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Applying qualitative comparative analysis in a systematic review: Lessons learned

Nutzung der Qualitative Comparative Analysis (QCA) in einem systematischen Review: Lessons Learned

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ABSTRACT

Background: Evidence synthesis of primary studies assessing complex interventions poses challenges due to the heterogeneity of study populations, interventions, outcomes, or study designs. Qualitative comparative analysis (QCA) aims to identify conditions or combinations of conditions that lead to a specific outcome and may be an appropriate instrument to deal with heterogeneity and complexity.
Objective: We aimed to describe the lessons learned when applying QCA in a systematic review on technology-based counselling interventions in dementia.
Methods: The lessons learned were generated through research team reflection and discussion of the challenges and problems encountered in the process of applying the initial steps of the QCA. As the QCA remained incomplete, a brief account of aspects to be considered when using QCA methodology for data synthesis within a systematic review is presented.
Results: The lessons learned comprise the importance of clear eligibility criteria representing the core elements of interventions and the need for a consistent dataset based on sufficient reporting and suitable publication types. We also recommend adoption of a multi-perspective view by integrating theoretical and practical knowledge.
Conclusion: QCA may increase knowledge gain in systematic reviews by capturing the complexity of interventions and contexts. An adequate dataset is needed to enable systematic comparison. To achieve this, adherence to frameworks guiding the development, implementation, and evaluation of complex interventions as well as to reporting guidelines is essential.

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ZUSAMMENFASSUNG

Hintergrund: Die Synthese der Evidenz aus Primärstudien zu komplexen Interventionen ist mit Herausforderungen verbunden, die aus der Heterogenität von Studienpopulationen, Interventionen, Outcomes oder Studiendesigns resultieren. Die Qualitative Comparative Analysis (QCA) zielt darauf ab, Bedingungen oder Kombinationen von Bedingungen zu identifizieren, die zu einem spezifischen Outcome führen, und kann ein geeignetes Instrument sein, mit Heterogenität und Komplexität umzugehen.
Ziel: Unser Ziel ist, die Lessons Learned aus der Anwendung der QCA in einem systematischen Review über Technologie-basierte Beratung bei Demenz zu beschreiben.
Methoden: Die formulierten Lessons Learned basieren auf den Reflexionen und Diskussionen der Mitglieder des Forschungsteams über die Herausforderungen und Probleme, die bei der Umsetzung der ersten Schritte der QCA aufgetreten sind. Da die QCA unvollendet blieb, wird ein kurzer Überblick über Aspekte gegeben, die bei der Anwendung der QCA-Methodik für die Datensynthese im Rahmen eines systematischen Reviews zu berücksichtigen sind.

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Ergebnisse: Die Lessons Learned umfassen die Bedeutung klarer Einschlusskriterien, welche die Kernelemente der Interventionen repräsentieren, sowie die Notwendigkeit eines konsistenten Datensets auf der Grundlage einer angemessenen Berichterstattung und geeigneter Publikationen. Zudem empfehlen wir die Umsetzung eines multiperspektivischen Ansatzes, der sowohl theoretisches als auch praktisches Wissen integriert.

Schlussfolgerungen: Die QCA kann zu einem erhöhten Erkenntnisgewinn in systematischen Reviews beitragen, indem sie die Komplexität von Interventionen und Kontexten erfasst. Ein angemessener Datensatz ist notwendig, um systematische Vergleiche zu ermöglichen. Um dies zu erreichen, ist es erforderlich, dass die Richtlinien für die Entwicklung, Implementierung und Evaluation von komplexen Interventionen und für die Berichterstattung umgesetzt werden.

Background

Synthesising data from studies assessing complex interventions may be challenging due to the heterogeneity of populations, interventions, comparisons and outcomes, study designs, and the interactions between components of interventions and/or systems [1]. There are different methodological approaches to overcome these challenges in synthesising evidence on complex interventions [2].

Qualitative Comparative Analysis (QCA) was introduced by Charles Ragin in 1987 as a comparative method in social sciences [3] and has been applied for data synthesis in health services research during the last decade [4-9]. By adopting a complex system perspective [1], QCA aims to identify configurations of conditions that lead to a specific outcome [5].

