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Design and Implementation of Mixed Methods Research in General Practice: Key Points and Case Analysis (Postprint)

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Abstract

General practice research attends to both patients' physical health and their psychological well-being, to both physicians' professional competence and their vocational motivation, and to both the quality of healthcare services and the doctor-patient relationship and collaboration. These issues typically necessitate qualitative research methodologies to yield more valuable findings. However, qualitative research is often perceived as having small sample sizes and high subjectivity, primarily serving exploratory purposes; moreover, quantitative research currently predominates in the field of general practice. Consequently, mixed-methods research, which integrates qualitative and quantitative approaches by combining their respective strengths, enables broader and deeper analysis of specific issues and is well-suited for investigating complex problems, thereby charting a course for general practice research that bridges clinical medicine and sociology. Nevertheless, the application of mixed-methods research in domestic general practice remains in its nascent stages, with the standardization of its design and implementation requiring urgent enhancement. Therefore, this article aims to provide a detailed exposition of the key considerations in designing and implementing mixed-methods research from a methodological perspective, integrating theory with practice, to serve as a reference for general practitioners intending to undertake such research.

Full Text

Preamble

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General practice research attends not only to patients' physical health but also to their psychological wellbeing, not only to physicians' professional competence but also to their motivation to practice, and not only to the quality of medical services but also to the relationship and collaboration between doctors and patients. These issues often require qualitative research methods to yield more valuable findings. However, qualitative research is typically considered to have small sample sizes and strong subjectivity, and is mainly used for exploratory purposes. Meanwhile, quantitative research remains dominant in general practice. Therefore, mixed methods research, which integrates qualitative and quantitative approaches and combines their strengths, can analyze specific problems more broadly and deeply. It is suitable for studying complex issues and points to a path for general practice research that integrates clinical medicine and sociology. Nevertheless, the application of mixed methods research in domestic general practice is still in its infancy, and the standardization of its design and implementation urgently needs improvement. This paper therefore aims to provide a detailed introduction to the key points in the design and implementation of mixed methods research from a methodological perspective, combining theory with practice, to serve as a reference for general practitioners planning to conduct mixed methods studies.

Keywords: general practice, mixed methods research, study design, implementation

Abstract

General practice research often pays attention not only to the physical health of patients, professional competence of doctors, and the quality of medical ser-

vices, but also to the spiritual feelings of patients, motivation of doctors to practice, and the cooperation between doctors and patients. However, these are not resolved well only using quantitative research which still dominates the field of general practice. Mixed methods research, which integrates qualitative and quantitative research and combines the advantages of both, can analyze specific problems more broadly and in depth, and increase the generalizability of research results, making it suitable for studying complex problems. However, the application of mixed methods research in general practice is still limited in China, and the standardization of its design and implementation needs to be improved. Therefore, this paper plans to introduce the key points in the design and implementation of mixed methods research from a methodological perspective, combining theory with practice, so as to provide reference for general practitioners who intend to carry out mixed methods research.

Keywords: general practice, mixed methods research, study design, implementation

Introduction to Mixed Methods Research

Mixed Methods Research is a research paradigm in which researchers simultaneously collect and analyze quantitative and qualitative data within the same study and integrate both sets of results for interpretation [1]. Compared with purely quantitative research (such as cross-sectional surveys, randomized controlled trials) or qualitative research (such as phenomenology, ethnography, grounded theory), mixed methods research was recognized and applied by the academic community relatively later: it was not until the 1990s that a unified methodology and norms gradually took shape (such as using pragmatism to drive mixed methods research and the three most commonly used core designs). After entering the 21st century, the most critical information integration techniques in its methodological system gradually matured (such as meta-inference and joint displays). Therefore, mixed methods research is currently a relatively novel research philosophy with relatively mature implementation norms, and has been widely applied in fields such as medicine [2, 3], education [4], and sociology [5].

General practice and primary healthcare were major application contexts for mixed methods research even in its pioneering era. In the early 1990s, a group of researchers had already begun using early forms of mixed methods research to address scientific questions in general practice [6]. One classic study from that period illustrates this well: while implementing a workplace health promotion program, researchers found that in most workplaces, only a small number of employees were willing to participate. However, the information provided by quantitative surveys was very limited and insufficient to provide an adequate basis for subsequent interventional research. It was the qualitative data from semi-structured interviews with some employees that saved the study, explaining the reasons why employees chose to participate or not. Consequently, researchers were able to determine the content and methods for subsequent inter-

vention studies, thereby increasing participation in workplace health promotion programs.

