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A pragmatic guide to data integration for pediatric researchers:

The nuts and bolts of mixed methods analysis

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Abstract

Objective: To provide pragmatic guidance on data analysis, integration, and reporting guidance for investigators new to mixed methods research.

Methods: Three core mixed methods designs (convergent, explanatory sequential, exploratory sequential) are described. Key decision points related to data integration – specifying intent, data selection, data preparation, integration strategies, use of analysis software, reporting – are explained, including comparison of decision points across the different mixed methods designs.

Results: Recommendations for addressing key decisions during analysis are provided and supported with published examples from mixed methods studies focused on pediatric populations.

Conclusions: Integration of qualitative and quantitative data is the defining characteristic of mixed methods research but can be challenging to fully achieve and adequately report. Decision making about the aims of the mixed methods analysis and how they will be achieved should begin early in the research process through collaboration among team members' with expertise and experience in qualitative, quantitative, and mixed methods studies. A variety of approaches to data integration and write-up of the integrated results can be taken and are reviewed in the current manuscript.

Keywords: Mixed methods; analysis; decision making; design; integration; research

Introduction

Across disciplines, pediatric investigators use varied research designs aimed at promoting the health and wellbeing of children, adolescents, and young adults (hereafter referred to as *children*), and their families. Studies span multiple aspects of development and functioning and can advance evidence-based practice. Common study designs in pediatric psychology include observational studies, both cross-sectional and longitudinal, and intervention studies that aim to understand and improve child health outcomes (Canter et al., 2018). Given the scope and complexity of topics addressed, pediatric-focused investigators increasingly use a mixed methods approach (i.e., the collection and integration of qualitative and quantitative data) to achieve their research aims. As cited in a previously published primer on mixed methods research, Wu et al. (2019) identified the hallmarks of mixed methods research as "the intentional collection and analysis of qualitative and quantitative data, and… integration of these data…to address research questions" (Wu et al., 2019, p. 905). Creswell & Plano Clark (2018) described integration as the "centerpiece" of mixed methods research. When designing a mixed methods study, investigators identify qualitative, quantitative, and mixed methods research questions, and propose analytic strategies for integrating results across the research questions.

Data integration entails joint examination of qualitative and quantitative results to add depth of understanding, generate new and explanatory insights, and/or determine next steps in a study or program of research. Integration yields knowledge beyond what is learned from a study's separate qualitative and quantitative results (Creswell & Plano Clark, 2018). Integration is a distinctive strength of mixed methods research and what differentiates it from multi-method research. In mixed methods research, the qualitative and quantitative data are integrated, while multi-method research collects both types of data, but does not link them during analysis.

Creswell & Plano Clark (2018) identified three core mixed methods designs (convergent, sequential explanatory, and sequential exploratory) that differ in overall intent and sequencing of qualitative and quantitative data collection; integration occurs at different points in each design (see Figure 1).

Despite being a defining characteristic of mixed methods designs, integration is recognized as a particularly challenging activity that investigators do not always fully achieve or adequately report (Creswell & Plano Clark, 2018). Common challenges to data integration include specifying the intent of the mixed methods analysis, determining the timing or point of integration, developing analytic strategies, and reporting results. To ensure that potential strengths of mixed methods designs are fully realized and clearly articulated, each has varied key decision points and data integration analytic strategies. Investigators should select an approach consistent with their research questions and specific mixed methods design.

Pertaining to the above challenges, few foundational resources exist to guide researchers new to data integration. In the current article we address this gap and provide guidance on data analysis, integration, and reporting for mixed methods research by answering the questions:

(1) What is the purpose and nature of data integration across the three core designs?

(2) What are key decision points in an integrative analysis?

(3) How is mixed methods research reported?

The current manuscript extends the Wu et al. (2019) prior step-by-step primer on mixed methods research and Thompson et al. (2022) pragmatic guide to qualitative analysis. Recognizing that the field uses a variety of terms to describe mixed methods research, in Table 1 we specify the terminology used in this paper. This manuscript is directed to researchers new to mixed methods research and research teams whose members have varied areas of

methodological expertise and different levels of understanding and experience in mixed methods research. The content stems from well-established conventions (Creswell & Plano Clark, 2018), our examination of published mixed methods studies focused on pediatric populations, our considerable collective experiences conducting mixed methods studies in pediatric psychology, and monthly discussions over two years when conceptualizing and writing this paper.

The goal of this article is to offer a concise introduction and pragmatic guidance that incorporates current guidelines and will contribute to readers' understanding of the potential of mixed methods studies and how they can advance the knowledge base on the health and well-being of children and their families. For readers interested in more theoretically-oriented discussions, we recommend Lynam et al.'s (2020) article on theoretical models supporting integration and Sandelowski et al.'s (2009) article addressing underpinning assumptions linking different types of data in mixed methods studies. For readers interested in mixed methods approaches to instrument development, there are excellent discussions in the literature, e.g., Blackwell et al. (2022), Cella et al. (2022), and Forrest et al. (2012).

