



Systematic Review

Mixed methods research in general practice: Key points of design and implementation and case analysis



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ABSTRACT

General practice research focuses on a range of topics, such as patients' physical health and mental health, physicians' competencies and career motivation, quality of healthcare and physician-patient relationships and cooperation. However, these are not resolved well only using quantitative research which is still dominated in the field of general practice of China. In this case, qualitative method is often required, although it is considered to be subjective, and is mainly used to describe a phenomenon that is little known in a small sample. Mixed methods research, which incorporates qualitative and quantitative research and combines the advantages of both, can analyze specific problems more extensively and intensively, is suitable for studying complex problems, and for general practice research as an approach integrating clinical medicine and sociology. However, mixed methods research in general practice is still in its early phase in China, and the standardization of its design and implementation needs to be improved. For better elaborating the key points in the design and implementation of mixed methods research, we detailed a study using mixed methods, providing a reference for general practitioners to carry out mixed methods research.

General practice research focuses on a range of topics, such as patients' physical health and mental health, physicians' competencies and career motivation, quality of healthcare and physician-patient relationships and cooperation. Currently, research on primary care in China is still predominantly quantitative. However, the issues mentioned above can yield more valuable insights when approached through qualitative research methods. Qualitative research is mainly used to explore questions for subjectivity and small sample. Mixed methods research integrates both qualitative and quantitative research, combines the strengths of both to analyze specific issues more broadly and deeply, increases the generalizability of findings to suit complex issues, inte-

grates clinical medicine and sociology to solve primary care research questions.

Mixed methods research is a research paradigm in which researchers simultaneously collect and analyze both quantitative and qualitative data within the same study and integrate the results to provide a comprehensive interpretation¹. Compared to quantitative research (cross-sectional surveys, randomized controlled trials) or qualitative research (phenomenology, ethnography, grounded theory), mixed methods research gained recognition and application later. Unified methodology and standards of mixed methods research (such as using pragmatism to drive mixed methods research and adopting three core designs) emerged

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in 1990s, the key techniques for integrating information within this methodological framework (such as meta-inference and joint displays developed in the 21st century). As a result, mixed methods research is now considered a developed research method with innovative research concepts and well-established implementation protocols. It has been widely applied in medicine^{2,3}, education⁴, and sociology⁵.

Given the holistic approach of general practice, its treatment and research are characterized by complexity and comprehensiveness. Therefore, mixed methods research was primarily applied and considered as well-suited approach in general practice and primary care since inception^{6,7}, it emerged as a new method parallel and intersects with evidence-based medicine paradigms (randomized controlled trials, systematic reviews, and guidelines), providing mutual support and promotion⁸. Several studies in general practice and primary care using mixed methods research were published in China, covering clinical research and health services research^{9–13}. Nevertheless, the use of mixed methods research in general practice and primary care remains limited with quality variation. Therefore, this paper introduces an example of explanatory sequential mixed methods research to outline the three core design types of mixed methods research and key theories, to share basic guidelines and practical experiences in primary care for mixed methods research, and promote the development and communication of mixed methods research and general practice research in China.

Research example: An explanatory sequential mixed methods study

In December 2021, the research team published a mixed methods research in JAMA Network Open. The study employed an explanatory sequential design, aimed to understand the factors influencing the use of low-sodium salt substitutes among rural patients with hypertension and coronary heart disease¹⁴. We use this study as an example to explain the necessity of using mixed methods research for the research question, the rationale for using an explanatory sequential design, study case design framework, sampling methods, data collection methods, data analysis, integration and presentation, and the writing of the research results.

Background

Using low-sodium salt substitutes to reduce sodium intake has been shown to reduce blood pressure and urinary albumin levels, but it remains unclear whether it can further reduce the incidence of cardiovascular and cerebrovascular events. Professor Wu Yangfeng from Peking University Clinical Research Institute and Professor Bruce Neal from the George Institute for Global Health collaborated on a large-scale cluster randomized controlled trial in rural China, known as the Salt Substitution and Stroke Study (SSaSS)^{15,16}. The study aimed to assess the impact of replacing regular salt with low-sodium salt on the incidence and mortality of stroke. The primary endpoint of the study was stroke, while the secondary endpoints included major cardiovascular and cerebrovascular events, as well as overall mortality. The study was conducted in 600 rural villages across five northern provinces of China, with approximately 35 high-risk individuals selected from each village, for a total of 20,995 participants. Participants were randomly divided to the intervention group and control group in a 1:1 ratio by village. In the intervention group, households received low-sodium salt to replace regular table salt at no cost, along with continued health education on salt reduction; the households in the control group maintained their usual diet.