Twenty years later, Professor Kurt Stange, the lead author of that study, wrote a famous series of seven editorials aimed at elucidating the scientific thinking in general practice while serving as editor-in-chief of the world' s most renowned general practice research journal, *Annals of Family Medicine* [7]. In the sixth article, "Ways of Knowing, Learning, and Developing," he emphasized the unique knowledge system related to general practitioners' work and learning, involving multiple quadrants including individual and collective, internal and external dimensions. For example, when developing new drugs or therapies for diabetes, relevant questions include not only macro-level knowledge (such as how drugs affect individual bodies and how healthcare systems provide treatment), but also collective knowledge about small groups (such as the impact of diabetes treatment on families and how healthcare teams collaborate to improve diabetes management), as well as knowledge about single individuals (such as the lived experience of a patient with diabetes) [8]. In other words, general practitioners' knowledge systems essentially involve multiple dimensions including clinical practice, patients, team building, community health, health services, health policy, and biomedicine, and require integrating these dimensions based on overarching knowledge to construct their "generalist knowledge" system.

Mixed methods research is precisely one of the effective tools and pathways that can help general practitioners build this "generalist knowledge" system through research. Its primary advantage lies in its pragmatic stance, spanning different levels, accommodating multiple perspectives of theory and practice, obtaining diverse knowledge crucial to general practitioners' work and learning, and integrating and connecting this knowledge to form higher-level holistic understanding [9]. Therefore, since the early 21st century, mixed methods research has been considered a pragmatic approach suitable for global general practice and primary healthcare research [10], and has become a new research path that runs parallel to, yet partially intersects with, assists, and mutually promotes evidence-based medicine research paradigms (such as randomized controlled trials, systematic reviews, and guidelines) [11].

In China, some general practice and primary healthcare studies using mixed methods research have been published in recent years, covering subfields such as clinical research and health services research [12-16]. However, even so, cases of mixed methods research in general practice and primary healthcare remain relatively few, with uneven quality that requires further development. Therefore, through this paper, we hope to share the basic norms for implementing mixed methods research and practical experience from implementing such research in China' s primary and community settings with researchers in this field, to promote the common development and mutual advancement of mixed methods research and general practice research in China' s primary healthcare environment.

Three Core Design Types of Mixed Methods Research

Due to differences in researchers' disciplines or research fields and personal preferences, terminology for mixed methods research designs often varies in rhetorical language, research pathways, and design type expressions. This paper introduces three core design types that are conceptually simple and frequently used: explanatory sequential mixed methods research design, exploratory sequential mixed methods research design, and convergent mixed methods research design. We first introduce their design essentials and applicable situations:

Explanatory Sequential Mixed Methods Research Design

Explanatory Sequential Mixed Methods Research involves collecting and analyzing quantitative data first, followed by collecting and analyzing qualitative data to explain the initial quantitative results. This design is applicable when: researchers want to use quantitative data to determine trends, relationships, and effect sizes, and explain the mechanisms or reasons behind these trends, relationships, and effects; qualitative data are needed to explain significant (or non-significant), anomalous, or unexpected quantitative results; or researchers want to group samples based on quantitative results and conduct further qualitative research on these groups. The design diagram and basic implementation process for explanatory sequential mixed methods research are shown in [Figure 1: see original paper] and [Figure 2: see original paper], respectively.

Figure 1. Explanatory Sequential Mixed Methods Research Design Diagram
Figure 2. Basic Implementation Process for Explanatory Sequential Mixed Methods Research

Exploratory Sequential Mixed Methods Research Design

Exploratory Sequential Mixed Methods Research involves initially collecting and analyzing qualitative data to explore a phenomenon, with subsequent quantitative data collection based on qualitative findings to test trends or relationships in a larger sample. Using this design implies that exploratory research is needed because: quantitative measurement cannot be directly applied or measurement tools are unavailable; variables are unknown; or no guiding framework or theory exists. Therefore, this design is applicable when: researchers initially lack measurement tools and need to develop and test them; important variables need to be identified for quantitative research when variables are unknown; qualitative findings need to be generalized to different groups, or multiple aspects of new theories or classification principles need to be tested; researchers want to explore a phenomenon more deeply and measure variation in its attributes; or they want to generalize, evaluate, or test qualitative exploration results to examine whether these results can be generalized to a sample or population.