What Is the Purpose and Nature of Data Integration across the Three Core Designs?

Although broadly defined as "the point in the research procedures where the qualitative research interfaces with the quantitative research" (Creswell & Plano Clark, 2018, p. 449), the purpose and nature of integration varies across mixed methods designs (convergent, explanatory sequential, and exploratory sequential). These designs provide a guiding context for data integration by specifying the purpose of integration and the analytical point where integration occurs. Table 2 provides an overview of the purpose of the core designs, highlighting how sequencing of qualitative and quantitative data collection and analysis and the focus of integration varies across designs.

Investigators considering a mixed methods study should specify the goal of their approach and the qualitative, quantitative, and integrated research questions they will address, followed by the selection of an appropriate mixed methods design. Research questions (qualitative, quantitative, and integrated) should reflect the concept(s) the investigator proposes to describe or explain during each phase of analysis. Purposive sampling, defined by Creswell and Clark (2018) as intentional selection of participants "who have experienced the central phenomenon or key concept being explored" (p. 176), is often used to address the integrated research question. While there are multiple purposive sampling approaches, investigators select the approach that best aligns with their research questions and research design. For example, maximum variation sampling is used to identify respondents likely to reflect diverse perspectives, while homogenous sampling is used to select respondents with a shared characteristic.

The *convergent mixed methods design* (Creswell & Plano Clark, 2018) is appropriate when investigators aim to provide a comprehensive, credible understanding of the topic under investigation. This design entails collecting qualitative and quantitative data concurrently followed by a separate analysis of each dataset. Selected, conceptually similar results (e.g., quantitative quality of life scores and qualitative themes related to quality of life), are then linked. For example, in a study of health-related quality of life (HRQOL) of children with congenital adrenal hyperplasia (CAH) (Carroll et al., 2021), the purpose was "to provide a more comprehensive understanding of HRQOL of children" (Carroll et al., 2021, p.88). To achieve this goal, they asked what is the HRQOL of children with CAH (quantitative research question); what were children's and caregivers' perceptions and experiences related to living with CAH (qualitative research question); and, to what extent did quantitative findings converge with

qualitative findings? (integrated research question). Child-caregiver dyads completed a quantitative measure of HRQOL, with a subsample of those respondents participating in an individual semi-structured qualitative interview about their perceptions of living with the condition. Based on their analysis of HRQoL scores and interview data, Carroll, et al. (2021) identified areas of convergence and non-convergence between qualitative and quantitative results and concluded that a mixed methods approach increased understanding of the consequences of treatment regimens, while also highlighting individual differences in how treatments were experienced.

Investigators using an *explanatory sequential mixed methods* (Creswell & Plano Clark, 2018) design draw on qualitative findings to provide further insight into quantitative results, especially those that are unexpected or difficult to interpret, such as subgroups for whom an intervention was ineffective or individuals who scored differently than expected on quantitative measures. After analyzing quantitative data, investigators identify results requiring further explanation and purposively select a sample of respondents from whom to collect qualitative data, typically through interviews or focus groups. Following analysis of qualitative data, findings are connected to the quantitative results for which further explanation is needed. For example, through an online survey, Kim et al. (2020) quantitatively examined associations among sleep problems in children with cancer, parental sleep-related behavior and children's sleep hygiene throughout treatment followed by a qualitative telephone interview with a sub-sample of parents who had completed the survey, aligning the interview questions with the overall study aims and conceptual focus. The investigators hypothesized that (i) treatment side effects would be associated with parents' engagement in accommodating behaviors during bedtime, negatively affecting children's sleep quality, and (ii) both parental behaviors and

children's sleep would change during the treatment course. Contrary to hypotheses, children's sleep quality and parents' behaviors did not vary across treatment stages. Interview data provided further support for quantitative results. Parents did not describe changes in their child's sleep or their accommodative behaviors across the course of treatment. Interview findings that returning home was sometimes associated with continued emotional distress that negatively impacted children's sleep provided explanatory insights into why children's sleep and parents' behaviors did not change over time.

Using an *exploratory mixed methods design* (Creswell & Plano Clark, 2018) investigators can determine a logical next step in a study or program of research. The goal is systematic development of a new product (e.g., intervention, mHealth application) or quantitative study feature (e.g., survey). The three-stage process, entailing two points of data integration, includes an initial qualitative study to gather foundational information followed by a design stage where qualitative findings are used to develop a product or new feature of the project. The final stage entails evaluation or testing of that new product or feature. For example, Swallow et al. (2014; 2016) developed the Online Parent Information and Support (OPIS) application for parents of children with kidney disease using this design. Based on desirable features of the support platform identified though Stage 1 interviews with parents and health care professionals, the investigators developed a prototype version of OPIS (Stage 2) and then completed feasibility testing and a small-scale randomized controlled trial (Stage 3) which included tracking usage, quantitative assessment of acceptability, usability and outcomes and qualitative interviews with parents purposively selected to include maximum variation in age, background, and sex to elicit accounts of their experiences using OPIS. Based on quantitative Stage 3 data analysis, the authors reported that intervention group parents showed greater improvement in perceived

competence to manage their child's condition compared to control group parents. Analysis of Stage 3 qualitative interviews provided evidence that OPIS incorporated desirable features identified during Stage 1 and recommendations for further strengthening OPIS.