The study followed participants for five years, with a random sample of at least 60 villages selected annually from the baseline and subsequent surveys to assess intermediate outcome indicators, including blood pressure and 24-hour urine test markers. During the implementation of the study, a mixed-methods process evaluation was designed, combining both quantitative and qualitative methods to identify the barriers and facilitators to the use of low-sodium salt substitutes in a large-scale population.

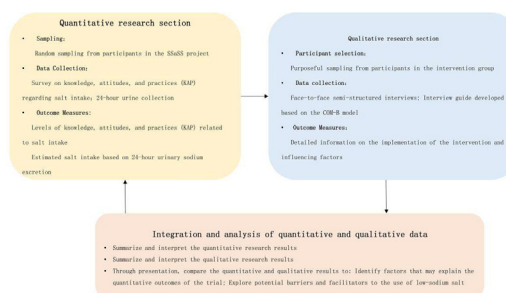


Fig. 1. The process of the design for this mixed methods study.

Rationale for using mixed methods research

This study tracks a series of quantitative process indicators annually, which can directly or indirectly reflect the effectiveness of the intervention. These indicators include urinary sodium, urinary potassium, urinary creatinine, blood pressure, and knowledge related to sodium and low-sodium salt. However, what role do the annual quantitative results play in adjusting intervention measures or improving patient adherence to the intervention? What factors influence the patient outcomes and the implementation of the intervention? These questions cannot be fully explained by the quantitative results alone.

In large-scale population intervention trials with confounding factors, qualitative research is required to modify the intervention and continue implementation according to the study protocol by interpreting follow-up results. In the study, qualitative research is employed to understand the barriers and facilitators to using low-sodium salt substitutes in the high-risk rural stroke population, in order to provide a more comprehensive explanation of the quantitative follow-up results.

Study case design

This process evaluation employed an explanatory sequential design. First, quantitative data were collected and analyzed. Sampling is performed based on the quantitative results, followed by the collection and analysis of qualitative data. The design flowchart is shown in Fig. 1.

Data collection and analysis of the study case

Data collection and analysis of the quantitative data

The mixed methods study discussed in the article used quantitative data from the third follow-up survey, including structured questionnaire surveys, blood pressure measurements, and 24-hour urine sample collection. Salt intake (g/d) was estimated based on 24-hour urinary sodium, calculated as: Salt intake (g/d) = Sodium concentration in the 24-hour urine sample (mmol/L) × 24-hour urine volume (L) × 23/1,000. The total urine volume includes the estimated hidden losses.

Multivariate linear regression was used to analyze the association between the use of low-sodium salt from the questionnaire and the estimated salt intake based on the 24-hour urine sample, adjusting for baseline age, gender, and education level. Additionally, descriptive analysis was performed on the data from the quantitative survey. Data analysis was conducted using Stata 14.2 statistical software, with statistical significance defined as a two-sided $P < 0.05$.

Data collection and analysis of qualitative interviews

Based on the quantitative research results from the third-year follow-up, qualitative interview participants were selected.

The sampling strategy: Three provinces were chosen based on the reduction in urinary sodium levels compared to baseline, categorized into high, medium, and low reduction groups. One village was randomly

Table 1
Integrating quantitative and qualitative findings in the mixed methods study as a case.

