotion in Youth:

In this school-based intervention, if there had solely been quantitative questionnaires to measure the outcomes, it is likely that the researchers would have measured knowledge and behavior change about cardiovascular health in students. Quantitative data alone, devoid of any focus group input or journal entries from students, would fail to provide insight into how well the program was received by the students, how the program was perceived by the students, or if they were more empowered to make healthier choices in lifestyle. The qualitative aspect also gives good insight into the cultural and social dynamics that may play a role in the success of the program. These are elements that perhaps might be lost with a purely quantitative approach, which would thus yield a less adaptable and less effective intervention, especially as aspects of the program may not be consistent with the experience of the students participating in it.

4.4 Disease Surveillance and Outbreak Investigation during the Ebola Outbreak in Sierra Leone :

If only quantitative data were used, then such attention would have been given to infection rates, mortality rates, and compliance with IPC measures during the outbreak of Ebola. Such data would provide a very clear view of both the progress of the outbreak and the true effectiveness of the IPC protocols in place but without the key qualitative insights into the psychosocial impacts on both healthcare workers and the community. Understanding fear, stigma, and misinformation through interviews with the affected individuals and healthcare providers was paramount to getting to the bottom of community reluctance to

adhere to IPC guidelines. Without these insights, pure quantitative surveillance would provide only an incomplete portrait of an outbreak and pave the way for policies that might be technically sound but socially ineffective.

5. Conclusions

This review emphasizes the critical contribution of mixed methods research to public health by showing that in such situations, it may provide comprehensive insight into complex health issues. The use of case studies from various areas of health needs assessment, intervention evaluation, health promotion, and disease surveillance gave the impression that mixed-methods approach offered some advantages not observed with purely quantitative or qualitative approaches. It embeds statistical strength in contexts, hence allowing subtle and more culturally appropriate interventions that could address not only the measurable outcomes but also facilitating and inhibiting contexts of the challenges at hand. In Conclusion, the application of mixed methods enhances the robustness of public health research by combining empirical data with the lived experiences of communities. This leads to more effective, adaptable, and inclusive health strategies. With the absence of a mixed-methods approach in the case studies reviewed, key factors, such as the social determinants of health, community behavior, and problems in program implementation, may not have been captured and will result in poorly effective interventions and policies. Hence, mixed-methods studies have become an instrument of high value and importance for unraveling the complex nature of issues concerned with public health.

Conflict of Interest and Financial Disclosure

The author(s) declare no conflict of interest regarding the publication of this paper. Additionally, no financial support, grants, or funding was received from any organization or individual that could influence the outcomes or interpretations of this study.

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