What are Key Decision Points in an Integrative Analysis?

Deliberate decisions about when and how to integrate data are critical to achieving an integrated analysis and ensuring the integrated research question is fully addressed. Prior to launching a project, investigators describe their plans for addressing each research question, including how to address the integrated research question. This includes describing the synergy among the research questions, theoretical/conceptual underpinnings, and mixed methods components. Describing the conceptual alignment of qualitative and quantitative data being integrated, including the selection of data to guide the integrative analysis, is important to include in this description. Key decision points include deciding what data to include in the integrative analysis, how to prepare data for analysis, what analytic strategies will be used and how qualitative data analysis software (QDAS) could be used. Figure 1 describes the focus of these decisions and point(s) in the study when decisions are made. Changes (minor and major) or methodological decisions differing from those originally proposed should be included in investigators' continuing documentation of analytic decisions made during the study, sometimes referred to as an audit trail (Wolf, 2003).

Data Preparation and Integration Strategies in Mixed Methods Analysis

Before beginning data preparation and integration, investigators must decide what data are needed to address the mixed methods research question. These data may include all or a subset of the complete dataset.

The integrated research question guides decision making about what data to use in the

analysis. For example, in their convergent mixed methods study of parenting a seriously ill child, Mooney-Doyle et al. (2018) conducted qualitative interviews with parents who also completed a quantitative measure of parenting challenges and priorities. Their decision to collect these data was made prior to data collection. The point of data integration using the entire data set occurred following separate analyses of the two data sets.

In contrast, when undertaking an explanatory sequential study, investigators identify results requiring further elaboration or explanation following the initial stage of data collection. For example, in their study of sleep disturbances in children with cancer, Kim et al. (2020) conducted follow-up qualitative interviews to understand why hypotheses that quantitatively measured sleep-related behaviors would change over time were not supported.

In an exploratory sequential design where the goal is to develop a new product or design feature, investigators decide what data to include in the integrative analysis at two points. The first point of integration follows collection of qualitative data aimed at informing development of a new product or design feature, when investigators identify qualitative results which will inform development of their new product or design feature. The second point of integration follows initial testing when investigators identify testing outcomes related to aspects grounded in the qualitative results. The intent of the second integrative analysis is to assess if and how qualitative underpinnings are reflected in the product (e.g., intervention, measure). The previously referenced study by Swallow et al. (2016; 2014) describes the different subsets of data used in the integrative analyses across study phases.

After determining what data to use in the integrated analysis, investigators decide what steps are needed to prepare data for analysis and what data integration strategies they will use. For quantitative data, basic preparatory steps include scoring measures and calculating

descriptive statistics. For qualitative data, preparatory steps often include developing and applying a coding scheme. A useful step at this stage is to create two master data folders, one containing qualitative data and the other containing the quantitative data, to be used in the analyses.

Creswell & Plano Clark (2018) identify visual displays as a foundational integration strategy used across the three core designs. Matrices, charts, graphs, tables, and/or scatter plots are used to visually display qualitative and quantitative data. During analysis, visual displays are a foundational strategy used across the three core designs for aligning qualitative (e.g., categories, themes, types) and quantitative (e.g., scores, rankings, significant relationships) data across respondents (Creswell & Plano Clark, 2018). Displaying these linkages contributes to answering the investigators' mixed methods research question(s). For example, Table 3 provides an adapted, anonymized excerpt of a visual display from a convergent mixed methods study of problematic feeding symptoms in infants (Thoyre, et al., 2025). In addition to identifying trajectories of problematic feeding, the investigators asked a research question about the impact of feeding challenges on parents and collected data from a subset of primary caregivers using qualitative interviews and a quantitative measure of feeding impact. Using the fully developed version of Table 3, the investigators examined the extent to which caregivers' quantitatively assessed perceptions of feeding impact were consistent with their qualitative interview descriptions. Based on these comparisons, they were able to explain discrepancies between the two data sources (Estrem, Knafl, & Thoyre, 2025). Guetterman et al. (2015, 2021) provide additional examples of how various types of visual displays can be used to support data integration in mixed methods research.