| COM-B Model Dimension | Quantitative Research Results (n(%)) | Qualitative Research Results(n(%)) | Integrated Inference |
|---|--------------------------------------|---|---|
| Capability | | | |
| Attempting to reduce salt intake | 426(81.9) | Salt intake is primarily through home cooking, where it is possible to use low-sodium salt regularly | Expansion: Reducing salt usage and using low-sodium salt in home cooking confirm participants' ability to reduce salt intake, but a lack of knowledge about the recommended salt intake might be a barrier to reducing sodium intake. |
| Aware that the recommended daily salt intake is <6g/day | 102(19.6 %) | Lack of awareness of the recommended daily salt intake | |
| Opportunity | | | |
| Heard about low-sodium salt | 498(95.8) | Low sodium salt availability is low and hard to obtain; it cannot be found in rural stores. People are sensitive to its price and tend to use regular salt because it is cheaper. | Confirmation and Supplementation: As the quantitative research results showed, the intervention group had a higher awareness of low-sodium salt. Price sensitivity increased adherence to using low-sodium salt in the trial. Accessibility and price sensitivity may hinder the promotion of low-sodium salt outside of the trial. |
| Motivation | | | |
| Aware that high salt intake harms health | 355(68.3) | Can accept the taste of low-sodium salt; it is slightly bitter but tolerable; some people do not notice the bitterness | Inconsistency: The quantitative research results show that patients had relatively high awareness of salt intake and its relationship with health outcomes. However, qualitative interviews revealed that most patients were not knowledgeable about low-sodium salt. Qualitative interviews further revealed two other factors related to using low-sodium salt: its taste, and the continued use of regular salt for preserving food, which is a common local practice. |
| Aware that salt intake is related to blood pressure | 332(63.9) | Lack of knowledge about the health benefits of using low-sodium salt; most patients cannot explain the potential benefits of low-sodium salt | |
| Aware that salt intake is related to stroke risk | 272(52.3) | Not prefer to use low-sodium salt when preserving food because they find it bitter | |
| Behavior | | | |
| Frequently consume preserved foods | 99(19.0) | Frequently consume preserved foods, which is a local dietary habit | Inconsistency: The quantitative research results showed that the frequency of consuming preserved foods was relatively low, but qualitative interviews revealed that preserved foods were commonly eaten. |
| Add extra salt when eating | 55(10.6) | | |
| Use monosodium glutamate (MSG) | 177(34.0) | Frequently use MSG, which is found in most home kitchens | Confirmation: Both qualitative and quantitative data indicate the commonly used monosodium glutamate |

Note: ^arefers to the <6g/day guideline for the study, which has now been revised to <5g/day.

COM-B Model = Capability, Opportunity, Motivation and Behavior Model.

selected from each province. Patients in each village were ranked by their urinary sodium levels, and then divided into four groups based on quartiles. Priority should be given to inviting patients in the upper and lower quartiles for interviews, particularly those with extremely high or low urinary sodium levels. The sampling method aims to include varies participants in quantitative results, their behaviors or intervention factors might vary greatly, gather rich information to explain, analyze the results, and modify the intervention protocol.

The qualitative interviews were primarily semi-structured, with the interview guide based on the behavior change wheel framework. During the interviews, two interviewers (a member of the SSaSS project team and an independent researcher with extensive experience in qualitative research) conducted "one-on-one, face-to-face" interviews with each participant. All interviews were recorded after obtaining verbal consent from the participants. The interviewers also observed the participants' kitchens, focusing on the use of salt and other seasonings.

The qualitative data were analyzed thematically based on the Capability, Opportunity, and Motivation (COM-B) model from the Behavior Change Wheel. All interview recordings were transcribed, and two researchers independently coded the data, identifying key themes within the COM-B model domains. In the study, Capability refers to the physical conditions for individuals to use low-sodium salt substitutes, as well as their knowledge about low-sodium salt; Opportunity refers to external factors that influence the use of low-sodium salt, aside from individual factors; Motivation refers to individuals' self-preference for salt and other factors that may affect the use of low-sodium salt substitutes. The coding results from the two researchers were compared, and if necessary, a third researcher was consulted to reach a consensus. NVivo 12 software was used for coding and analysis.

Integration of qualitative and quantitative results

This study employs an explanatory sequential design, and the integration of qualitative and quantitative results primarily occurs in the following aspects: How to derive qualitative research questions from the quantitative results? How to integrate quantitative and qualitative results after completing both sections to explain the research results?

The questionnaires in the quantitative section and the interview guide in the qualitative section were both designed based on the COM-B model to link the qualitative and quantitative results and present them in parallel. The researchers analyzed the relationship between the quantitative and qualitative results, such as confirmation, expansion, or contradiction. This analysis provides a more comprehensive explanation of the quantitative results and potential influencing factors after three-year-intervention, to refine the intervention and improve adherence to the intervention.

Writing and presentation of research results

This study adopts an explanatory sequential design, using a sequential presentation of results. The quantitative results are presented first, followed by the qualitative results, and both are integrated to explain the results.

