Innovation in Aging, 2025, **9**, igae109
https://doi.org/10.1093/geroni/igae109
Advance access publication: 13 December 2024
Original Research Article

Development of a Complex Intervention for Promoting Participation in Resistance Exercise Among Community-Dwelling Frail Older Adults in China: A Multimethod Qualitative Study

Xuemei Sun, PhD,[1] Wenqi Liu, BS,[2] Lingqi Li, BS,[2] Jinlu Song, BS,[2] Yinyan Gao, MS,[2] Weiru Zhang, PhD,[1] and Irene X.Y. Wu, PhD,[2,3,*]

[1]Department of General Medicine, Xiangya Hospital, Central South University, Changsha, Hunan, China.
[2]Xiangya School of Public Health, Central South University, Changsha, Hunan, China.
[3]Hunan Provincial Key Laboratory of Clinical Epidemiology, Changsha, Hunan, China.

*Address correspondence to: Irene X.Y. Wu, PhD. E-mail: irenexywu@csu.edu.cn

Decision Editor: Steven M. Albert, PhD, MS, FGSA

Abstract

Background and Objectives: Regular resistance exercise (RE) showed a promising effect in reducing frailty in older adults. However, the participation of RE among this population remains low. This study was, therefore, aimed at developing a complex intervention tailored to community-dwelling frail older adults in China to promote participation in RE and reduce frailty ultimately.

Research Design and Methods: Using a multimethods qualitative study design, this study included 2 parts: (1) a qualitative study was performed to explore barriers and facilitators for participation in RE among frail older adults through stakeholder interviews. The interview was guided by the comprehensive framework of implementation research; (2) two rounds of expert consultation, guided by the social cognitive theory, were conducted to identify the key barriers and facilitators, and corresponding implementation strategies for promoting participation in RE. A complex intervention was developed accordingly.

Results: Interviews were conducted with 16 frail older adults (mean age = 72.9) and 10 community workers (mean working years = 11.2). A total of 10 barriers and 16 facilitators were identified; safety concerns, decline in physical function, and lack of knowledge were frequently mentioned barriers, while health needs, social support, and professional guidance were common facilitators. Then 10 experts (mean working years = 20.9) were consulted to determine the main barriers and facilitators, and a list of corresponding implementation strategies was developed subsequently. Thus, a tailored complex intervention delivered by community workers in the community setting, including the core component of "group elastic-band RE," and supplementary components of "community education, feedback, goal setting, and reinforcement guidance" was developed.

Discussion and Implications: This study constructed a list of key barriers and facilitators as well as corresponding implementation strategies for promoting participation in RE among community-dwelling frail older adults. A tailored complex intervention was developed accordingly, which will facilitate the management of frail older adults in the Chinese community setting.

Keywords: Barriers and facilitators, Complex intervention, Frailty, Social cognitive theory

Translational Significance: There exists a gap between research evidence and the real world in frailty management among older adults. By employing a theoretical framework and engaging multiple stakeholders through a systematic process, this study successfully identified barriers and facilitators, and corresponding implementation strategies for the participation in RE among community-dwelling frail older adults in China. Subsequently, a tailored complex intervention was developed accordingly. This study will facilitate the management of frail older adults in the community setting in China, and bridge the existing gap between research evidence and real-world practice in frailty management.

Background and Objectives

Frailty is a complex age-related condition characterized by a decline in physiological capacity across multiple organ systems, and contributes to increased vulnerability to stress (Dent et al., 2019). Frailty is prevalent in the older population, with the prevalence of frailty and pre-frailty in community-dwelling older adults at 12% and 46% worldwide, respectively (O'Caoimh et al., 2021). The corresponding prevalences are reported as 13% and 45% in China (Tian et al., 2019). Moreover, frailty is often overlooked and consequently leads

Received: June 4 2024; Editorial Decision Date: November 27 2024.

to a series of adverse outcomes, such as falls, dementia, disability, hospitalization, diminished quality of life, mortality, and increased healthcare burden (Hoogendijk et al., 2019).

Frailty, on the other hand, is a dynamic condition that can be prevented, delayed, and even reversed through effective interventions (Hoogendijk et al., 2019). Currently, non-pharmacological interventions are considered as the |primary options for managing frailty (Izquierdo et al., 2021). Our team previously conducted a network meta-analysis that demonstrated that resistance exercise (RE) is the most effective one among non-pharmacological interventions (Sun et al., 2023). The World Health Organization and Physical Activity Guidelines for Chinese both recommend that older adults should participate in RE at least two times per week (Bull et al., 2020; Chen & Zhao, 2022). However, a gap between research evidence and real-world practice in frailty management among older adults exists. Despite its promising effects, the proportion of older adults engaging in the recommended levels of RE remains low in the community, with less than 15% of community-dwelling older adults meeting the recommended levels of RE (Burton et al., 2017; Garcia-Hermoso et al., 2023). Although there are not yet studies that specifically focus on this proportion of frail older adults in China, the study expects it to be even lower (Wang et al., 2022). As a result, intervention strategies aimed at increasing participation in RE among frail older adults are needed to bridge the gap between research evidence and real-world practice.

Translating research evidence into real-world practice is formidable (Berwick, 2003). Understanding the barriers and facilitators and developing targeted implementation strategies to address the barriers and capitalize on the facilitators is a crucial step (Kirk et al., 2016). Complex interventions allow for the design of interventions that synthesize barriers and facilitators to implementation, integrating multiple intervention components such as research evidence and implementation strategies, and are particularly suitable for addressing multifaceted barriers to the implementation of research evidence and facilitating the translation of research evidence into real-world practice.

Hence, this study aims to investigate the key barriers and facilitators as well as corresponding implementation strategies for participation in RE among community-dwelling frail older adults in China. Based on these findings, intervention components were selected and a tailored complex intervention was developed to promote participation in RE and reduce frailty.

Research Design and Methods

This study consisted of two parts: (1) to understand the barriers, facilitators, and preferences for participation in RE among community-dwelling frail older adults using qualitative study and (2) to develop a complex intervention to promote RE participation among community-dwelling frail older adults through expert consultation. The whole procedure is shown in Figure 1. The study was reviewed and approved by the ethical committees of Xiangya School of Public Health, Central South University, China [no. XYGW-2021-56], and informed consent was obtained from all participants before the interviews and expert consultation.