Because visual displays developed during the analysis can be lengthy, abbreviated

versions of displays may be used to report results of the integrated analysis, accompanied by a description of the analysis. For example, in their study of parenting a child with a life-threatening illness, Kim et al. (2020) described the creation of informational data matrices aligning qualitative and quantitative data about the child with data about their siblings to provide a more complete understanding of the parenting experience. In the explanatory and exploratory mixed methods designs, investigators use visual displays in their analyses to link data across different study phases. Across designs, the intent of a visual display is to ensure the systematic review and analysis of aligned qualitative and quantitative data.

In some cases, data preparation includes quantitizing qualitative data or qualitizing quantitative data that can be used in further statistical analyses. For example, in a study of the prevalence of adolescent depression, Kenny et al. (2021) statistically analyzed the presence or absence of qualitative themes identified through content analysis of medical records in relation to change in adolescent depression scores. Qualitizing entails incorporating quantitative data into the description of patterns or narrative case profiles. For example, in their study of mothers of child brain tumor survivors, Lucas et al. (2014) identified four patterns of expectations for function and independence based on thematic analysis of mothers' interview data and quantitative measures of family management and medical sequelae scores.

Use of Qualitative Data Analysis Software (QDAS) in Mixed Methods Analysis

QDAS can be used to support both data preparation and data analysis. QDAS tools provide structure for identifying existing and emergent themes/categories and to expedite rapid retrieval of information to share with others during dissemination. Investigators need to decide if and how they are going to use QDAS. There are multiple QDAS tools (e.g. Atlas.ti, Dedoose, MAXQDA, NVIVO) available. For examples of analyses supported by QDAS, see Carroll et al.

(2021) and Waller et al. (2021). In general, QDAS tools enable efficient management of multiple data types and sources, as well as documenting the direction and timeline of the analysis and emergent concepts. QDAS can support data preparation (e.g., coding qualitative data and importing quantitative data), creation of visual displays, data transformation through qualitizing and quantitizing, analysis, and interpretation. QDAS tools enable researchers to increase the depth and rigor of analyses by searching and interrogating data sources using a combination of data management tools. QDAS tools make it easier to answer questions and prepare narratives for data displays about how and how often various subgroups within the sample reflect various codes, categories, or themes. Ultimately, however, analytic interpretation remains with the researchers (Bazeley, 2018; Kuckartz & Rädiker, 2021; Paulus et al., 2017).

While there are many positives to the use of QDAS tools, there are also potential downsides such as increased pressure on researchers to focus on volume and breadth rather than on depth and meaning, the time and energy required to learn to use QDAS, and the potential for distraction from the important conceptual work of analysis. When deciding whether to use QDAS tools, St John & Johnson (2000) recommend that researchers consider the capabilities of the QDAS tool, their own computer literacy and knowledge of the tool, or the time required to gain these skills, and the suitability of the tool for their research. Researchers' methodological expertise also should inform their choice and use of QDAS. Other factors to consider include cost and likelihood that software will be used in future projects, specific QDAS capabilities, availability of introductory webinars on the chosen tool, and ongoing support from a researcher with relevant skills or a software company helpline. An alternative to QDAS is Microsoft Excel, which is widely available and offers a systematic method to rigorously manage and display qualitative data and create visual displays of mixed methods data that have greater transparency

than those using manual methods alone. Using a software spreadsheet such as Excel removes the need to purchase and learn more complicated and dedicated software. Excel is shareable within the research team and relatively easy to learn (Swallow et al., 2003; Swallow et al., 2014).

Reporting Mixed Methods Research

When analyses are complete, the next step is to report results, including those resulting from qualitative, quantitative, and integrated analyses. Reporting mixed methods results can be complicated, and there is not one formulaic way to accomplish this important task. Because this paper focuses on a pragmatic approach to integration, we emphasize common reporting approaches. More detailed descriptions of the various approaches are available (Creswell & Plano Clark, 2018; Fetters & Freshwater, 2015). When reporting results of a mixed methods study, the primary goal is to report the qualitative, quantitative, and mixed methods findings in a way that clearly and concisely conveys what was discovered about each research question. Before beginning to write, thoughtful reflection of the qualitative, quantitative, and mixed methods research questions, careful consideration of how to clearly convey what was learned from the study, and what these learnings contribute to the field are important steps (Creswell & Plano Clark, 2018).

Reporting Guidelines

Standard reporting guidelines such as those published by the American Psychological Association are available to guide reporting decisions (Levitt et al., 2018). For example, the Mixed Methods Article Reporting Standards (MMARS) (American Psychological Association, 2024) are designed to guide authors' decisions about what to include in mixed methods publications and where to include it (Kazak, 2018). When reporting qualitative and quantitative results, the guidelines recommend reporting the results in the order in which the data were

collected in the research cycle. Therefore, the mixed methods research design selected for a study can be helpful for determining the order in which the results are presented.