A total of 1,170 patients were included in the quantitative survey, of whom 1,025 provided urine samples, with an average age of 67.4 ± 7.5 years, and 502 (49.0 %) were females. The results showed that those who believed high salt intake was beneficial for health had higher salt intake. However, the difference was not statistically significant when compared to those who believed high salt intake was harmful to health (OR (95 % CI) = 0.84 (0.04, 1.72)). Thirty pa-

Table 2
Typical characteristics and logics for integration of three main types of designs for mixed methods research.

| Dimension | Explanatory sequential mixed methods research | Exploratory sequential mixed methods research | Convergent mixed methods research |
|---------------------------------------|--|--|--|
| Definition | Sequential use of research methods: first collect and analyze quantitative data, then collect and analyze qualitative data based on the quantitative results. | Sequential use of research methods: first collect and analyze qualitative data, then collect and analyze quantitative data based on the qualitative results. | Simultaneously collect both quantitative and qualitative results, analyze them separately, and merge the two datasets. |
| Design Purpose | To explain the quantitative research results | To validate or measure the qualitative results | To gain a more comprehensive understanding of the topic, requiring mutual validation or confirmation. |
| Quantitative and Qualitative Sequence | Sequence: quantitative first, then qualitative | Sequence: qualitative first, then quantitative | Simultaneous data collection and analysis |
| Key Integration Points | Sampling, data collection, and result interpretation | Data collection, result interpretation | Data analysis and result interpretation |
| Common Sample Relationships | Nested sampling | Validating qualitative research results: expanded sampling Tool development: independent sampling for both qualitative and quantitative data | Qualitative and quantitative samples are the same Qualitative and quantitative samples are independent Nested sampling |
| Qualitative and Quantitative Samples | Connecting the quantitative and qualitative sections: from quantitative data analysis to qualitative data collection. In the second section, the qualitative research questions, samples, and data collection are determined based on the quantitative results. | Connecting the qualitative and quantitative sections: from qualitative data analysis to quantitative data collection. In the second section, the quantitative research questions, samples, and data collection are determined based on the qualitative results. | Combining both quantitative and qualitative sections: after analyzing both types of data separately, further analysis is conducted on the two sets of results, such as comparison or conversion. |
| Presentation of Results | Sequential: present quantitative research results first, then qualitative research results, and interpret the combined quantitative and qualitative research results. Explain the role of the quantitative research results in the subsequent qualitative research. | Sequential: present qualitative research results first, then quantitative research results, and interpret the combined quantitative and qualitative research results. Explain the role of the qualitative research results in the subsequent quantitative research. | Intersection: present quantitative, qualitative research results (order adjustable), and mixed results for each theme/dimension. |
| Examples from Primary Care Research | A study on reducing benzodiazepine use in the elderly: first conducted quantitative research to analyze the reduction in the dose of benzodiazepines prescribed between October 1, 2015, and June 30, 2017. Based on the quantitative research results, healthcare institutions were divided into high and low dose-reduction groups, and qualitative interviews were conducted with participants in these groups to explain the measures and influencing factors for reducing benzodiazepine prescriptions. The results showed that the age-adjusted average daily dose in October 2015 was (1.34 ± 0.17) mg/day, with an annual reduction rate of (-0.27 ± 0.09) mg/day. All interviewed institutions used passive strategies, including appropriate prescriptions, alternatives, identifying potential patients, and providing health education. High-performance institutions adopted one or more active strategies, including personalized suggestions, administrative barriers to prescriptions, and performance-based incentives for clinicians ²⁰ | A study exploring key healthcare provider behaviors for building trust reported by patients: first conducted qualitative research by interviewing 40 patients to identify key behaviors related to building trust with healthcare providers. From the qualitative research results, a quantitative questionnaire was developed and tested with a larger representative sample (6,392 participants) to verify the robustness of the qualitative research results. The quantitative research results showed that patients' trust in healthcare providers was strongly correlated with eight items related to communication, concern, and expert knowledge. Therefore, to build trust with patients, healthcare providers should actively listen, offer detailed explanations, demonstrate concern for patients, and display extensive knowledge and skills ²¹ | A study examining the quality of life and experiences of patients with non-specific symptoms suspected of having cancer: The data collection tools included quantitative scales and corresponding qualitative interview guides. A survey was conducted with 838 participants, and qualitative interviews were conducted with 21 participants. The quantitative survey found that the patients' quality of life improved over time, and the qualitative interviews confirmed and expanded on the quantitative results. The mixed methods research data analysis emphasized that as time passed, patients' experiences and quality of life assessments changed due to their adaptation to the environment. Clinicians need to understand this change and provide appropriate interventions ²² |

tients participated in the qualitative interviews, including 18 females and 12 males, with an average age of 70.3 ± 6.0 years. Both quantitative and qualitative results indicated good acceptability and adherence to low-sodium salt use. The qualitative interviews also identified several barriers to low-sodium salt use, including a lack of awareness about salt reduction and the widespread use of high-sodium pickled foods. Some patients using low-sodium salt also mentioned reducing their antihypertensive medication usage without following medical advice. The quantitative and qualitative results are presented in a parallel table to help readers understand the integration of the findings (Table 1).

Design and implementation points of mixed methods research

The above example of explanatory sequential mixed methods study provides reference for researchers. Additionally, there are other design types. Below, we briefly introduce various design types along with key considerations for their design and implementation.

The three core design types of mixed methods research

Due to differences in the expertise and preferences of researchers proposing specific design types for mixed methods research, terminol-



Fig. 2. Design of the explanatory sequential mixed methods research

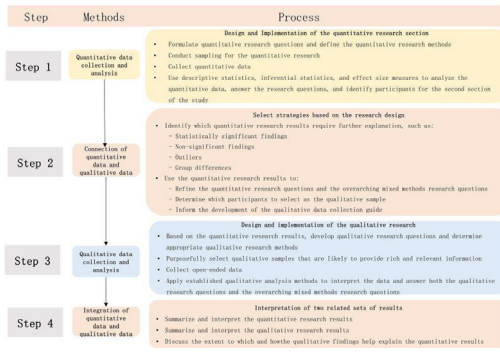


Fig. 3. General implementation process of the explanatory sequential mixed methods research.

ogy often varies in terms of rhetorical language, research paths, and the way design types are expressed. The article introduces three core design types that are conceptually simple and widely used: explanatory sequential mixed methods research, exploratory sequential mixed methods research, and convergent mixed methods research. The key design points and applicable situations for these three core design types are discussed below, along with typical characteristics, integration logic, and research cases^{17–19} presented in Table 2.

Explanatory sequential mixed methods research

The explanatory sequential mixed methods research involves collecting and analyzing quantitative data, followed by the collection and analysis of qualitative data to help explain the initial quantitative results. This type of design is appropriate in the following situations:

- (1) Quantitative data are required to identify trends, relationships, effect sizes, and the mechanisms or reasons of the findings;
- (2) Qualitative data are required to interpret significant (or non-significant) quantitative results, outliers, or unexpected findings;
- (3) Quantitative data are used as grouping basis and further qualitative research was conducted on the specific groups.

Explanatory sequential mixed methods research

In an exploratory sequential mixed methods research, the initial purpose of qualitative data collection and analysis is to explore the phenomenon, followed by quantitative data collection, which is based on the results of qualitative research, to test trends or relationships in a larger sample.

This design is used for exploratory research due to the following reasons:

- (1) The inability to directly use quantitative measurements or the absence of measurement tools;
- (2) Unknown variables; and
- (3) The lack of a guiding framework or theory.

Thus, this design is applicable in the following situations:

- (1) Lack of measurement tools and needs to develop and test them;
- (2) Needs to identify important variables for quantitative research in the absence of known variables;
- (3) Aim to generalize qualitative results to different groups or test new theories or classification principles;



Fig. 4. Design of the sequential exploratory mixed methods research.

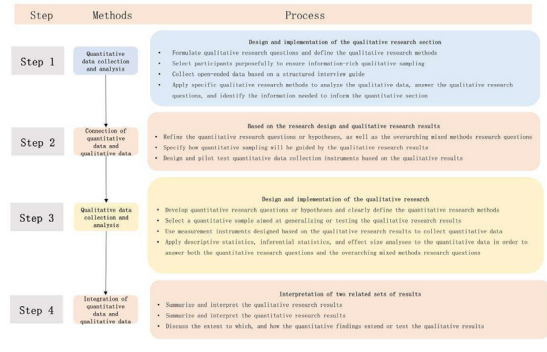


Fig. 5. General implementation process of the sequential exploratory mixed methods research.