Part 1. Investigating the Barriers, Facilitators, and Preferences for Participation in RE

In this part, qualitative methods were used to investigate the barriers, facilitators, and preferences for participation in RE for community-dwelling frail older adults. The results of this part were reported by following the consolidated criteria for reporting qualitative research (Buus & Perron, 2020).

Participants

A purposive sampling method (Moser & Korstjens, 2018) was used to select stakeholders (including older adults and community workers) as interviewees in the community of Changsha, Hunan, China. The sample size was determined based on the principle of data saturation; interviews concluded when the information provided by participants became repetitive and no new themes emerged during data analysis. Eligibility criteria for older adults were: (i) ≥60 years

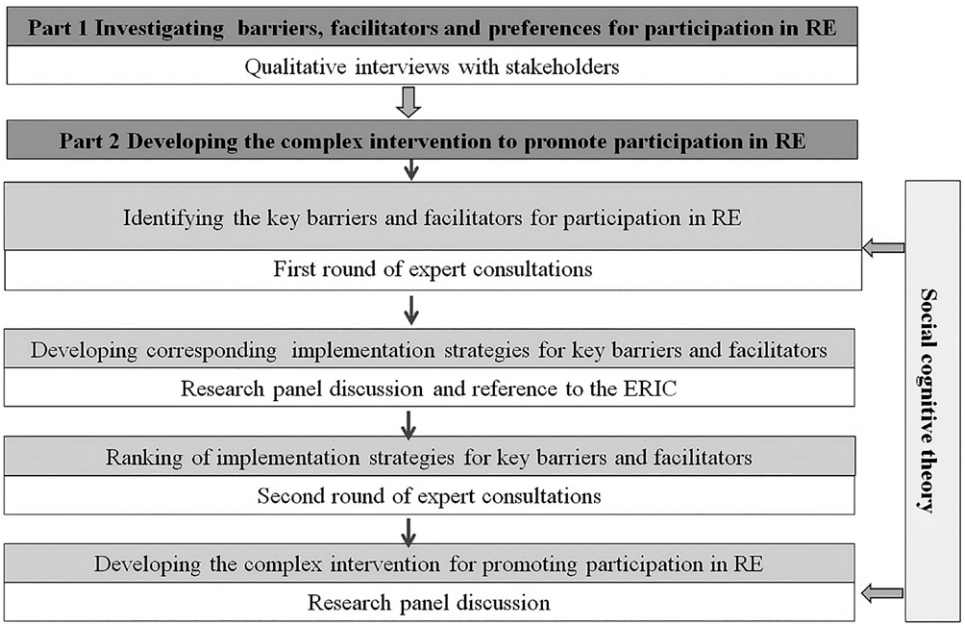

Figure 1. Procedure for developing the complex intervention. ERIC = expert recommendations for implementing change; RE = resistance exercise.

old; (ii) Fried frailty phenotype score ≥1 (Fried et al., 2001); (iii) absence of severe heart, brain, and psychiatric disorders; and (iv) willingness to participate in this study. Eligibility criteria for community workers were: (i) engaged in geriatric services or management in community health centers for at least 1 year; and (ii) willingness to participate in this study.

Interview content

Guided by four selected domains from the Consolidated Framework for Implementation Research (CFIR; Damschroder et al., 2009, 2022), including innovation, outer setting, inner setting, and individual domain, separate interview guides were developed for older adults (innovation recipients) and community workers (innovation deliverers). This study was conducted before the implementation of the innovation, so the process domain of CFIR was not included. Before the formal interviews, pilot interviews were conducted with one community-dwelling older adult and one postgraduate student with community work experience. The interview guides were then refined based on the findings of the pilot interviews. The interview content focused on: (i) innovation, such as the relative advantages and cost of RE; (ii) outer setting, such as key events and external pressures that influence older adults to participate in RE; (iii) inner setting, such as available resources and incentives for older adults to participate in RE; (iv) individuals, including the needs and abilities of older adults to participate in RE; (v) preferences for participation in RE of older adults, such as the types, time, and sites for participating in RE; and (vi) basic information about the interviewees, such as gender, age, and education. The details of the interview guides are shown in Supplementary Material Section S1.

Data collection

Before the interview, an interview invitation for the interview was sent to the participants via personal social media or in person. For those who agreed to participate, further confirmation regarding the interview time, method of approach, and setting was made. Semi-structured interviews were then conducted either via phone or in person. The interviews were performed in a quiet and private room by a researcher with a postgraduate degree and qualitative interview expertise. The purpose and process of the interview were explained to the participants, along with a promise to keep all individual information confidential. RE was explained with details and photos of RE demonstrations were provided during the interviews for clear clarification (Supplementary Material Section S1). Audio recordings and handwritten notes were used to document the interviews. A neutral stance was maintained, without asking leading questions, while encouraging the interviewees to fully express their views.

Data analysis

The audio recordings were transcribed verbatim within 24 hr after each interview. During the transcription process, the researcher meticulously reviewed and proofread the transcripts while repeatedly listening to the audio recordings. Data analysis was conducted using NVivo 12.0 software, guided by the CFIR framework (Damschroder et al., 2022; Dhakal, 2022).

First, a codebook was developed based on the CFIR framework. Second, the transcripts were coded by assigning one or more categories to each meaningful statement. Third, each category was rated as "−" (barrier), "0" (neutral), or "+" (facilitator) based on the nature of the statements. Last, proportions of "−," "0," and "+" with each category were calculated, and the "majority rule" (the category with the highest proportion was graded as the final rating for that category) was applied to determine the final rating of each category as a facilitator, neutral, or barrier (Damschroder & Lowery, 2013; Zanoni et al., 2021).

Data analysis was independently conducted by two researchers, with a third researcher being consulted for any disputed content to reach a consensus. As a result, a list of barriers and facilitators for participation in RE among community-dwelling frail older adults was formed.

Part 2. Developing the Complex Intervention to Promote Participation in RE

In this part, two rounds of expert consultations were conducted based on social cognitive theory (SCT; Bandura, 2001). The objective was to identify the key barriers, facilitators, and preferences for participation in RE among community-dwelling frail older adults and corresponding implementation strategies. Based on the results, intervention components were selected, and a complex intervention was developed accordingly. Results from this part were reported by following the standards for conducting and reporting Delphi studies (CREDES; Jünger et al., 2017).

Participants

First, a research panel was established to prepare expert inquiry forms, organize and analyze consultation results, and determine the final complex intervention through discussion. The research panel consisted of one professor and five postgraduate students in relevant research areas. Second, selection of experts, 10 experts in the fields of nursing, clinical, community management, and implementation science were selected for consultation using purposive sampling (de Villiers et al., 2005). Eligibility criteria for experts were: (i) engaged in relevant fieldwork for ≥10 years; (ii) familiar with geriatric health management; and (iii) willingness to participate in this study.