Others have also published recommendations on how to report mixed methods findings. O'Cathain et al. (2008) reviewed the quality of mixed methods publications in health services research. They found a diversity of reporting methods and concluded that the field could benefit from a greater focus on what to include when reporting this type of study, including a clear description and justification of the design, description of each component and results, and careful integration of the results. Reporting standards for mixed methods research in health services were recently published which include a 20-item checklist to guide authors when publishing mixed methods studies (Tovin & Wormley, 2023). Other tools such as the Mixed Methods Assessment Tool (Hong et al., 2018) designed to assess the quality of mixed methods studies in a systematic review and best practices for writing and evaluating a mixed methods grant application (Creswell et al., 2011) may be useful to those intending to conduct mixed methods research.

Considering these recommendations, a decision needs to be made regarding the target journal for reporting the results. Based on the authors' collective experience, it can be challenging, but not impossible, to report qualitative or integrated results in a journal that primarily reports quantitative results. To learn more about the types of articles a journal publishes, review its aims and author guidelines. Some journals also list the types of articles they typically publish. Reviewing several past issues of the journal can also be helpful. Another consideration is word limit; due to the nature of mixed methods research, these papers can be lengthy (Creswell & Plano Clark, 2018). If you are unsure whether your article fits the journal's scope, contact the journal, and ask if they publish mixed methods research.

Ordering and Structuring Submissions

Even though reporting guidelines exist, authors need to give careful consideration to how to best present the results of a mixed methods study. For example, some researchers opt to publish the qualitative, quantitative, and integrated results separately or concurrently in the same journal (i.e., the staged approach) (Fetters & Freshwater, 2015). Other investigators choose to publish the results in one paper (i.e., the contiguous approach) (Fetters & Freshwater, 2015). Choosing to publish the qualitative, quantitative, and integrated results separately enables authors to select journals with the best fit for the type of research being reported and makes it less likely word limits will be a restriction. When choosing to use this approach, it is recommended that the methods sections of each paper indicate that the paper is part of a wider mixed methods research study; it is also recommended that each paper cites the other papers (Creswell & Plano Clark, 2018). Advances in mixed methods research recognize the advantages of publishing the research in separate papers because it enables researchers to more fully describe the methods, results, and implications of each stage of the research (Creswell & Plano Clark, 2018).

Although there are no set guidelines for reporting analytic results in one paper, the order in which the data were collected typically guides the presentation of results (i.e., temporal approach) (Fetters & Freshwater, 2015). For example, in an explanatory sequential design, quantitative results would be presented first, followed by qualitative results, then integrated results. Alternatively, in an exploratory sequential design, the qualitative findings would be presented first, followed by the quantitative results, then integrated results. For a convergent design, the order of data collection typically guides the presentation of results (Fetters &

Freshwater, 2015). If the authors choose to report each type of research separately, the temporal guideline also applies; i.e., for explanatory sequential design, the first paper would be the quantitative results, the second would focus on the qualitative results, and the third would present the integrated results (Fetters & Freshwater, 2015). When reporting qualitative and quantitative results in the same manuscript, a decision is also needed regarding where in the manuscript to report the integrated results. While often presented in the results section, authors may choose to present them in the discussion section (Creswell & Plano Clark, 2018) if clearly delineated as such and if consistent with journal guidelines.

Reporting integrated findings

The hallmark of mixed methods research is integration of qualitative and quantitative data and the additional insight obtained from integration (Creswell & Plano Clark, 2018). As demonstrated in this paper, integration can take place at various points in the research cycle (e.g., data collection, analyses, reporting) (Wicen, 2022; Yaqoob & Barolia, 2023). Regardless of where integration occurs, determining how to present the integrated results can be challenging. Here, we present three options: narrative description; results of data transformation (i.e., qualitizing or quantizing); and summarized versions of visual displays (Fetters & Freshwater, 2015; Yaqoob & Barolia, 2023).

Integration of qualitative and quantitative findings can be presented in narrative format (i.e., text). When this occurs, results of the two types of research are presented together, using a technique called weaving (Fetters & Freshwater, 2015; Yaqoob & Barolia, 2023). For example, in the exploratory sequential design, qualitative themes would be presented, immediately followed by quantitative findings to enhance understanding and insight (Fetters & Freshwater, 2015). Data transformation typically occurs in the analysis stage using the qualitizing or

quantitizing techniques described earlier (Fetters & Freshwater, 2015; Yaqoob & Barolia, 2023). For example, to address mixed methods research questions, qualitative themes can be converted to frequency counts and used to explain quantitative results (Yaqoob & Barolia, 2023). Finally, guided by the research question, visual display of the transformed data created during analyses would be the basis of a new focused visual display reporting the data that addresses the mixed methods research question. Visual displays present both types of data together in one table and are the most popular method for presenting results to support new insights (Yaqoob & Barolia, 2023). The final consideration is how to structure the discussion section of the manuscript and what to include.