Figure 3 [Figure 3: see original paper]. Exploratory Sequential Mixed Methods Research Design Diagram

Figure 4 [Figure 4: see original paper]. Basic Implementation Process for Exploratory Sequential Mixed Methods Research

Convergent Mixed Methods Research Design

Convergent Mixed Methods Research Design refers to simultaneously collecting quantitative and qualitative data in a single study, independently analyzing each type of data, and then integrating the quantitative and qualitative results during the overall interpretation phase. Data collection and analysis are often concurrent but need not be perfectly synchronized. Researchers adopt this design to combine quantitative and qualitative methods so that quantitative approaches (large sample sizes, trends, effects) and qualitative approaches (small sample sizes, details, depth) can compensate for each other' s weaknesses and complement each other' s strengths (Patton, 1990). Therefore, this design is applicable when: the research aims to test and validate, and researchers want to directly compare quantitative statistical results with qualitative findings for mutual validation; qualitative findings are used to illustrate quantitative results; or quantitative and qualitative results are synthesized to obtain a more comprehensive understanding of a phenomenon.

Figure 5 [Figure 5: see original paper]. Convergent Mixed Methods Research Design Diagram
Figure 6 [Figure 6: see original paper]. Basic Implementation Process for Convergent Mixed Methods Research

Data Integration and Presentation in Mixed Methods Research

There are three main methods for integrating quantitative and qualitative data: (1) aggregating data, which involves juxtaposing qualitative and quantitative results for comparison, typically used in convergent designs; (2) explaining data, which uses qualitative data to explain quantitative results, typically used in explanatory sequential designs; and (3) building data, which uses qualitative results to build quantitative research, typically used in exploratory sequential designs, such as constructing new research tools or interventions.

When integrating qualitative and quantitative results, researchers need to articulate the relationship between them, including: (1) explanation, where qualitative data collection and analysis explain prior quantitative findings; (2) confirmation, where results from one data type support findings from the other; (3) enhancement, where information from both qualitative and quantitative results improves explanatory power and meaning; (4) illumination, where paradoxes and contradictions are sought by reframing research questions or reintegrating results from both methods; (5) transformation, where qualitative findings are considered from participants' perspectives regarding their relevance to broader populations, phenomena of interest, contexts, or theories; and (6) extrapolation, where quantitative research generalizes findings from study populations to target

populations in larger samples. After articulating these relationships, researchers should supplement with specific explanations of how the results demonstrate each relationship.

Summary of Typical Characteristics of the Three Core Design Types

The table below summarizes the typical characteristics of the three core design types:

Characteristic	Explanatory Sequential Design	Exploratory Sequential Design	Convergent Design
Design Logic	Methods used sequentially: quantitative data collected and analyzed first, followed by qualitative data collection and analysis based on quantitative results	Methods used sequentially: qualitative data collected and analyzed first, followed by quantitative data collection and analysis based on qualitative results	Quantitative and qualitative data collected simultaneously, analyzed separately, and then merged
Purpose	Need to explain quantitative research results	Need to validate or measure qualitative exploration findings	Need more comprehensive understanding of topic; need mutual validation or confirmation
Timing	Sequential: quantitative first, then qualitative	Sequential: qualitative first, then quantitative	Concurrent or simultaneous
Integration Point	Sampling, data collection, and results interpretation	Data collection stage; results interpretation stage sometimes	Data analysis and results interpretation stage