Research processes

Identifying the key barriers and facilitators for participation in RE

Based on the results of the first part, an expert consultation questionnaire was designed for the first round of expert consultations to identify the key barriers and facilitators for participation in RE. The expert consultation questionnaire consists of four parts: (i) introduction: including the background, objectives, and requirements; (ii) evaluation of the importance of the barriers and facilitators for participation in RE and the feasibility of using according strategies, with a Likert 5-point scale ranging from "strongly disagree" to "strongly agree"; (iii) identification of additional barriers and facilitators for participating in RE that should be considered, along with any other recommendations; and (iv) basic information of the expert, experts' familiarity, and judgment justifications (Li et al., 2014).

The level of expert consensus on each barrier and facilitator was calculated. Consensus was considered to be achieved if the agreement (agree + strongly agree) was higher than 70% and the disagreement (disagree + strongly disagree) was lower than 15%. Barriers and facilitators with consensus

were identified as key barriers or facilitators (Jebara et al., 2020) to form a list of key barriers and facilitators.

Developing corresponding implementation strategies for key barriers and facilitators

A systematic review was performed by our team while we were developing the complex intervention to identify existing intervention components for promoting physical activity participation among older adults based on SCT (the systematic review is in preparation for publication). The key information on the intervention components identified through the systematic review (e.g., country, setting, target population, intervention dosage, effectiveness of the intervention, and applicability to the community in China) is presented in Supplementary Table S1. The results showed that most of the existing intervention components are applicable to older adults in the community setting in China and have promising intervention effectiveness. Based on the results of the systematic review, a list of corresponding implementation strategies for the key barriers and facilitators was developed through a research panel discussion and reference to the Expert Recommendations for Implementing Change (ERIC; Powell et al., 2015).

Ranking of implementation strategies for key barriers and facilitators

A second round of expert consultation was conducted to rank the implementation strategies for key barriers and facilitators. The importance and feasibility of implementation strategies were evaluated using the same method as the first round. Mean values and standard deviations of the importance, feasibility, and synthesis of each implementation strategy were calculated. Implementation strategies were ranked based on their mean values. If the means were equal, the one with a smaller standard deviation was prioritized (Kernan et al., 2023; Perry et al., 2017), thus forming a ranking list of implementation strategies.

Developing the complex intervention for promoting participation in RE

Based on the preferences of older adults and the ranking list of implementation strategies, the research panel selected intervention components from three dimensions of SCT (individual, environmental, and behavioral factors; Young et al., 2014), and developed the complex intervention accordingly.

The reliability of experts

The reliability of experts was assessed with two indicators: (i) expert positivity coefficient, measured with the response rate (%) of the experts. A response rate >70% was considered as good (Keeney et al., 2001); (ii) expert authority coefficient, calculated as the mean value of experts' familiarity and judgment justifications coefficient. An expert authority coefficient ≥0.7 was considered as good (Wang & Qin, 2011). Data analysis was conducted using SPSS 23.0.

Results

Part 1. Investigating Barriers, Facilitators, and Preferences for Participation in RE

A total of 26 participants were interviewed for this study, including 16 older adults (all in person) and 10 community workers (seven in person and three via telephone), coded as L1 to L16 and G1 to G10, respectively. The interview duration ranged from 15 to 40 min. The frail older adults included 6 (37.5%) males and 10 (62.5%) females, aged between 60 and 88 years, with an average age of 72.9 ± 8.8 years, more than half (62.5%) had a middle school education and below. The community workers included 3 (30.0%) males and 7 (70.0%) females, with a mean working year of 11.2 ± 6.8 (2–21 years), half of whom worked more than 10 years, and more than half (60.0%) had a bachelor's education and above. The basic characteristics of the interviewees are shown in Supplementary Table S2.

Barriers and facilitators for participation in RE

A total of 29 influencing factors for participation in RE among community-dwelling frail older adults were identified, including 10 barriers, 16 facilitators, and three neutrals. Safety concerns, decline in physical function, lack of time, lack of knowledge, and lack of available equipment were frequently mentioned barriers, while health needs, adequate available sites, mass media education, social support, and professional guidance were common facilitators. Further details can be found in Tables 1 and 2 and Supplementary Tables S3 and S4.

Preferences for participation in RE

If the community organizes RE activities, 12 (75.0%) of the 16 older adults expressed their willingness to participate. The preferences of older adults' participation in RE are shown in Supplementary Table S5. A majority of older adults prefer to participate in group-based RE using elastic bands in community activity rooms.

Part 2. Developing the Complex Intervention to Promote Participation in RE

The experts included 1 (10.0%) male and 9 (90.0%) females, with a mean working year of 20.9 ± 10.8 (12–45 years) half of them worked more than 20 years, and half of them with a doctoral degree. The basic characteristics of the 10 experts are shown in Supplementary Table S6. In two rounds of expert consultations, all 10 experts provided valid feedback, resulting in a response rate of 100% for both rounds of consultation, indicating good expert positivity. Good expert authority was reached as the expert authority coefficients for the two rounds of expert consultations were 0.90 and 0.89, respectively (Supplementary Table S7).

Key barriers and facilitators for participation in RE

In the first round of expert consultation, a total of 5 barriers and 12 facilitators met the criteria for consensus and were identified as the key barriers and facilitators. Key barriers included safety concerns, difficulty in long-term persistence, lack of community organization, lack of community education, and lack of knowledge. Key facilitators included supported by high-quality evidence, advantages and benefits, flexibly adaptable exercise plan, incentives, mass media education, exercise atmosphere, organized by specialists, professional guidance, health needs, self-efficacy, social support, and interest. The majority (12/15, 70.6%) of barriers and facilitators were relevant to the intervention deliverer. More details are presented in Table 3 and Supplementary Table S8.