Writing the discussion section for a mixed methods study can be a daunting task. Rather than a simple expansion of the mixed methods study results being reported, the guiding principle for the discussion section is to summarize key results and place them in the context of the literature (Creswell & Plano Clark, 2018; Fetters & Freshwater, 2015). If qualitative or quantitative results are reported elsewhere it is particularly important to highlight how the results of the present manuscript replicate, extend, diverge or add to the literature on the topic. This section can also address potential implications of the results and study methods, particularly how mixed methods revealed novel or discrepant results and their implications (Creswell & Plano Clark, 2018; Fetters & Freshwater, 2015). Limitations of the research and conclusions are typically reported towards the end of the discussion section (Creswell & Plano Clark, 2018; Fetters & Freshwater, 2015), unless the target journal requires another format.

Conclusions

Integration of qualitative and quantitative data is the hallmark of mixed methods research. It is through integration that the full potential of such studies to advance knowledge of

the health and well-being of children and their families is achieved. The goal of this manuscript was to offer a concise introduction and pragmatic guidance related to process of data integration to inform investigators' planning and decision making in mixed methods studies, especially for investigators new to mixed methods and/or working with research teams with varied areas of expertise and experience with mixed methods research.

One recommendation that crosscuts those discussed in the manuscript entails the importance of pre-planning in mixed methods research including for data integration. For instance, many of the decision points summarized in Table 4 should ideally be discussed by the research team during the planning phase of the mixed methods study. Mixed methods studies and their analysis are most efficiently planned and implemented with engagement from all team members when decision points arise. The research team should include a member with expertise and experience in mixed methods research who can orient other team members to mixed methods research designs and analysis strategies. Team discussions provide an opportunity to consider different possibilities, address differing views, and arrive at a shared decision about the best course of action.

Mixed methods research can be both intellectually stimulating and challenging. In our opinion, it is best approached with a sense of adventure and openness to new ideas and ways of thinking about study design. Team members are likely to gain a greater understanding and appreciation for types of data and analyses they may have been skeptical of in the past, recognizing the value-added of a mixed methods approach. Ultimately, rigorously implemented and analyzed mixed methods studies offer a unique way to generate new knowledge and have the potential to contribute new insights to the scientific literature focused on enhancing children's health and lives.

Data availability statement

No new data were generated or analyzed in support of this research.

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Conflicts of interest

None declared.

Figure Legend

Figure 1. Decision points and integration by design. (A) Convergent design. (B) Explanatory sequential design. (C) Exploratory sequential design.

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Table 1. Clarification of terminology used in manuscript to describe mixed methods research.

Term	Definitions
Building	Using qualitative findings from initial phase of a study to advance further development of study or program of research.
Connecting	Using qualitative data to better understand or explain quantitative results.
Integration	Examining how qualitative and quantitative data jointly address research questions.
Linking	Aligning qualitative and qualitative data across respondents or cases.
Qualitizing	Using quantitative results in conjunction with qualitative results to characterize types of patterns of response.
Quantitizing	Transforming qualitative data into quantitative results through frequency counts or statistical analyses.
Results	Reporting of outcomes of qualitative, quantitative, and mixed methods analyses

Table 2. Overview of core research designs in mixed methods research design.

	Convergent	**Explanatory Sequential**	**Exploratory Sequential**
Design considerations			
Purpose	Deep understanding	Interpretation	Development
Sequence	Quantitative + Qualitative	Quantitative > Qualitative	Qualitative > Quantitative
Notation[a]	QUAN + QUAL	QUAN → qual	QUAL → quan
	Quan + QUAL	quan → QUAL	Qual → QUAN
	QUAN + qual		
Focus of data integration			
	Comparing	Connecting	Building
	Qualitative and quantitative data are collected simultaneously, each addressing a separate research question. Data are then **compared** to address mixed methods research question.	Following quantitative data collection, investigators decide what qualitative data are needed to explain results. Qualitative data are **connected** to quantitative data investigator wants to explain.	Following qualitative data collection, investigators decide what quantitative data are needed to take logical next step in research program through **building** on qualitative results.
	Goal is deep or more complete understanding of topic.	Goal is explanation of quantitative results.	Goal is to create something new.

[a] Quan indicates quantitative; Qual indicates qualitative; upper versus lower case indicates priority; symbol indicates research flow (+ indicates occurs simultaneously; → indicates order or flow) (Creswell & Plano Clark, 2018).