Characteristic	Explanatory Sequential Design	Exploratory Sequential Design	Convergent Design
Common Sample Relationship	Validate qualitative findings: augmented sampling; qualitative and quantitative samples same	Tool development: qualitative and quantitative independent sampling	Qualitative and quantitative samples independent; combine quantitative and qualitative parts
Primary Integration Strategy	Connect quantitative and qualitative parts: from quantitative data analysis to qualitative data collection	Connect qualitative and quantitative parts: from qualitative data analysis to quantitative data collection	Combine quantitative and qualitative parts: further analyze both sets of results after separate analysis (e.g., comparison or transformation)
Results Presentation	Sequential: present quantitative results first, then qualitative results, with combined interpretation explaining the role of quantitative results for subsequent qualitative research	Sequential: present qualitative results first, then quantitative results, with combined interpretation explaining the role of qualitative results for subsequent quantitative research	Interwoven: present quantitative, qualitative (order adjustable), and mixed results for each theme/dimension

Characteristic	Explanatory Sequential Design	Exploratory Sequential Design	Convergent Design
Example in General Practice	In a study on strategies to reduce benzodiazepine use in older adults [17], quantitative research was first conducted analyzing BZD prescription dose reductions from October 1, 2015 to June 30, 2017. Based on quantitative results, healthcare institutions were divided into groups with high vs. low dose reductions for qualitative interviews to explain measures and influencing factors for reducing BZD prescriptions. All institutions used passive strategies, while high-performing institutions utilized one or more active strategies.	In a study exploring patient-reported key health provider behaviors for building trust [18], 40 patients were first interviewed qualitatively to collect behaviors reported as trust-building, 提炼出有效沟通、关心患者和展示渊博知识三个维度的 8 个行为. Based on qualitative results, a quantitative questionnaire was constructed and tested in a larger, more representative sample (6,392 people) to examine the robustness of qualitative findings. Patient trust in providers was highly correlated with eight items on communication, care, and demonstrating expertise.	A convergent mixed methods study examined quality of life and experiences in patients with serious non-specific symptoms awaiting cancer evaluation [19]. Data collection tools included quantitative scales and corresponding qualitative interview outlines on the same dimensions. The scale surveyed 838 people, while 21 were interviewed qualitatively. Quantitative surveys found quality of life improved over time, while qualitative interviews confirmed and further expanded quantitative results. Mixed methods analysis emphasized that participants' experiences

Research Example: An Explanatory Sequential Mixed Methods Study

Our research team published an article in *JAMA Network Open* in December 2021 that applied an explanatory sequential mixed methods design to understand factors influencing the use of low-sodium salt substitutes among rural patients with hypertension and coronary heart disease [20]. Below, we illustrate the implementation framework and experience from six aspects: the necessity of using mixed methods for the research question and the appropriateness of using an explanatory sequential design, the study' s design framework, specific sampling methods, qualitative and quantitative data collection methods, data analysis steps, data integration and presentation, and results writing.

Background

Using low-sodium salt substitutes to reduce sodium intake has been proven to lower blood pressure and urinary albumin levels, though whether it can further reduce cardiovascular and cerebrovascular events remains unclear. Professor Wu Yangfeng from the Peking University Clinical Research Institute and Professor Bruce Neal from the George Institute for Global Health jointly led a large-scale cluster randomized controlled trial (SSaSS) in rural China [21, 22] to evaluate the impact of replacing regular salt with low-sodium salt on stroke incidence and mortality. The primary endpoint was stroke, with secondary endpoints being major cardiovascular events and all-cause mortality. The study was conducted in 600 villages across five northern Chinese provinces, with approximately 35 high-risk stroke patients selected from each village, totaling 20,995 participants. Villages were randomly assigned to intervention or control groups in a 1:1 ratio. The study followed participants for 5 years. Intervention group households received free low-sodium salt to replace regular table salt and ongoing salt reduction health education, while the control group continued their usual diet. The study designed a mixed methods process evaluation combining quantitative and qualitative approaches to understand barriers and facilitators to low-sodium salt substitute use in large populations.

Rationale for Mixed Methods Use

This study tracked and measured a series of quantitative process indicators annually that directly or indirectly reflected intervention effectiveness, including urinary sodium, urinary potassium, urinary creatinine, blood pressure, and mastery of health knowledge related to sodium and low-sodium salt. However, why these annual quantitative results could inform subsequent intervention modifications or improve implementation compliance, and what factors influenced results or implementation among study subjects across different distribution groups, were difficult to explain based on quantitative results alone. Such large-scale population intervention trials involve numerous confounding factors. Explaining follow-up results to revise intervention measures and ensure continued implementation according to the research protocol required further qualitative

research to understand barriers and facilitators to low-sodium salt substitute use among high-risk rural stroke populations, providing deeper explanation for quantitative follow-up results.