Corresponding implementation strategies for the key barriers and facilitators

The implementation strategies corresponding to the key barriers and facilitators for participation in RE in the community

Table 1. Barriers for Participation in Resistance Exercise

Theme	Subtheme	Illustrative quote	Relevant roles
Innovation domain			
Complexity	Safety concerns	L14: "Being older, I am afraid of falling or fractures, if I do, it would be a problem." G7: "There is a possibility of muscle strain or other injuries, such as fractures or falls."	Recipients and deliverers
	Complexity of movements	G10: "The movements of resistance exercise would be somewhat difficult for older adults, and if they do not master them well, it might not be effective."	Recipients
	Difficulty in long-term persistence	G9: "Resistance exercise is a long-term process that can only benefit from persistence over time. Its effectiveness is not always immediate, and the results cannot be seen in one or two days, so it may influence older adults' motivation and adherence."	Recipients
Inner setting domain			
Relative priority	Lack of community organization	G6: "At present, our activities for older adults are all related to the National Basic Public Health Service Program, such as the prevention of hypertension, diabetes, and infectious diseases. There are very few activities aimed at physical activity, and usually add a few statements in the lectures, and even fewer involving resistance exercise."	Deliverers
Available resources	Lack of available equipment	G2: "Every community usually has some kind of equipment that allows for resistance exercise, but few older adults use them, and many of them are broken and not repaired anymore."	Deliverers
Access to Knowledge and Information	Lack of community education	L10: "I have not received any education from the community on this subject." G4: "The activities in this area are fewer because, in the past few years, we have been engaged in epidemic prevention and other daily affairs, the workload is indeed more than enough, and no activities have been organized for this area."	Deliverers
Individuals domain			
Capability	Decline in physical function	L2: "I can't exercise for too long, I have some heart problems … I also have lumbar herniated discs and cannot bend down easily, it limits my exercise a lot. In addition, I also have osteoarthritis of the knee, which also limits my exercise." G8: "Many of older adults in our community are not particularly healthy, and many have underlying diseases such as diabetes, hypertension, and heart disease. They are not suitable for participating in this kind of heavy exercise."	Recipients
	Lack of knowledge	L11: "Doing housework is also a form of exercise, because I am constantly moving, right?" L6: "If you start doing this kind of exercise from your thirties or forties and keep doing it, it's okay. But for us, it's not suitable, it's too tiring." L5: "I just do my exercise, as long as I am happy, it's fine. I don't know or care about meeting exercise quotas or doing the movements correctly."	Recipients
	Lack of experience	L14: "I have never been exposed to resistance training before, and I am not used to this type of exercise now."	Recipients
Opportunity	Lack of time	L11: "I am not participating in any physical exercise anymore, I am just doing housework and taking care of my grandchildren. I don't have time, how can I have time?"	Recipients

setting are presented in Table 3, with the details of intervention content presented in Supplementary Table S9. Regarding the ranking of implementation strategies, peer accompaniment, physical assessment, appropriate intervention plans, community education, and setting up exercise groups were deemed of high importance and feasibility, which could be prioritized in the development of the complex intervention. Moreover, feedback, goal setting, and professional guidance with higher synthesized rankings could also be considered (Table 4). The individuals relevant to implementation strategies are community workers (intervention deliverers) and frail older adults (intervention recipients). For "appropriate exercise plans" and "professional guidance," community workers may need assistance from other professionals (like exercise coaches or exercise experts) when necessary, and the remaining components of the implementation strategies could be implemented with simple training in the Chinese community setting.

The complex intervention for promoting participation in RE

According to the synthesized ranking of implementation strategies, group RE with appropriate intervention plans was selected as the core component of the complex intervention. Additionally, under the guidance of the SCT, community education, goal setting, feedback, and reinforcement guidance ("reinforcement guidance" was used here instead of "professional guidance" to differentiate from the exercise

Table 2. Facilitators for Participation in Resistance Exercise

Theme	Subtheme	Illustrative quote	Relevant roles
Innovation domain			
Evidence-base	Supported by high-quality evidence	G2: "Resistance exercise should be effective and be able to stand up to everyone's practice. If the older adult does not feel the effectiveness, he will not find the point to persist with it."	Deliverers
Relative advantage	Advantages and benefits	G5: "It is more targeted, and its intensity is greater than activities such as walking." G9: "It can more effectively improve muscle strength, endurance and balance."	Deliverers
Adaptability	Flexibly adaptable exercise plan	G3: "If there are some exercises designed specifically for older adults, simpler and suitable for them, they will be more easily accepted."	Deliverers
Outer setting domain			
Financing	Financial support	G10: "Investment is needed, there must be financial support to accomplish a series of things."	Deliverers
External pressure	Social pressure (advocacy)	G9: "Promotion is necessary, and it is effective, just like advertising. The more promotion there is, the more people will hear about it, and the more people will participate."	Deliverers
Inner setting domain			
Incentive systems	Incentives	G6: "To encourage older adults to participate more actively in exercise, a reward mechanism is important. This can be done by offering small gifts and implementing a 'check-in' system, where the longer they adhere, the bigger the reward they receive."	Deliverers
Available resources	Adequate available sites	G7: "Generally, there are some open sites in the community, although not very large. Additionally, communities have older adults activity rooms."	Deliverers
Access to knowledge and Information	Mass media education	G7: "With the advancement of the internet and the widespread use of smartphones, older adults can easily access the knowledge and information they need online."	Deliverers
Implementation climate	Exercise atmosphere	L11: "The atmosphere is important. If there is a small group, the atmosphere is different, and everyone will be happier and more willing to participate."	Recipients and deliverers
Individuals domain			
Implementation leads	Organized by specialists	G1: This kind of activity requires someone to organize it and conduct it regularly during fixed periods. Many older adults will come to participate.	Deliverers
Implementation facilitators	Professional guidance	G3: Older adults need scientific and professional guidance for resistance exercise. Without professional guidance, they may not control their strength well, which can cause injury and may not achieve good results.	Deliverers
Need	Health needs	L2: This type of exercise not only makes you feel better, but it is better. Look at me now, I'm 80 years old and I can still lift a 20 kg bag of rice. My body is also in good condition. Exercise is beneficial for both the body and lifespan. My ultimate goal is to live independently. Living independently is the ultimate goal for every older adult. Without self-sufficiency, there is no dignity. L6: It is beneficial to both physical and mental health. It can enhance physical fitness and communication with others during exercise, which can improve mood.	Recipients
Capability	Self-efficacy	L7: I know these various activities are meant to strengthen our exercise and improve our physical fitness, so I am willing to try and I can try exercises like this one.	Recipients
Opportunity	Social support	G9: It is necessary to have support at the family level. For example, some older adults may be busy taking care of their grandchildren or have other commitments. They may want to participate, but they don't have the time. L5: If someone could accompany me, I might be more willing to participate.	Recipients and deliverers
	Interest	G2: It is important to make older adults interested in resistance exercises. If they are interested, they will be more willing to accept and more likely to persist.	Recipients
	Individual identification with the organization	G3: Nowadays, older adults tend to be cautious when it comes to participating in activities. They may think you are trying to sell them something … That's why it's important to obtain the recognition of older adults.	Recipients

Table 3. List of Key Barriers and Facilitators for Participation in Resistance Exercise and Corresponding Implementation Strategies

Key barriers and facilitators	Descriptions	Relevant roles	Implementation strategies
Key barriers			
Safety concerns	Concerns and worries about the potential hazards and injuries associated with practicing resistance exercises.	Recipients and deliverers	Physical assessment; appropriate exercise plans; professional guidance
Difficulty in long-term persistence	In the process of continuing resistance exercises, individuals encounter challenges in maintaining their exercise habits due to various factors.	Recipients	Mass media education; community education; outcome expectations
Lack of knowledge	Individuals have insufficient understanding and information about resistance exercises.	Recipients	Mass media education; community education
Lack of community organization	At the community level, there is a lack of effective organization, resources, or support systems to promote and encourage participation in resistance exercises.	Deliverers	Dedicated organization
Lack of community education	There is a lack of education and promotion of knowledge and skills related to resistance exercises in the community.	Deliverers	Community education
Key facilitators			
Health needs	Individual requirements and expectations for improving or maintaining health through resistance exercises.	Recipients	Mass media education; community education; outcome expectations
Interest	Individual's curiosity, enthusiasm, or level of importance towards resistance exercise.	Recipients	Appropriate exercise plans; mass media education; community education
Advantages and benefits	The various positive effects and benefits of participating in resistance exercises.	Deliverers	Mass media education; community education
Self-efficacy	Individuals' confidence and belief in their ability to successfully participate in resistance exercises.	Recipients	Goal setting; feedback; self-monitoring
Social support	The emotional, informational, and pragmatic assistance that individuals receive from others (e.g., family, friends, community, etc.) when participating in resistance exercises.	Recipients and deliverers	Family involvement; peer accompaniment; setting up exercise groups
Professional guidance	Support and advice are provided by professionally trained coaches, fitness experts, or medical professionals.	Deliverers	Professional guidance
Supported by high-quality evidence	The effectiveness and safety of resistance exercise are supported by high-quality research and data.	Deliverers	Appropriate exercise plans
Flexibly adaptable exercise plan	The exercise plan for resistance exercises can be flexibly adjusted and changed according to individuals' needs, abilities, health conditions, and goals.	Deliverers	Appropriate exercise plans
Incentives	Rewards or factors that motivate individuals to participate in resistance exercises (e.g., money, material, or recognition, etc.).	Deliverers	Incentives
Mass media education	Using mass media (e.g., television, radio, newspapers, internet, and social media) to conduct educational promotions to enhance public awareness, attitudes, and participation in resistance exercises.	Deliverers	Mass media education
Exercise atmosphere	The environment and atmosphere in which resistance exercises are performed, including the physical environment, social dynamics, psychological state, and overall experience.	Recipients and deliverers	Setting up exercise groups
Organized by specialists	Resistance exercise programs or coaching sessions are designed and implemented by community workers, professionals, or coaches.	Deliverers	Organized by specialists

guidance provided by the intervention team during the implementation) were selected as intervention components for the complex intervention. By considering the preferences of older adults, elastic bands were selected as the exercise equipment and community activity rooms were designated as the exercise sites. Thus, a complex intervention for frail older adults in the Chinese community setting was formed, including the core component of "group elastic-band RE," and supplementary components of "community education, feedback, goal setting, reinforcement guidance," with trained community workers as the intervention deliverers. Furthermore, this complex intervention should also consider developing appropriate exercise plans, setting up an exercise group to implement the intervention, and conducting physical assessments of older adults as

Table 4. Ranking of Implementation Strategies for Key Barriers and Facilitators

Implementation strategies	Importance		Feasibility		Synthesize	
	Mean ± *SD*	Rank	Mean ± *SD*	Rank	Mean ± *SD*	Rank
Peer accompaniment	4.80 ± 0.42	1	4.70 ± 0.48	1	4.75 ± 0.44	1
Setting up exercise groups	4.70 ± 0.48	3	4.70 ± 0.48	1	4.70 ± 0.47	2
Appropriate exercise plans	4.80 ± 0.42	1	4.60 ± 0.52	3	4.70 ± 0.47	2
Feedback	4.70 ± 0.48	3	4.40 ± 0.70	7	4.55 ± 0.60	4
Community education	4.60 ± 0.70	6	4.50 ± 0.71	5	4.55 ± 0.69	5
Physical assessment	4.60 ± 0.52	5	4.40 ± 0.52	6	4.50 ± 0.51	6
Organized by specialists	4.60 ± 0.84	7	4.40 ± 0.84	8	4.50 ± 0.83	7
Professional guidance	4.40 ± 0.97	12	4.50 ± 0.53	4	4.45 ± 0.76	8
Goal setting	4.50 ± 0.53	8	4.20 ± 0.79	11	4.35 ± 0.67	9
Mass media education	4.40 ± 0.70	8	4.30 ± 0.82	9	4.35 ± 0.75	10
Family involvement	4.40 ± 0.70	10	4.20 ± 0.63	10	4.30 ± 0.66	11
Incentives	4.40 ± 0.84	11	4.10 ± 0.88	13	4.25 ± 0.85	12
Outcome expectations	4.30 ± 0.95	13	4.20 ± 1.03	12	4.25 ± 0.97	13
Self-monitoring	4.20 ± 0.63	14	3.70 ± 0.68	14	3.95 ± 0.69	14

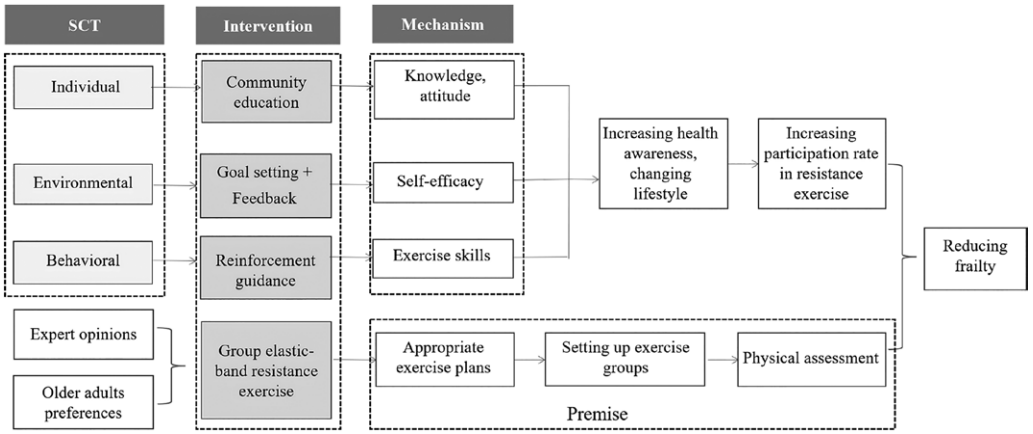

Figure 2. Intervention components and logic model of the complex intervention. SCT = Social Cognitive Theory.

premises to ensure their safety. Components and logic model of the complex intervention are presented in (Figure 2).