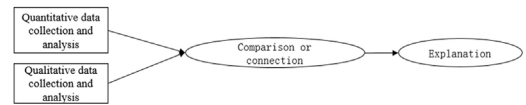


Fig. 6. Design of the convergent-parallel mixed methods research.

- (4) Aim to investigate a phenomenon and measure the variability of its attributes; and
- (5) Aim to generalize, evaluate, or test the qualitative results to assess whether the results can be generalized to a certain sample or population.

The exploratory sequential mixed methods research and its basic implementation process are shown in Figs. 4 and 5.

Convergent mixed methods research

In convergent mixed methods research, researchers collect and analyze both quantitative and qualitative data, integrate quantitative and qualitative results in the overall interpretation section. Data collection and analysis typically occur concurrently, they may also be partially synchronized.

This design aims to combine the strengths of both quantitative (e.g., large sample sizes, trends, effect sizes) and qualitative (e.g., small sample sizes, detailed insights, depth) methods, allowing each to complement. This design is appropriate in the following situations:

- (1) Aim to test and to validate results, directly compare quantitative and qualitative results for mutual verification;
- (2) Explain quantitative results based on qualitative results;
- (3) Integrate quantitative and qualitative results to obtain comprehensive understanding of phenomenon.

Figs. 6, and 7 illustrate the design and core implementation process of the convergent mixed methods research.

Data integration and presentation in mixed methods research

There are three primary strategies for integrating quantitative and qualitative data in mixed methods research.

- (1) Data convergence: Compare quantitative and qualitative results, which is commonly applied in convergent mixed methods research.
- (2) Data explanation: Explain quantitative results based on qualitative results, which is commonly applied in exploratory sequential mixed methods research.

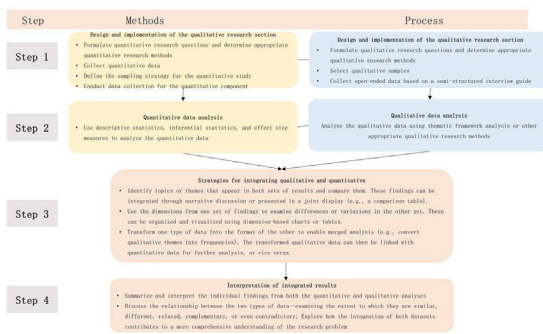


Fig. 7. General implementation process of the convergent-parallel mixed methods research.

- (3) Data construction: Develop quantitative research section based on qualitative results, which is commonly applied in exploratory sequential mixed methods research, such as developing new research tools or intervention measures.

The relationships between qualitative and quantitative results need explanation during integration, involving:

- (1) Explanation: interpret prior quantitative results based on the collection and analysis of qualitative results;
- (2) Verification: reinforce one type of results by other type of results;
- (3) Enhancement: enhance the explanatory capability and interpretability of by using qualitative and quantitative results
- (4) Expansion: explore contradictions or paradoxes by reconstructing questions or integrating qualitative and quantitative results.
- (5) Translation: explore relationship between qualitative results and broader populations, phenomena, contextual variables, or theoretical constructs from participants side.
- (6) Extrapolation: extrapolate results in subjects to target population based on larger-scale quantitative research.

The researchers should explain how results reflect relationship between qualitative and quantitative results after elaborating.

Discussion

The article reports on the implementation and experience of an explanatory sequential mixed methods research, briefly outlines the features and implementation processes of the three core designs in mixed methods research, aiming to provide the basic framework and process of conducting mixed methods research. However, mixed methods research faces greater challenges for the need to conduct and integrate quantitative and qualitative research rigorously.

Therefore, researchers of mixed methods research may carefully consider the following two questions:

- (1) Does the research team have sufficient technical expertise and resources to conduct both rigorous quantitative and qualitative research simultaneously, and to integrate the results of both? (2) Can mixed methods research yield scientific and practical findings exceed quantitative or qualitative research alone?

If researchers can answer both questions affirmatively, it will increase the successful rate of high-quality mixed methods research.

In the field of general practice and primary care in China, quantitative research is currently the most common method, the volume of qualitative research significantly increased in recent years, but remains relatively small. This reality may lead to following initial trends for mixed methods research in China.