Due to its ability to capture causal complexity, we considered QCA as an appropriate approach for identifying sufficient and necessary conditions of a successful implementation of complex interventions [10]. Necessary conditions are always present when the outcome occurs. In other words, the outcome does not occur if the necessary condition is not present. Necessary conditions can therefore be used to explain failure [10]. Whenever a sufficient condition is present, the outcome occurs; however, the outcome can also occur without the sufficient condition. Therefore, sufficient conditions can be used to explain success [10]. Causal complexity comprises the concepts of conjunctural causation, equifinality, and causal asymmetry [10]. While the concept of conjunctural causation means that combinations of conditions may produce the outcome, 'equifinality' describes that multiple pathways may lead to the same outcome. 'Causal asymmetry' illustrates that the presence and the absence of the outcome may require different explanations [10].

Based on set theory, the QCA's central approach is "comparing wholes as configurations of parts" to "link configurations of causally relevant conditions to outcomes" [11]. Within a systematic review, we focused on the implementation success of technology-based counselling interventions in dementia care [12–14]. Defined as a conversational therapy delivered by a trained therapist via information technology to help people with dementia and their informal carers cope with the impact of the disease [12], technology-based counselling qualifies as a complex intervention in accordance with the definition of the revised UK Medical Research Council guidance [15].

In our review, technology-based counselling interventions for people with dementia and their informal carers ('cases') were to be compared in order to identify features of interventions or contextual characteristics ('conditions') which are aligned with a successful implementation ('outcome').

Methods

The lessons learned presented here are derived from research team members' discussion along the process of applying initial steps of the QCA and from the reflections on the challenges and problems encountered. Since the calibration of the data sets could not be completed, aspects to be considered when using QCA methodology for data synthesis within a systematic review are discussed. Detailed methodological procedures of the systematic review were described in the protocol [12]. In the following sections, we initially describe the QCA research cycle [10] and then outline our approach based on the first steps of this research process.

QCA research cycle

Figure 1 displays the QCA research cycle as described by Mello 2021 [10]. QCA starts with the research interest or problem, leading to the formulation of a research question using the specific terminology of the methodological approach [10]. The next step is to identify a theoretical framework, because "[p]otential answers for the research question are found in theory, whether as broad conjectures or as formal hypotheses" [10]. Cases are the 'unit of analysis' listed in rows in the QCA data sheet. There are different ways to select cases, e.g., performing a purposeful selection of cases, including a given population, or selecting cases based on scope conditions [10]. The selection of conditions is informed by theory and this may contribute to fulfil two essential aspects of this step: all important conditions are included and a justification of their selection is provided [10]. Calibrating sets is the process in which "set membership scores are derived from empirical and conceptual knowledge" [16]. Raw data is translated into set membership scores by assigning a numerical value to quantitative or qualitative data extracted from included publications. There are different approaches to calibration: In crisp set QCA, membership is seen as dichotomous, "where 1 indicated the presence of a condition and 0 indicated its absence" [10]. In our review, this would mean that a case is successfully implemented (assigning value 1 for full membership in the set 'successfully implemented intervention') or not successfully implemented (set membership score 0). In fuzzy set QCA, graded membership scores with a value between 0 and 1 can be assigned to illustrate partial implementation success. The basis of the analysis is the truth table, which shows the distribution of cases in rows of possible combinations of conditions (a truth table of a QCA analysing three conditions comprises therefore eight rows). In the next step, necessity and sufficiency are analysed, and finally, the results are interpreted against the background of the theoretical approach.

Research interest, research question and theory

Our research interest was based on previous research focusing on technology-based counselling interventions for people with dementia and their informal carers [12]. In addition to evaluating the effectiveness of counselling interventions, we aimed to identify conditions that are aligned with the successful implementation of

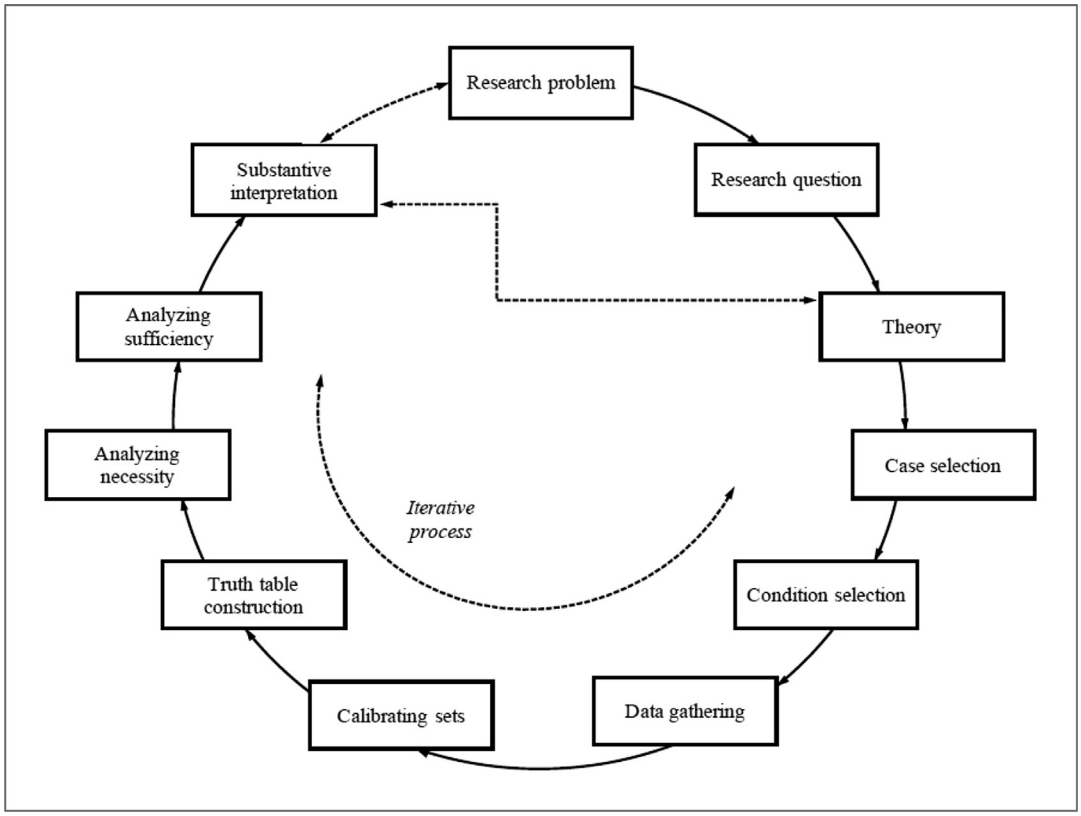

Figure 1. QCA research cycle [[10], p. 5; figure reprinted with kind permission from P. A. Mello].

these interventions. Following the QCA terminology, we considered interventions as 'cases' and characteristics of interventions or contexts as 'conditions'. The outcome to be examined is 'successful implementation'. Therefore, our research question was defined as: What are necessary or sufficient conditions that are aligned with successful implementation of technology-based counselling interventions in dementia? [12].

Implementation is defined as "deliberate efforts to increase impact and uptake of successfully tested health innovations" [15]. To assess the effectiveness of implementation efforts and the extent to which the cases are successfully implemented, we applied the Conceptual Framework for Implementation Outcomes [17]. Conceptualising 'implementation success' within this framework, Proctor et al. propose the eight outcomes acceptability, adoption, appropriateness, feasibility, fidelity, implementation cost, penetration, and sustainability [17], which we used to operationalise the outcome 'successful implementation'. Acceptability, adoption, appropriateness, feasibility, fidelity, implementation cost, penetration, and sustainability were regarded as indicators representing the degree of 'implementation success' that were to be aggregated into one outcome during the process of calibration. This approach was discussed in detail with an expert in the field of dementia counselling. We conducted a workshop and consulted a Dementia Care Nurse (DCN) [18] to enhance research group members' understanding of implementation success and to frame the theoretical approach from a practical perspective.

Case selection, condition selection, and data gathering

We applied criteria from the Template for Intervention Description and Replication (TIDieR) checklist [19] and from the revised Criteria for Reporting the Development and Evaluation of Complex Interventions (CReDECI 2) guideline [20] to extract data on potential conditions such as mode of delivery (technology used for counselling), theoretical underpinning, intervention components and reasons for their selection as well as provider (discipline and qualification), dosage (duration, frequency, and period) and procedures/materials for delivering counselling.

We also extracted data on 'implementation success' using the outcomes acceptability, adoption, appropriateness, feasibility, fidelity, implementation cost, penetration, and sustainability as categories [17].

Calibrating sets

To assess the degree to which the interventions were implemented successfully, we planned to calibrate data on each of the eight outcomes separately and to create a sum score, thereby applying a fuzzy set approach as described above [10,16]. This approach was based on the procedures described by Harris et al., who measured implementation success of school-based self-management interventions for asthma in children and adolescents by reviewing reports of attrition, intervention dosage, and treatment adherence [8]. Since we did not find a consistent database, we were unable to finalise the calibration, so that the procedure cannot be described in more detail.

Results and discussion

Requirements for conducting a QCA are the presence of a certain number of cases and their comparability [10]. By including 52 publications reporting on 27 technology-based counselling interventions in dementia [14], we identified a considerable number of interventions.

As we included individualised counselling interventions provided remotely by professionals (for detailed inclusion criteria please refer to [12]), interventions were heterogenous. We made no specifications on information technology used to deliver coun-

selling, so that the included cases depict the evolution of technology-based counselling over time: We found long-established telephone helplines sometimes complemented by e-mail or chat services, counselling provided via videoconferencing, or as part of a web-based psychosocial intervention comprising information, communication, and counselling. In addition, counselling was provided as a part of multicomponent programmes combining day care for people with dementia with remote counselling for informal carers [14]. To fulfil the criterion of comparability of the n = 27 cases, we rigorously applied the eligibility criteria throughout the study selection process. Cases in question were intensively discussed within the research team. For instance, we considered flexibility of services and counselling tailored to individual needs as central components, and excluded standardised and structured programmes. Therefore, the inclusion of interventions using predefined procedures but adapted the content of counselling sessions to individual needs was debated. Due to in-depth discussions of components and core elements, we were able to ensure that a common understanding of the interventions was established and that the core elements were consistent across cases.

Our **first lesson learned** is therefore to recognise the importance of clear eligibility criteria representing the core elements of interventions to be included as cases in QCA. In order to obtain an overview of the number of eligible cases, it may be necessary to conduct a scoping review in preparation for the QCA.

The presence of comparable data is another requirement for performing a QCA. The focus and design of studies included in our review varied widely, as did the type of publications. We found randomised controlled trials, studies applying a quantitative descriptive, qualitative, or case study design, as well as studies following a mixed-methods approach. Process evaluation studies focusing on implementation issues have only been conducted in two cases. The openness to both qualitative and quantitative data is considered a major advantage of the QCA approach [10] and its usefulness to integrate qualitative and quantitative evidence in the context of systematic reviews has been acknowledged [6,7,21]. By including a variety of study designs and different types of publications such as case reports or letters to editor, we intended to create a comprehensive dataset that allows various conditions to be identified. This approach, however, resulted in a heterogeneous and inconsistent dataset, impeding our ability to assess implementation success equally across interventions. We found information on 'appropriateness' for all cases (n = 27) and on 'acceptability' for n = 20 cases. In contrast to the amount of information found for these two categories, data on 'sustainability' and on 'feasibility' were provided for n = 13 cases each. While information on 'adoption' and on 'penetration' were reported for n = 12 and n = 11 interventions, respectively, details on 'fidelity' (n = 9) and 'implementation cost' (n = 3) were largely missing.

As described above, we were guided by the approach of Harris et al. [8] who used three outcomes to operationalise implementation success. The question arose as to whether a QCA exploring the conditions of a successful implementation of technology-based counselling could be conducted with the indicators for which a satisfactory amount of data was available ('acceptability' and 'appropriateness'). Due to the conceptual similarity of 'acceptability' and 'appropriateness' as well as an overlapping terminology used in literature, as pointed out by Proctor et al. [17], relevant dimensions of the concept of 'implementation success' would have been left out by a QCA performed with only these two indicators. In addition to the varying number of cases for which data were reported, the scope and comprehensiveness of information varied greatly. A detailed synthesis of data found on categories is provided elsewhere [14]. Due to varying detailedness or missing data, we were not able to assign consistent set membership scores. For example, the phrase "All participants (...) had a positive and satisfying experience with the platform" [22] suggests a high degree of acceptability and would result in a high calibration score (full membership in the set of 'acceptable intervention'). In contrast, the more detailed information "Participants who had used the e-mail support felt they could express themselves freely and relieve their stress in e-mails. (...) Some felt that writing in English did not allow them to express themselves fully." [23] indicates limitations in acceptability and therefore would lead to a (slightly) decreased calibration score. Although both cases would qualitatively belong to the set 'acceptable intervention', a differentiated assessment of fuzzy set scores would have been impaired by missing or limited data. Consequently, more comprehensive reporting, which in contrast to general statements also reflects limitations and shortcomings, would have resulted in lower scores for acceptability.

Thus, the **second lesson learned** is to ensure a consistent dataset based on sufficient reporting and suitable type of publications. Harris et al. [8] exclusively focused on process evaluation studies to identify intervention components and processes that are aligned with successful intervention implementation. Although this approach ensures a consistent dataset, it may have a limiting impact on the use of the QCA in systematic reviews, considering the number of process evaluations (n = 2) of 52 included publications in the present review. The extent to which QCA can be successfully applied in systematic reviews depends on the willingness of researchers to follow pertinent frameworks of research on complex interventions and on the quality of reporting. Some gaps in the dataset may be filled through author requests, but this method is not suitable for extensive missing data. As described in the first lesson learned, conducting a scoping review in advance could provide information on the quality of available data and determine whether QCA is feasible in the specific context.

QCA as an analytic approach "comprises a set of strategies and techniques that both bridge and transcend the qualitative-quantitative divide in social research" [11]. The use of the QCA methodology in combination with methods evaluating the effectiveness of interventions is considered valuable [6] as the QCA explores the conditions aligned with effectiveness or ineffectiveness [5]. In order to prepare for the conduct of the QCA, we had a two-day workshop held by an experienced researcher to familiarise the research team with the methodology. This methodologist was available to answer any questions that arose during the research process. In addition, we used a worked example [7] and examples of a successful application of QCA in a systematic review [8,24,25] as well as methodological publications [6,26] to guide our research. In the course of the research process, we extensively discussed theoretical approaches and definitions of relevant terms in team meetings. These discussions enabled us to establish a shared understanding of implementation success and to incorporate practical expertise. This formed a profound base for defining empirical anchors for calibrating the outcome and for identifying potential conditions, which would have been our next steps. Therefore, the **third lesson learned** comprises the recommendation to take a multi-perspective view by integrating theoretical and practical knowledge and to invest efforts and time in establishing a shared understanding within the research team, which is essential to deal with the complexities of interventions and contexts.

Conclusions

QCA is a method for data synthesis with the potential to increase the knowledge gain in systematic reviews by capturing the complexity of interventions and contexts and incorporating theoretical concepts and practical expertise. To identify combinations of components and contextual characteristics of complex interventions that lead to a specific outcome may help decision

makers to implement effective intervention programmes. However, for applying QCA in a systematic review, researchers rely on data provided in reports of empirical research. A sufficient dataset with an adequate number of studies and detailed descriptions of interventions and contexts in order to allow systematic comparison is needed. If this precondition is not met, QCA cannot be applied as in this case. To fulfil this requirement, empirical researchers should adhere to frameworks guiding the development, implementation, and evaluation of complex interventions as well as to reporting guidelines for research on these interventions.

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Conflict of interest

The authors declare that they have no competing interests.

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