Discussion and Implications

To address the gap between the research evidence and real-world practice in the management of frailty, this study developed a complex intervention for community-dwelling frail older adults, guided by the SCT, through a transparent process that considered the inputs from stakeholders. A list of barriers and facilitators for participation in RE among community-dwelling frail older adults in China was identified, including key barriers (safety concerns, lack of knowledge, and lack of community organization) and key facilitators (a flexibly adaptable exercise plan, self-efficacy, social support, and professional guidance). A list of corresponding implementation strategies was developed to address the key barriers and facilitators. Consequently, a tailored complex intervention delivered by trained community workers in the Chinese community setting was developed accordingly, including the core component of "group elastic-band RE," and supplementary components of "community education, feedback, goal setting, and reinforcement guidance."

This study aims to enhance the participation of RE among community-dwelling frail older adults by organizing stakeholders (older adults and community workers) as a whole to identify the personal characteristics of older adults and utilize community resources. Compared with available complex interventions for frail older adults (Oh et al., 2021; Walters et al., 2017), our study selected supplementary components targeting the identified barriers and facilitators that affect RE participation. It has been found that loneliness and social isolation resulting from inadequate social support are significant challenges faced by frail older adults, which can expedite the progression of frailty (Gale et al., 2018; Pan & Cao, 2023). This study found that social support is one of the key facilitators of RE participation. Group exercise can not only provide social support for older adults and create a favorable exercise environment that promotes better adherence but also increase social interaction, and reduce loneliness and social isolation, thereby improving mental health (Beauchamp et al., 2018; Mortazavi et al., 2013).

Consequently, group-based RE was chosen as the core component of this study.

Studies indicate that appropriate theoretical guidance is more conducive to the development of comprehensive and effective complex interventions (Bleijenberg et al., 2018; Plotnikoff et al., 2013). SCT is a valuable theory in exercise promotion research, which emphasizes the dynamic interaction between individuals, environments, and behaviors. As its key concept is self-efficacy, numerous studies have shown self-efficacy to be strongly and consistently associated with exercise levels (Plotnikoff et al., 2013; Young et al., 2014). Guided by SCT, this study comprehensively selected other appropriate intervention components from the individual, environmental, and behavioral aspects to improve the knowledge, social support, and RE skills of older adults, and consequently enhance their self-efficacy to further promote RE participation.

Implications for Future Research and Practice

RE is considered as the best approach to alleviate frailty in older adults (Sun et al., 2023), as well as the best to increase muscle strength, improve physical function, and prevent dementia in older adults (Hu et al., 2022; Lai et al., 2018). Clinical practitioners in the Chinese community are encouraged to manage community-dwelling older adults with the complex intervention developed in this study. However, before large-scale implementation, pilot and real-world effectiveness evaluation research are warranted. Furthermore, given stakeholders' concerns about the safety of RE, future studies need to give priority to developing appropriate exercise plans and conducting thorough physical evaluations before the adoption of the complex intervention to guarantee the safety of RE.

Strengths and Limitations

The major strengths of this study include the development of a complex intervention guided by a theoretical framework through a systematic process that invited the participation of multiple stakeholders and synthesized diverse evidence sources. Furthermore, the complex intervention holds promise for enhancing participation in RE among community-dwelling frail older adults in China, thereby bridging the gap between evidence and real-world practice in frailty management.

However, there are several limitations. Firstly, all older adults were sampled from Changsha City (Central China), which may limit the generalizability of the complex intervention. Nevertheless, we believe that the impact would be minimal, as the involvement of experts from various fields across the country and comprehensive collection of evidence from multiple sources combined with a systematic review and ERIC during intervention development. Therefore, we believe that the complex interventions can be considered for direct or adapted application in developing countries with similar characteristics of the intervention recipients and settings as this study; moreover, this study provides a useful methodological reference for the development of similar complex interventions in other contexts or countries (e.g., developed countries or low-income countries). Secondly, the final complex intervention was not reevaluated by stakeholders, which may affect its feasibility and applicability. In the future, stakeholder engagement should be sought during detailed intervention development. Lastly, the absence of relevant policy-makers in this study may hinder the large-scale promotion of the complex intervention. Policy-makers should be involved in the future to ensure a successful application of the complex intervention in practice.

Conclusions

Following the SCT, this study identified barriers and facilitators for the participation in RE among community-dwelling frail older adults in China, together with corresponding implementation strategies, and developed a tailored complex intervention delivered by community workers in the community setting accordingly, with the core component of "group elastic-band RE," and supplementary components of "community education, feedback, goal setting, reinforcement guidance." Our results will facilitate the management of frail older adults in the Chinese community setting. However, before large-scale implementation, pilot and real-world effectiveness evaluation studies are needed.

Supplementary Material

Supplementary data are available at *Innovation in Aging* online.

Funding

The research was supported by the National Key R&D Program of China (no. 2020YFC2008600), the Natural Science Fund of Hunan Province (no. 2023JJ30734), the Special Funding for the Construction of Innovative Provinces in Hunan (no. 2019SK2141), the China Oceanwide Holding Group Project Fund (no. 143010100), and High-level Talents Introduction Plan from Central South University (no. 502045003).

Conflict of Interest

None.

Data Availability

Application for accessing data can be sent to: sunsun9010@163.com. The study was not preregistered.

Human and Animal Rights

The study was reviewed and approved by the ethical committees of Xiangya School of Public Health, Central South University, China [no. XYGW-2021-56]. Confidentiality and anonymity of participant data were guaranteed in the study. All procedures performed in this study involving human participants followed the 1964 Helsinki Declaration and its later amendments.

Informed Consent

All participants signed informed consent before the assessments.

References

Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology*, 52, 1–26. https://doi.org/10.1146/annurev.psych.52.1.1

Beauchamp, M. R., Ruissen, G. R., Dunlop, W. L., Estabrooks, P. A., Harden, S. M., Wolf, S. A., & Rhodes, R. E. (2018). Group-based physical activity for older adults (GOAL) randomized controlled trial: Exercise adherence outcomes. *Health Psychology*, 37(5), 451–461. https://doi.org/10.1037/hea0000615

Berwick, D. M. (2003). Disseminating innovations in health care. *Journal of the American Medical Association*, 289(15), 1969–1975. https://doi.org/10.1001/jama.289.15.1969

Bleijenberg, N., de Man-van Ginkel, J. M., Trappenburg, J. C. A., Ettema, R. G. A., Sino, C. G., Heim, N., & Schuurmans, M. J. (2018). Increasing value and reducing waste by optimizing the development of complex interventions: Enriching the development phase of the Medical Research Council (MRC) Framework. *International Journal of Nursing Studies*, 79, 86–93. https://doi.org/10.1016/j.ijnurstu.2017.12.001

Bull, F. C., Al-Ansari, S. S., Biddle, S., Borodulin, K., Buman, M. P., Cardon, G., & Willumsen, J. F. (2020). World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *British Journal of Sports Medicine*, 54(24), 1451–1462. https://doi.org/10.1136/bjsports-2020-102955

Burton, E., Farrier, K., Lewin, G., Pettigrew, S., Hill, A. M., Airey, P., & Hill, K. D. (2017). Motivators and barriers for older people participating in resistance training: A systematic review. *Journal of Aging and Physical Activity*, 25(2), 311–324. https://doi.org/10.1123/japa.2015-0289

Buus, N., & Perron, A. (2020). The quality of quality criteria: Replicating the development of the Consolidated Criteria for Reporting Qualitative Research (COREQ). *International Journal of Nursing Studies*, 102, 103452. https://doi.org/10.1016/j.ijnurstu.2019.103452

Chen, J., & Zhao, W. (2022). Physical activity guidelines for Chinese 2021. *Chinese Journal of Public Health*, 38(02), 129–130. https://doi.org/10.28220/n.cnki.ndzws.2022.000017

Damschroder, L. J., Aron, D. C., Keith, R. E., Kirsh, S. R., Alexander, J. A., & Lowery, J. C. (2009). Fostering implementation of health services research findings into practice: A consolidated framework for advancing implementation science. *Implementation Science*, 4, 50. https://doi.org/10.1186/1748-5908-4-50

Damschroder, L. J., & Lowery, J. C. (2013). Evaluation of a large-scale weight management program using the Consolidated Framework for Implementation Research (CFIR). *Implementation Science*, 8, 51. https://doi.org/10.1186/1748-5908-8-51

Damschroder, L. J., Reardon, C. M., Widerquist, M. A. O., & Lowery, J. (2022). The updated Consolidated Framework for Implementation Research based on user feedback. *Implementation Science*, 17(1), 75. https://doi.org/10.1186/s13012-022-01245-0

de Villiers, M. R., de Villiers, P. J., & Kent, A. P. (2005). The Delphi technique in health sciences education research. *Medical Teacher*, 27(7), 639–643. https://doi.org/10.1080/13611260500069947

Dent, E., Martin, F. C., Bergman, H., Woo, J., Romero-Ortuno, R., & Walston, J. D. (2019). Management of frailty: Opportunities, challenges, and future directions. *Lancet (London, England)*, 394(10206), 1376–1386. https://doi.org/10.1016/S0140-6736(19)31785-4

Dhakal, K. (2022). NVivo. *Journal of the Medical Library Association*, 110(2), 270–272. https://doi.org/10.5195/jmla.2022.1271

Fried, L. P., Tangen, C. M., Walston, J., Newman, A. B., Hirsch, C., Gottdiener, J., & McBurnie, M. A. (2001). Frailty in older adults: Evidence for a phenotype. *Journals of Gerontology, Series A: Biological Sciences and Medical Sciences*, 56(3), M146–156. https://doi.org/10.1093/gerona/56.3.m146

Gale, C. R., Westbury, L., & Cooper, C. (2018). Social isolation and loneliness as risk factors for the progression of frailty: The English Longitudinal Study of Ageing. *Age and Ageing*, 47(3), 392–397. https://doi.org/10.1093/ageing/afx188

Garcia-Hermoso, A., López-Gil, J. F., Ramírez-Vélez, R., Alonso-Martínez, A. M., Izquierdo, M., & Ezzatvar, Y. (2023). Adherence to aerobic and muscle-strengthening activities guidelines: A systematic review and meta-analysis of 3.3 million participants across 32 countries. *British Journal of Sports Medicine*, 57(4), 225–229. https://doi.org/10.1136/bjsports-2022-106189

Hoogendijk, E. O., Afilalo, J., Ensrud, K. E., Kowal, P., Onder, G., & Fried, L. P. (2019). Frailty: Implications for clinical practice and public health. *Lancet*, 394(10206), 1365–1375. https://doi.org/10.1016/S0140-6736(19)31786-6

Hu, M., Hu, H., Shao, Z., Gao, Y., Zeng, X., Shu, X., & Feng, H. (2022). Effectiveness and acceptability of non-pharmacological interventions in people with mild cognitive impairment: Overview of systematic reviews and network meta-analysis. *Journal of Affective Disorders*, 311, 383–390. https://doi.org/10.1016/j.jad.2022.05.043

Izquierdo, M., Merchant, R. A., Morley, J. E., Anker, S. D., Aprahamian, I., Arai, H., & Fiatarone Singh, M. (2021). International Exercise Recommendations in Older Adults (ICFSR): Expert consensus guidelines. *Journal of Nutrition, Health & Aging*, 25(7), 824–853. https://doi.org/10.1007/s12603-021-1665-8

Jebara, T., Cunningham, S., MacLure, K., Palivalapila, A., Awaisu, A., Al Hail, M., & Stewart, D. (2020). A modified-Delphi study of a framework to support the potential implementation of pharmacist prescribing. *Research in Social & Administrative Pharmacy*, 16(6), 812–818. https://doi.org/10.1016/j.sapharm.2019.09.005

Jünger, S., Payne, S. A., Brine, J., Radbruch, L., & Brearley, S. G. (2017). Guidance on Conducting and REporting DElphi Studies (CREDES) in palliative care: Recommendations based on a methodological systematic review. *Palliative Medicine*, 31(8), 684–706. https://doi.org/10.1177/0269216317690685