Study Design

This process evaluation adopted an explanatory sequential design, first collecting and analyzing quantitative data, then sampling based on quantitative results for qualitative data collection and analysis. The basic design diagram is shown in [Figure 7: see original paper].

Figure 7 [Figure 7: see original paper]. Study Case Design Flowchart

Quantitative Data Collection and Analysis

The study stratified and randomly selected a subsample of at least 60 villages annually after baseline survey for intermediate indicator assessment. The quantitative data in this mixed methods study were collected in the third year, including structured questionnaires, blood pressure measurements, and 24-hour urine sample collection.

Salt intake was estimated from 24-hour urinary sodium using the formula: Salt intake (g/d) = Sodium concentration in 24-hour urine (mEq/L [converted to mmol/L by multiplying by 1.0]) × 24-hour urine volume (L) × 23/1000, where total urine volume included estimated missing amounts. Multivariable linear regression was used to explore associations between low-sodium salt use data from questionnaires and salt intake estimated from 24-hour urine samples, adjusted for age, gender, and education level at baseline. Additionally, descriptive analysis was performed on quantitative survey data. Statistical analysis used STATA 14.2. All P-values were two-sided, with $P < 0.05$ considered statistically significant.

Qualitative Data Collection and Analysis

Qualitative interview participants were selected based on third-year follow-up quantitative results. The sampling strategy was: select three provinces with high, medium, and low average urinary sodium reduction from baseline in the third-year follow-up data; randomly select one village from each province; rank participants in each village by urinary sodium level; and prioritize inviting participants from the highest and lowest quartiles (prioritizing individuals with extremely high or low urinary sodium). This sampling aimed to include participants with large differences in quantitative results, as their behaviors or intervention-related factors might differ substantially, facilitating rich information acquisition to explain interim analysis results and revise intervention implementation.

Qualitative interviews were primarily semi-structured, with outlines developed based on the Behavior Change Wheel. Two interviewers (one SSaSS study

staff member and one experienced qualitative researcher independent of the project) conducted one-on-one face-to-face interviews with each participant. All interviews were audio-recorded after obtaining verbal consent. Interviewers also observed participants' kitchens, focusing on salt and other condiment use.

Qualitative data analysis employed thematic analysis based on the Capability, Opportunity, and Motivation (COM-B) model from the Behavior Change Wheel. All interview recordings were transcribed. Two researchers coded independently and identified main themes under COM-B model domains. In this study, capability referred to individuals' physical conditions for consuming low-sodium salt substitutes and their knowledge about them. Opportunity referred to factors outside the individual influencing low-sodium salt use. Motivation referred to individuals' self-preferences regarding salt and other factors potentially influencing low-sodium salt use. Coding results were compared and discussed between the two analysts, with a third researcher (H.C.) participating in discussions to reach consensus. NVivo 12 was used to assist coding and analysis.

Integration of Qualitative and Quantitative Results

As an explanatory sequential design, integration of qualitative and quantitative results in this study primarily manifested in: how qualitative research questions were raised based on quantitative results, and how quantitative and qualitative parts were connected to jointly interpret findings after both were completed. Additionally, questionnaires used in the quantitative phase and interview outlines used in the qualitative phase were primarily designed based on COM-B theory, enabling qualitative and quantitative results to be associated through this theory, presented in juxtaposed form, and analyzing relationships between quantitative and qualitative results—such as confirmation, expansion, or inconsistency—to provide more comprehensive explanations for quantitative results after three years of low-sodium salt intervention and their potential influencing factors, thereby revising intervention measures and improving implementation compliance.

Results Writing and Presentation

This explanatory sequential design used sequential results presentation, stating quantitative results first, then qualitative results, followed by integrated interpretation.

The quantitative survey included 1,170 participants, of whom 1,025 provided urine samples. Mean age was 67.4 (SD: 7.5) years, with 502 (49.0%) women. Participants who believed high salt intake was beneficial to health had higher salt intake, but the difference was not statistically significant compared to those who believed high salt intake was harmful (0.84 g/d [95% CI, -0.04 to 1.72 g/d]). Thirty participants completed qualitative interviews (18 women, 12 men; mean age 70.3 years). Both quantitative and qualitative data indicated good acceptability and compliance with low-sodium salt.

Qualitative interviews identified barriers to low-sodium salt use, including lack of awareness about salt reduction and widespread production and consumption of high-sodium pickled foods. Additionally, some low-sodium salt users mentioned they had reduced antihypertensive medication use without medical consultation.

Joint Display of Qualitative and Quantitative Results

A side-by-side table was used for joint display of quantitative and qualitative results, enabling readers to more clearly understand the integration relationship between them (see).

Table 1 . Joint Display of Quantitative and Qualitative Results

COM-B Model Dimension	Quantitative Results n (%)	Qualitative Results	Integration
Capability	Attempted to reduce salt intake: 426 (81.9%)Knew recommended salt intake (<6g/day*): 102 (19.6%)Could use low-sodium salt daily	Salt intake mainly through home cooking; lack of knowledge about recommended daily salt intake may be a barrier to sodium reduction	Both dimensions confirm participants' capability for salt reduction, though lack of knowledge about recommended intake may hinder sodium reduction

COM-B Model Dimension	Quantitative Results n (%)	Qualitative Results	Integration
Opportunity	Heard of low-sodium salt: 498 (95.8%)	Low accessibility; not available in village shops; price-sensitive; prefer regular salt due to price	High awareness of low-sodium salt in intervention group as shown by survey; price sensitivity enhances compliance in trial; accessibility and price sensitivity may hinder promotion outside trial

COM-B Model Dimension	Quantitative Results n (%)	Qualitative Results	Integration
Motivation	Know high-salt diet harms health: 355 (68.3%)Know salt intake affects blood pressure: 332 (63.9%)Know salt intake affects stroke: 272 (52.3%)Often eat pickled foods: 99 (19.0%)Add extra salt at meals: 55 (10.6%)Often use MSG: 177 (34.0%)	Acceptable taste; slightly bitter but acceptable; some don't notice bitternessLack of understanding; most can't state potential health benefitsDon't prefer low-sodium salt for pickling due to perceived bitternessOften eat pickled foods; common local dietary habitOften use MSG; found in most home kitchens	Quantitative data show relatively good knowledge of salt-health associations, yet qualitative interviews reveal most lack understanding of low-sodium salt. Qualitative interviews further reveal two additional factors: taste of low-sodium salt and continued use of regular salt for pickling, which is common locally.**Inconsistency:** Quantitative survey shows low proportion eating pickled foods frequently, but qualitative interviews find pickled food consumption very com-

*6 grams was the guideline standard at study start; current standard has been revised to less than 5 grams.

Discussion

In this paper, we concisely elaborated the characteristics and implementation processes of the three core designs of mixed methods research, and reported the implementation methods and experiences from a completed explanatory sequential mixed methods study to illustrate the basic framework and process as clearly as possible. Nevertheless, as a relatively complex method requiring simultaneous implementation of rigorous quantitative and qualitative research integrated at the holistic level, mixed methods research is more difficult to implement than purely quantitative research (such as cross-sectional surveys) or qualitative research (such as semi-structured interviews) under otherwise similar conditions. Therefore, when choosing to use mixed methods research, we advise researchers to first carefully consider two questions: (1) Does the research team have sufficient expertise and resources to complete rigorous quantitative and qualitative research and integrate them? and (2) If mixed methods research is chosen, can it produce findings with significantly greater scientific and applied value than standalone quantitative or qualitative research? Affirmative answers to both questions will increase the likelihood of completing high-quality mixed methods research.

The two editors-in-chief of the *Journal of Mixed Methods Research*, Fetters and Molina-Azorin, have proposed that in addition to Western philosophies and worldviews such as pragmatism, transformative theory, and postmodernism, Chinese Daoist philosophy—particularly the concepts of Taiji and Yin-Yang—also provides a worldview sufficient to support mixed methods research. They compare quantitative research to Yang, emphasizing objective, rigorous, solid data, and qualitative research to Yin, highlighting subjective, empathetic, sensitive insights, suggesting their combination forms a unified, natural Taiji. Within Taiji, Yin and Yang exhibit natural movement, complementarity, mutual generation, and mutual transformation [23]. This concept essentially highlights the international mixed methods research community's encouragement of embracing and matching diverse global philosophies and regional characteristics, enabling pragmatic understanding and application in local contexts.

In China' s general practice and primary healthcare fields, quantitative research is currently the most widely used method. While qualitative research use has increased significantly in recent years, its quantity remains relatively small. Against this background, mixed methods research development in China may initially tend toward two directions.

First, quantitative researchers may begin adding qualitative components to quantitative studies to corroborate or supplement results, thereby enhancing robustness and comprehensiveness— "supplementing large Yang with small Yin." The case example we presented belongs to this category. In that study, the

qualitative component validated quantitative findings (e.g., challenging the credibility of the quantitative finding that residents rarely ate pickled foods, while strengthening confidence in the finding that residents frequently used MSG) and supplemented them (building upon the quantitative finding that a low proportion of residents knew the recommended salt intake to further reveal residents' lack of awareness about recommended daily salt intake) [20]. However, implementing this type of mixed methods research generally requires two preconditions: (1) having a complete plan and resources for implementing a high-quality quantitative study, and (2) obtaining support from methodological experts with good knowledge and experience in qualitative research and mixed methods. This type of mixed methods research may thus be more suitable for institutions and teams with adequate resources and research experience to generate more robust and comprehensive findings beyond quantitative discoveries.

The second direction involves deriving quantitative components from initially conducted qualitative research— "generating small Yang from small Yin." At a time when general practice and primary healthcare service research are rapidly developing in China, individual general practitioners or small research teams working on the frontlines, closer to patients and more likely to discover entirely new practical problems, may be better suited for this type of mixed methods research. For example, many recent studies in general practice and primary healthcare have emerged from general practice departments, community health centers, and primary health clinics. Research questions have addressed numerous novel issues closely connected with China' s current general practice development, such as community-level cardiac rehabilitation [24], implementation of essential public health services [25], feasibility of family doctor contracting guidelines for specific populations [26], frequent healthcare-seeking behaviors of elderly patients in communities [27], and implementation of general practitioner incentive measures [28]. Conducting qualitative research first on these issues, then expanding to larger, more representative samples for quantitative information, undoubtedly represents a valuable research pathway that generates holistic theory from frontline practice and expands small-sample exploration into generalizable findings.

However, promoting this type of mixed methods research may require solving at least three fundamental problems: (1) enabling a considerable number of small general practice research groups/teams to conduct rigorous qualitative research through various training and technical support; (2) prompting China' s general practice and primary healthcare researcher community, as well as academic journals, to recognize and value the academic merit of small-scale but highly innovative and practical qualitative research; and (3) establishing collaboration pathways between grassroots research-oriented general practitioners and large research teams in universities and major hospitals, so that innovative small-scale qualitative research can be upgraded and transformed into larger-scale quantitative research. Therefore, developing consensus and cooperation between mixed methods researchers and leading researchers, institutions, and academic journals in China' s general practice field will be a long-term endeavor.

Finally, based on the purpose of this paper, we recommend the following three classic mixed methods research works that have been translated into Chinese for systematic learning: John Creswell' s *Designing and Conducting Mixed Methods Research* [29] and *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* [30], and Michael Fetters' *The Mixed Methods Research Workbook: Designing, Implementing, and Publishing*. Additionally, John Creswell' s 2019 article "Mixed Methods and Survey Research in Family Medicine and Community Health" [31] and the translated mixed methods research quality assessment tool introduction "Introduction to Mixed Methods Appraisal Tool—MMAT" [32] are also worthwhile introductory readings.

Conclusion

This paper introduced the three core design types of mixed methods research and their key points, supplemented by an explanatory sequential mixed methods study, to provide reference for researchers planning to use mixed methods in general practice. Much research in general practice tends to be highly applied implementation studies with complex interventions. Whether in overall study design or process evaluation, the issues involved are intricate and complex. Mixed methods research, integrating qualitative and quantitative approaches, has excellent application value for guiding the design and implementation of general practice research and translating research results into routine clinical practice. We look forward to mixed methods research opening another window for scientific inquiry in general practice.

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