The first trend is to add qualitative section to support or supplement quantitative results, to enhance the robustness of the results and the comprehensiveness of the data²⁰. The example presented in the article aligns with this trend.

In the study, the qualitative section validate (e.g., challenging the credibility of the quantitative results that "residents rarely consume pickled food" and reinforcing the credibility of the result that "residents commonly use monosodium glutamate") and supplement (e.g., revealed that "residents lack awareness of the recommended daily intake of salt" based on the quantitative result that "a lower proportion of residents know the recommended daily intake of salt") the qualitative results¹⁴.

However, conducting this type of mixed methods research needs the following two prerequisites: (1) comprehensive plan and adequate resources for high-quality quantitative research; (2) support from methodological experts with substantial knowledge and experience in qualitative and mixed methods research. Therefore, this type of mixed methods research better suited for institutions and teams with sufficient resources and experience, as generates more robust and comprehensive results based on quantitative results.

The second trend is to derive quantitative research section from qualitative research section²⁰.

With the rapid development of general practice and primary care in China, general practitioners(GPs) and small research teams may better suit this type of mixed methods research for closer to the "frontline" and more attuned to emerging research issues in practice. In recent years, a significant portion of general practice and primary care research are conducted in primary care facilities(departments of general practice, community health centres, and township health centres). The research topics include basic public health services implementation²¹, the feasibility of family doctor contracted services for specific populations²², frequent visits of elderly patients to community health centres²³, implementation of incentive strategies for GPs²⁴.

Conducting qualitative research on these issues and expanding to obtain quantitative data from a more representative, larger sample population is a valuable research approach. It evolves from frontline practice, generates overarching theories, and expands from small-scale research to allow for statistical inferences in larger population. However, advancing the type of mixed methods research in practice needs to address three fundamental challenges:

- (1) Small general practice research teams need comprehensive research training and technical support for the capability to conduct rigorous qualitative research;
- (2) General practice and primary care researchers, as well as academic journals in China should recognize and value the academic worth of small-scale qualitative researchers with high innovation and practicality;
- (3) Research-oriented GPs and large research teams in universities and general hospitals should collaborate, enabling the transformation of innovative small-scale qualitative research to large-scale quantitative research. Therefore, based on the current context, promoting consensus and collaboration between mixed methods researchers in China and leading researchers, institutions, and academic journals in the field of general practice will be an ongoing effort requiring long-term commitment.

Finally, to facilitate the systematic learning of mixed methods research, the following three articles on mixed methods research, which have been translated into Chinese, are recommended for GPs interested in applying mixed methods research to general practice and primary care research: Designing and Conducting Mixed Methods Research²⁵, Qualitative, Quantitative and Mixed Methods Approaches²⁶, and The Mixed Methods Research Workbook: Activities for Designing, implementing, and Publishing Projects²⁷. Additionally, the Chinese-translated papers Mixed Methods and Survey Research in Family Medicine and Community Health²⁸ and An Introduction to Mixed Methods Appraisal Tool²⁹ are also valuable introductory readings.

In conclusion, the article introduces three core design types of mixed methods research and highlights the key points of each design type. It also presents an example of an explanatory sequential mixed methods research, with the aim of providing strategies for GPs in general prac-

tice who are planning to use mixed methods. Many studies in general practice focus on implementable research with complex interventions, leading to complex design and process evaluation. While mixed methods research integrates qualitative and quantitative research, leads to practical value in guiding research design and implementation in general practice, facilitating the translation of research findings into clinical practices. We hope another research approach for general practice by mixed methods research.

Declarations

Not applicable.

Authors' contributions

Conceptualization, not applicable; Methodology, not applicable; Data curation, not applicable; Formal analysis, not applicable; Funding acquisition, not applicable; Project administration, not applicable; Resources, not applicable; Supervision, C.Y. and Z.S.; Validation, C.Y. and Z.S.; Writing—original draft, C.H., L.Y., W.Y., T.M.; Writing—review and editing, Y.Z., Z.L., L.N., W.Y., Z.Y. and C.C. All authors have read and agreed to the published version of the manuscript.

Ethical approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

Not applicable.

Competing interests

W.Y. T.M. and C.C. is the editorial member of Chinese General Practice Journal, he is not involved in the editorial review or the decision to publish this article. All authors declare that there are no competing interests.

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