Keeney, S., Hasson, F., & McKenna, H. P. (2001). A critical review of the Delphi technique as a research methodology for nursing. *International Journal of Nursing Studies*, 38(2), 195–200. https://doi.org/10.1016/s0020-7489(00)00044-4

Kernan, L. M., Dryden, E. M., Nearing, K., Kennedy, M. A., Hung, W., Moo, L., & Pimentel, C. B. (2023). Integrating CFIR-ERIC and e-Delphi methods to increase telegeriatrics uptake. *Gerontologist*, 63(3), 545–557. https://doi.org/10.1093/geront/gnac107

Kirk, M. A., Kelley, C., Yankey, N., Birken, S. A., Abadie, B., & Damschroder, L. (2016). A systematic review of the use of the Consolidated Framework for Implementation Research. *Implementation Science*, 11, 72. https://doi.org/10.1186/s13012-016-0437-z

Lai, C. C., Tu, Y. K., Wang, T. G., Huang, Y. T., & Chien, K. L. (2018). Effects of resistance training, endurance training and whole-body vibration on lean body mass, muscle strength and physical performance in older people: A systematic review and network meta-analysis. *Age and Ageing*, 47(3), 367–373. https://doi.org/10.1093/ageing/afy009

Li, Y., Ehiri, J., Hu, D., Zhang, Y., Wang, Q., Zhang, S., & Cao, J. (2014). Framework of behavioral indicators for outcome evaluation of TB health promotion: A Delphi study of TB suspects and Tb patients. *BMC Infectious Diseases*, 14, 268. https://doi.org/10.1186/1471-2334-14-268

Mortazavi, S. S., Shati, M., Ardebili, H. E., Mohammad, K., Beni, R. D., & Keshteli, A. H. (2013). Comparing the effects of group and home-based physical activity on mental health in the elderly. *International Journal of Preventive Medicine*, 4(11), 1282–1289.

Moser, A., & Korstjens, I. (2018). Series: Practical guidance to qualitative research. Part 3: Sampling, data collection and analysis. *European Journal of General Practice*, 24(1), 9–18. https://doi.org/10.1080/13814788.2017.1375091

O'Caoimh, R., Sezgin, D., O'Donovan, M. R., Molloy, D. W., Clegg, A., Rockwood, K., & Liew, A. (2021). Prevalence of frailty in 62 countries across the world: A systematic review and meta-analysis of population-level studies. *Age and Ageing*, 50(1), 96–104. https://doi.org/10.1093/ageing/afaa219

Oh, G., Lee, H., Park, C. M., Jung, H. W., Lee, E., Jang, I. Y., & Kim, D. H. (2021). Long-term effect of a 24-week multicomponent intervention on physical performance and frailty in community-dwelling older adults. *Age and Ageing*, 50(6), 2157–2166. https://doi.org/10.1093/ageing/afab149

Pan, C., & Cao, N. (2023). Patterns of social isolation and low social support and frailty trajectories among Chinese older adults. *Journal of Applied Gerontology*, 42(12), 2325–2334. https://doi.org/10.1177/07334648231194508

Perry, L., Nicholls, R., Duffield, C., & Gallagher, R. (2017). Building expert agreement on the importance and feasibility of workplace health promotion interventions for nurses and midwives: A modified Delphi consultation. *Journal of Advanced Nursing*, 73(11), 2587–2599. https://doi.org/10.1111/jan.13345

Plotnikoff, R. C., Costigan, S. A., Karunamuni, N., & Lubans, D. R. (2013). Social cognitive theories used to explain physical activity behavior in adolescents: A systematic review and meta-analysis. *Preventive Medicine*, 56(5), 245–253. https://doi.org/10.1016/j.ypmed.2013.01.013

Powell, B. J., Waltz, T. J., Chinman, M. J., Damschroder, L. J., Smith, J. L., Matthieu, M. M., & Kirchner, J. E. (2015). A refined compilation of implementation strategies: Results from the Expert Recommendations for Implementing Change (ERIC) project. *Implementation Science*, 10, 21. https://doi.org/10.1186/s13012-015-0209-1

Sun, X., Liu, W., Gao, Y., Qin, L., Feng, H., Tan, H., & Wu, I. X. Y. (2023). Comparative effectiveness of non-pharmacological interventions for frailty: A systematic review and network meta-analysis. *Age and Ageing*, 52(2), afad004. https://doi.org/10.1093/ageing/afad004

Tian, P., Yang, N., Hao, Q. K., & Peng, C. M. (2019). A systematic evaluation of the prevalence of senile debility in China. *Chinese Journal of Evidence-Based Medicine*, 19(06), 656–664. https://doi.org/10.7507/1672-2531.201901056

Walters, K., Frost, R., Kharicha, K., Avgerinou, C., Gardner, B., Ricciardi, F., & Iliffe, S. (2017). Home-based health promotion for older people with mild frailty: The HomeHealth intervention development and feasibility RCT. *Health Technology Assessment*, 21(73), 1–128. https://doi.org/10.3310/hta21730

Wang, C. Z., & Qin, S. (2011). Statistical processing of data in the Delphi method and its application. *Journal of Inner Mongolia University of Finance and Economics*, 9(4), 92–96. https://doi.org/10.13895/j.cnki.jimufe.2011.04.019

Wang, H., Qin, F., Li, M. W., & Han, B. R. (2022). A qualitative study of facilitators and barriers to exercise behavior among frail older adults in nursing facilities. *China Nursing Management*, 22(08), 1204–1209. https://doi.org/10.3969/j.issn.1672-1756.2022.08.018

Young, M. D., Plotnikoff, R. C., Collins, C. E., Callister, R., & Morgan, P. J. (2014). Social cognitive theory and physical activity: A systematic review and meta-analysis. *Obesity Reviews*, 15(12), 983–995. https://doi.org/10.1111/obr.12225

Zanoni, P., Scime, N. V., Benzies, K., McNeil, D. A., & Mrklas, K.; Alberta FICare in Level II NICU Study Team. (2021). Facilitators and barriers to implementation of Alberta family integrated care (FICare) in level II neonatal intensive care units: A qualitative process evaluation substudy of a multicentre cluster-randomised controlled trial using the Consolidated Framework for Implementation Research. *BMJ Open*, 11(10), e054938. https://doi.org/10.1136/bmjopen-2021-054938