Table 3. Adapted excerpt from a display table used in integrated analysis of feeding impact score and qualitative interview data from study of trajectory of infant problematic feeding symptoms[a]

Respondent	**Feeding Impact Score**[b] (possible range 12-54)	**Contextual Influences** (from Structured Interview Summary)	**Perceptions of Impact** (from Structured Interview Summary)	**Example Quotes from Interview Transcripts**	**Preliminary Interpretation**
001	12	Continuing positive working relationship with day care provider. Mother and provider work together to plan meals.	Impact on Family Life: When asked how much time is spent feeding the children states she doesn't pay much attention to time. She states she doesn't think much about meal planning because child eats most foods. Grocery shopping is not linked to any special diet needs for the children.	"I could be way off on this because I never actually pay attention to the time. But maybe thirty minutes a meal, hour and a half roughly out of the day." "They'll eat pretty much anything. I don't have to spend much time at the grocery store trying to decide on what to feed him. It's pretty much just whatever we have to eat."	Minimal time spent thinking about feeding. Amount of time feeding takes is not a concern.
002	21	Stay-at-home mother with one other child. Grandparent cares for child one day a week.	States she and husband spend about an hour a day feeding the child – 15 minutes each feeding. She thinks about feeding about 5 minutes before each meal. Mother's day focuses on childcare.	"It's become my job. I have two children under three. My day revolves around them eating and sleeping."	Considerable effort devoted to feeding and childcare, but this is not viewed as problematic.

003	30	Mother engaged and fiancé occasionally helps with child. Mother has blood pressure-related health challenges Insurance will not cover cost of surgery for tongue tie surgery, making feeding more challenging.	Child requires dairy free products which are more expensive. Estimate two hours a day is spent feeding the child. Talks about her love of cooking and enjoying meal planning and clarifies focus is on planning for family and not child.	"I think about feeding all the time because I am always wondering what I am going to feed him." "I've learned to manage everything pretty well as far as time."	Financial impact concerns. Feeding part of usual family routine, considerable time spent thinking about family meal planning because she loves cooking.
004	35	Mother, father, and child had COVID which she describe as a difficult experience. Mother's sister lives with them and is available to help.	Estimates one hour a day feeding child and minimal time spent thinking about feeding child	"Feeding is very easy because I know what's in the pantry and can pick out what I thinks he should eat for the day."	Spends little time thinking about feeding. Feeding described as easy.
005	54	Both parents work and share caregiving. Mom and grandmother are nurses Grandparents have taken child overnight so parents can spend time together	Usually 5 meals/day – about 30 minutes each. With preparation time meals account for about 3.5 hours/day. Because of work schedules and parenting demands she and her husband have very little time together. States they feel like single parents.	"Most days I feel like, I mean my whole days revolves around him." "Because I have to plan what he is going to eat and I have anxiety, so I pretty much think about it all the time."	Family routine focused on feeding. Considerable time spent thinking about feeding. Negative personal impact – stress and anxiety.

	Describes herself as exhausted by the time her husband gets home. “I just want to go to bed”. Parents have had a couple nights away from child at hotel with grandparent or friend taking care of baby. They are trying to work out scheduling so they can do this on a more regular basis.	“By the time my husband gets home I am exhausted and just want to go to bed.”	Negative impact on couple – limited time together. Anticipates child will gradually improve, eat “normally” and enroll in daycare.

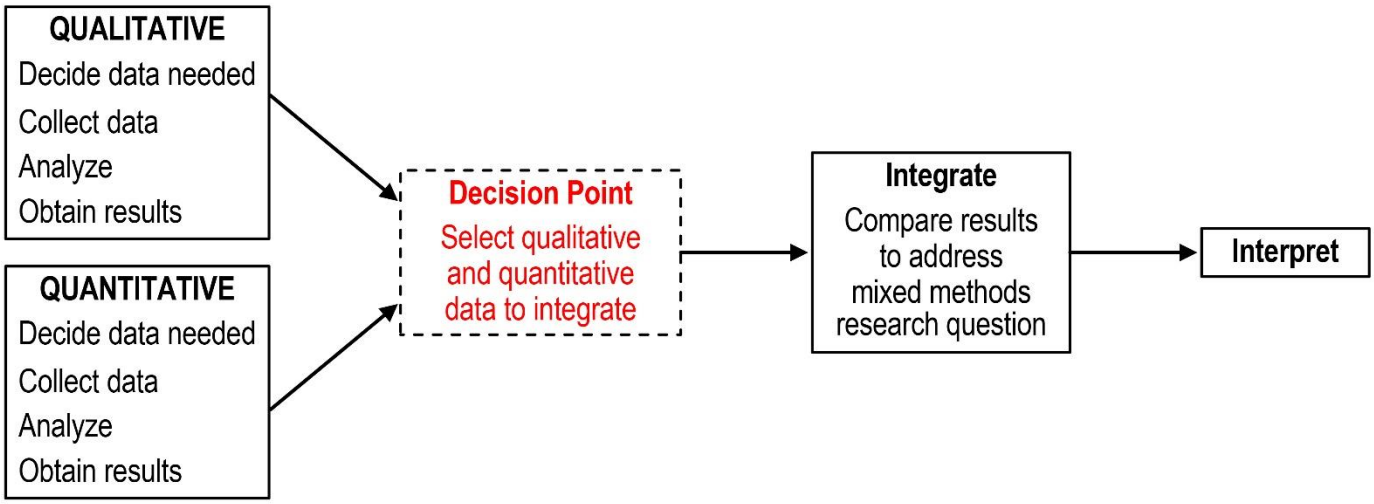
[a] Grant to S. Thoyre from the National Institute of Nursing Research of the National Institutes of Health under award number R01NR018192. Table adapted with permission of principal investigator. Structure of larger summary template used in the analysis was developed through research team discussions.

[b] Estrem, H. H., Pados, B. F., Park, J., Thoyre, S., McComish, C., & Nguyen, T. (2022). The impact of feeding on the parent and family scales (Feeding Impact Scales): Development and psychometric testing. *Journal of Nursing Measurement, 30*(1), 5-20. https://doi.org/10.1891/JNM-D-20-00008

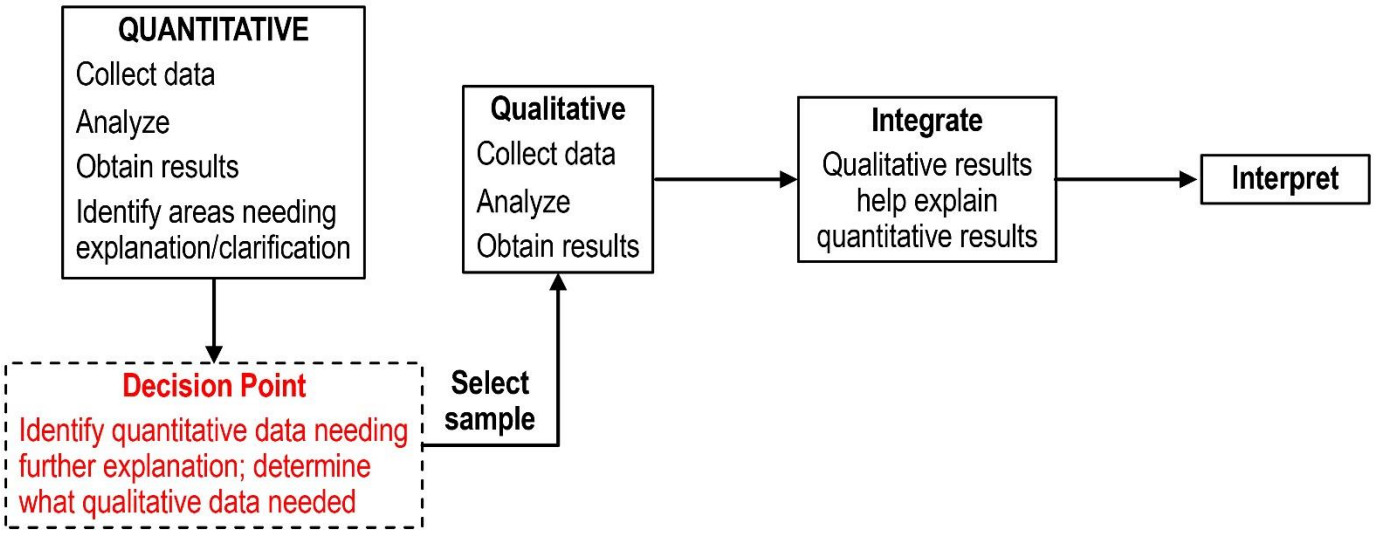
Table 4. Recommendations for addressing key decision points related to data integration in mixed methods analyses.

Key decision points	Recommendations
Mixed methods study design	• Specify mixed methods research question • Select the mixed methods core design that best aligns with your research questions • Include someone with expertise and experience in mixed methods research on the research team • Address key decision points during proposal development
Data to be used in the integrated mixed methods analysis	• Clarify the conceptual focus of the integrated analysis • Determine if all or a subset of data is needed to answer the mixed methods research question
Data preparation	• Decide what initial analyses of qualitative and quantitative data are needed to address the mixed methods research question(s) • Complete preparatory analyses of qualitative and quantitative data
Data integration strategies	• Determine how results of preparatory analyses will be aligned across cases • Develop data displays (tables, figures or charts) aligning data • Summarize results of integrative analysis
Use of qualitative data analysis software (QDAS)	• Discuss with the research term how QDAS could be used to support aspects of the mixed methods analysis (e.g. coding, data display) • Consider the pros and cons of using QDAS • Make a decision about whether QDAS will be used for the current project
Reporting mixed methods research	• Select an appropriate journal for publishing the results of the mixed methods study based on journal's focus and submission guidelines • In the manuscript, specify rationale for publishing qualitative, quantitative, and mixed methods results in a single or separate manuscripts • Consider how narrative and visual formats can be used to convey results • Use discussion section to summarize key findings and highlight how results advance knowledge, avoiding reporting new results

A. Convergent Design:



B. Explanatory Sequential Design:



C. Exploratory Sequential Design: