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ORIGINAL RESEARCH

Exploring the Willingness of Young and Middle-Aged CHD Patients to Participate in Home-Based Cardiac Rehabilitation: A Qualitative Study

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Purpose: With the rapid development of medical science and technology and the increasing trend of coronary heart disease (CHD) rejuvenation, home-based cardiac rehabilitation (HBCR), with its unique advantages, shows great potential for application in the field of prevention and treatment of CHD. In-depth understanding of the subjective perception and willingness to participate in HBCR of patients with CHD is crucial to the precise formulation of rehabilitation programs and the promotion of the clinical application of HBCR. The aim of this study was to explore the factors influencing young and middle-aged CHD patients' willingness to participate in HBCR.

Patients and Methods: This study used the qualitative descriptive approach. Using purposive sampling, a total of 20 young and middle-aged patients with CHD who were admitted to a tertiary hospital in Taiyuan from June to August 2024 were selected to participate in this study. This study used the theory of planned behavior (TPB) as the theoretical framework to carry out data collection and analysis. Face-to-face, semi-structured interviews were used to collect the data. Data were analyzed using content analysis. Two researchers independently read, coded, categorized, and refined themes.

Results: Based on the framework of the TPB, four themes emerged from the analysis: (1) attitude; (2) subjective norm; (3) perceived behavioral control; and (4) Knowledge mastery level. Of the 20 participants in this study, 15 participants had positive attitudes toward HBCR, but their willingness to participate was still influenced by multiple factors. Economic conditions are the fundamental factor influencing patients' willingness to participate in HBCR. Social support, self-efficacy, emotional state, and knowledge mastery level are also crucial. The lack of face-to-face professional guidance and the HBCR risks perceived by patients impede their participation. Moreover, the social roles of young and middle-aged CHD patients are a unique factor influencing their willingness to participate.

Conclusion: Under the guidance of TPB, this study deeply explored the factors influencing young and middle-aged CHD patients' willingness to participate in HBCR. Based on these factors, it is necessary to make precise interventions in the future at the government level, among healthcare professionals, and within social support systems. By identifying these factors, we can not only improve patients' willingness to rehabilitate and the rehabilitation effect, help them return to society, and reduce social pressure, but also promote the clinical application of HBCR and optimize the CR grading system.

Keywords: coronary heart disease, young and middle-aged adults, cardiac rehabilitation, participation willingness, influencing factors, theory of planned behavior

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Introduction

Cardiovascular disease (CVD) continues to be the world's leading cause of death and disease burden, with an estimated 35.6 million cardiovascular deaths worldwide by 2050, primarily due to coronary heart disease (CHD).[1] While we typically think of CHD as a chronic disease influencing older people, social pressures and unhealthy lifestyles are

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increasing its prevalence in young and middle-aged adults.[2] Young and middle-aged adults play significant roles in the family and at work, and if they suffer from CHD, it will seriously impact their lives and careers. This will not only worsen the patients' financial burden and lower their quality of life, but it will also present significant challenges to society.[3] Compared to older patients, young and middle-aged patients with CHD had a better prognosis, a lower severity, and a higher percentage of modifiable risk factors.[4] Therefore, we must strengthen the comprehensive management of young and middle-aged patients with CHD to reduce risk factors and improve the disease prognosis.

Cardiac rehabilitation (CR) is the comprehensive management of cardiac patients to ensure their best possible physical, psychological, and social functioning.[5] The European Society of Cardiology (ESC) recommended CR as a secondary prevention intervention for CVD, stating that it consists of patient assessment, exercise training, dietary management, risk factor management, and psychological support, with exercise training at its core.[6] Although center-based cardiac rehabilitation (CBCR) has been widely implemented and its effectiveness and safety in patients with CHD have been demonstrated,[7] the participation and completion rates are not promising.[8] And it has been noted that younger patients drop out of CBCR at a higher rate than older patients.[9] Participation in CBCR is also unequal, with female patients, older patients, and patients with lower socioeconomic status less likely to participate in CBCR. In addition, CBCR is characterized by significant problems such as low referral rates, transportation limitations, and poor flexibility.[10] Young and middle-aged patients with CHD who have social and familial obligations face significant challenges due to the current issues with CBCR.

Home-based cardiac rehabilitation (HBCR) is a potential strategy to address these problems. According to a 2019 scientific statement, HBCR serves as an alternative to CBCR due to its utilization of information technology for remote monitoring, which allows patients and their families to receive training and instruction on relevant rehabilitation knowledge in their home environments.[11] Studies have shown that HBCR is just as effective as CBCR in contributing to helping young and middle-aged patients with CHD improve their functional ability, quality of life, and risk factor control.[12] Additionally, HBCR is more flexible and can better fit the schedules and work rhythms of young and middle-aged adults. Given the accelerating trend of the youthfulness of CHD and the ongoing development of medical technology, HBCR, which has its own benefits, has a wide range of potential applications in the prevention and treatment of CHD patients. The implementation of HBCR also faces challenges that cannot be ignored. Medical insurance policies, technology accessibility, the readiness of healthcare providers, economic conditions, digital literacy, and patient compliance will all influence patients' acceptance of HBCR.[13,14] One of the major advances in CR has been the tendency of many studies to focus on patient engagement and compliance.[15] The perceptions and willingness of CHD patients to participate in HBCR are as important as the support from the government and healthcare organizations for the successful implementation and promotion of HBCR.[16]

The theory of planned behavior (TPB), one of the most well-known theories of attitude-behavior relationships, was put forth by American psychologist Ajzen on the foundation of rational behaviorism.[17] According to the TPB, a person's intention to carry out a particular behavior is the primary determinant of that behavior. The more strongly an individual intends to carry out a behavior, the more likely they are to do so. Three main factors influence behavioral intention: attitude, subjective norm, and perceived behavioral control. Attitude is expressed as a positive or negative evaluation of the behavior; subjective norm refers to the social pressure an individual may feel to perform or not perform a particular behavior; and perceived behavioral control is the perceived ease or difficulty of performing a particular behavior. Numerous behavioral research fields have extensively applied the theory, which is highly operational and explanatory. Hsu et al used the TPB to study the factors influencing diabetic patients' willingness to receive injection therapy,[18] and the study by Jormand et al demonstrated that educational interventions based on the TPB can effectively promote self-care behaviors in older adults with knee osteoarthritis.[19] In addition, prior research has used the TPB in the field of CR and shown good effectiveness. A study has confirmed the effectiveness of the TPB in explaining the exercise behavior of CHD patients during HBCR.[20] The core of the TPB lies in predicting and explaining individuals' behavioral intentions. The goal of this study is to gain in-depth insights into the willingness of young and middle-aged patients with CHD to participate in HBCR and the influencing factors behind it. Evidently, the core of TPB is highly consistent with the purpose of this study. Based on this, we used TPB as a research framework to explore the factors from the three dimensions of attitude, subjective norm, and perceived behavioral control, which are the key elements of the theory. In this study, behavioral intention represents the patient's personal willingness to participate in HBCR after discharge from the hospital; attitude represents the positive or negative evaluations the patient holds about participation in HBCR, while subjective norm represents the influence of significant others on the patient's participation in HBCR, and perceived behavioral control represents the patient's perceptions of the factors that either facilitate or impede their participation in HBCR.

Specialized scales are now available to investigate the factors that influence patient participation in CR. Grace et al developed the Cardiac Rehabilitation Barriers Scale (CRBS), which was designed to assess patients' perceptions of stage II CR disorders in order to understand patients' reasons for not participating or adhering to the program.[21] The CRBS has been translated into several languages and applied in many quantitative studies to assess CR disorders in different cultural contexts.[21,22] These studies have identified gender, age, transportation distance, and rehabilitation costs as factors influencing patients' participation in CR.[23,24] However, there are fewer qualitative studies on the factors influencing patients' willingness to participate in CR. In addition, previous studies on CHD patients' willingness to participate in CR have concentrated on the early CR stage.[25] Certain studies that concentrate on the home CR phase have overlooked other aspects of HBCR, instead focusing solely on the willingness of patients with CHD to participate in exercise training.[26] Furthermore, while some researchers have focused on the willingness of elderly CHD patients to participate in HBCR,[27] there is a dearth of research on the program's perception among young and middle-aged adults. There are significant differences in the needs and challenges of HBCR in young and middle-aged CHD patients compared to older patients. Young and middle-aged patients need to return to work and family responsibilities as soon as possible compared with older patients, and patients in this age group may face greater psychological stress and a longer disease course.[28] Therefore, HBCR needs to focus on improving patient endurance, attending to the patient's psychological state, and emphasizing long-term risk factor management. The time constraints and lack of social support are important challenges for young and middle-aged patients to participate in HBCR,[16] which puts higher demands on the development of HBCR programs. Compared with previous studies, this study focuses its perspective on a special group of young and middle-aged patients with CHD. Through in-depth interviews with them to understand the real-life situations they face in their daily lives, this study can fully reveal the unique factors that influence their participation in HBCR. The results of this study will provide a basis for designing rehabilitation programs more suitable for this age group and conducting targeted health education for this population.

Considering the increased focus society has placed on the health management of young adults, the implementation of HBCR as a viable preventive and therapeutic measure for young and middle-aged CHD patients is crucial. However, there is a lack of research on HBCR perceptions in this particular group. Therefore, the aim of this study is to investigate the factors that influence the willingness of young and middle-aged patients with CHD to participate in HBCR.

Materials and Methods

Design

This study used the qualitative descriptive approach, which provides the most intimate and straightforward account of participants' experiences and perceptions.[29] The Consolidated Criteria for Reporting Qualitative Research (COREQ) guidelines were adhered to in this study.[30](Appendix 1).

Setting and Participants

The study was carried out in the Department of Cardiology of a tertiary hospital in Taiyuan, Shanxi Province, China, between June and August of 2024. The department is the National Chest Pain Center of China, and the department's Cardiac Rehabilitation Center is also certified as a National Standardized Cardiac Rehabilitation Center. In order to participate in this study, participants had to: (1) meet the diagnostic criteria for CHD; (2) be ≥18 and <60 years of age; (3) have good cognitive and communication skills; and (4) voluntarily participate. We excluded patients with severe osteoarthropathy, uncontrolled malignant arrhythmias, uncontrolled hypertension, severe infections, severe organic diseases, and other conditions not suitable for exercise rehabilitation.

We applied the purposive sampling method in this study.[31] In order to gather as much information as possible and to better understand the real views of young and middle-aged patients with CHD, we conducted a maximum difference strategy sampling based on patients' demographic information (eg, age, gender, occupation, and education level) and disease-related information (eg, disease duration, comorbidities, and whether a heart stent was implanted). Clinical nursing specialists and cardiologists reviewed the hospitalized patients' clinical records and identified potential participants who met the inclusion criteria.

Data Collection

This study employed face-to-face, semi-structured interviews. Based on the TPB and a thorough review of the relevant literature, we initially established an interview outline. The interview outline developed questions based on the three main elements of TPB, which included attitude, subjective norm, and perceived behavioral control. The first author conducted pre-interviews with each of the three patients who matched the requirements for inclusion. After discussing the problems that arose from the pre-interviews, two medical professors and a clinical nursing expert assisted in revising the interview outline. The finalized interview outline includes the following main questions: (1) Can you describe your experience with CHD? (2) What practices have you taken to promote physical recovery? (3) How much do you know about CR and HBCR? (After the participants' responses, the interviewer will explain CR and HBCR in detail). (4) What is your attitude toward HBCR? (5) Do you feel that HBCR is valuable or risky for you? (6) Whose views do you think will influence your decision to participate or not participate in HBCR? (7) Are you confident in participating in HBCR? (8) What factors influence your decision to participate or not participate in HBCR?

All of the participants were interviewed in person by the first author in the department's conference room, which was quiet and separate to prevent any disruptions. The first author initially explained the study's purpose, the confidentiality principle, and the necessity of audio recording during the entire interview to the participants. Participants signed an informed consent form that included demographic and disease information. After a brief greeting, the first author gradually initiated a conversation with the participant based on the interview outline. Important details and non-verbal communication during the interviews were recorded in field notes. We transcribed the audio recordings within 24 hours of each interview. After 17 interviews, newly collected data were duplicated with previously obtained data, and no new themes or codes emerged, indicating data saturation.[32] We conducted three more interviews to ensure no new themes emerged. Thus, we conducted a total of 20 interviews during the data collection phase.

Data Analysis

The data was analyzed using the content analysis method.[33] The three core elements of TPB, attitude, subjective norm, and perceived behavioral control, were used throughout the key steps of data analysis. Firstly, the researchers needed to read the textual material in depth and ensure accuracy by listening to the audio recordings repeatedly and reviewing field notes. Secondly, the researchers broke down the text into smaller units of meaning and labelled the codes based on their understanding of the material. Thirdly, by comparing their similarities and differences, the researchers condensed and then categorized the extended meaning units and codes. Fourthly, the researchers developed the frequent and meaningful codes into subthemes, and then compared and collated these subthemes to form themes. The process of qualitative analysis is described in Appendix 2.

We used NVivo 14 software for data collection and analysis. The first and second authors worked independently to read, code, categorize, and refine the themes. We then compared and discussed the data analysis results in regular group discussions until we reached a consensus. During the analysis, we adjusted and optimized the results by incorporating elements of the TPB.

Ethical Considerations

The study was approved by the Ethics Committee of the Second Hospital of Shanxi Medical University (No. 2024-YX-269) on June 3, 2024. All participants signed an informed consent form after being fully informed about the study's purpose and procedures before the interview. Participants participated voluntarily, and they had the right to withdraw at any time. The confidentiality principle was strictly adhered to throughout the research process.

Rigor

To ensure rigor, the qualitative study adhered to the following principles: dependability, credibility, confirmability, and transferability.[34] Before the study started, all of the researchers received systematic training in qualitative research methods in order to guarantee the study's dependability. The purposeful selection of participants and obtaining saturation data guaranteed the study's credibility. Prior to data collection, the first author built a trustworthy relationship with the participants by approaching them during her clinical practice. This pre-existing connection might have introduced a form of personal relationship bias. During the interviews, the first author might unconsciously show more empathy towards the patients who had interacted with her before. As a result, she might over-focus on the factors these patients mentioned as barriers to participation while overlooking some factors that could promote their participation. The researchers are aware of the potential impact of these biases on the research results. Therefore, throughout the interviews, the first author remained impartial, objective, and nonjudgmental; she avoided asking leading questions and used interview techniques to get in-depth information. Important details were documented in field notes for the researchers' own reflection. We made the transcribed textual information available for the participants to review after each interview, ensuring an accurate representation of their real opinions. Two researchers independently analyzed the data, identifying all codes and themes through group discussion. We thoroughly documented the background information and research process to verify the study's transferability. Data collection and analysis were fully documented and kept for verification.

Results

The study included 20 young and middle-aged CHD patients, with 13 males and 7 females (Table 1). The participants were coded as P1 to P20 in order to protect their privacy. They are between 36 and 57 years old. The interviews lasted between 32 and 78 minutes. This study identified four themes: attitude, subjective norm, perceived behavioral control, and knowledge mastery level. These themes, along with their subthemes, comprise the factors that influence the willingness of young and middle-aged CHD patients to participate in HBCR.

Table 1 Participant Demographics and Disease-Related Information

No	Gender	Age (Years)	Marital Status	Profession	Educational Background	Monthly per Capita Household Income (CNY)	Duration of Disease (Months)	Comorbidities	Whether a Heart Stent was Implanted
P1	Male	46	Married	Salesman	③	<3000	3	A	Yes
P2	Female	48	Married	Teacher	⑥	3000–5000	8	—	No
P3	Female	50	Married	Retiree	⑤	3000–5000	1	—	No
P4	Female	51	Married	Teacher	⑥	>5000	60	AC	Yes
P5	Male	47	Married	Restaurant owner	②	>5000	4	A	Yes
P6	Male	45	Married	Civil servant	⑤	3000–5000	1	A	No
P7	Female	48	Married	Office Clerk	④	3000–5000	60	AB	Yes
P8	Male	52	Married	Farmer	①	<3000	36	A	Yes
P9	Male	36	Married	Company employee	⑤	3000–5000	3	—	Yes

(*Continued*)

Table 1 (Continued).

No	Gender	Age (Years)	Marital Status	Profession	Educational Background	Monthly per Capita Household Income (CNY)	Duration of Disease (Months)	Comorbidities	Whether a Heart Stent was Implanted
P10	Female	55	Widow	Worker	③	3000–5000	156	ABC	Yes
P11	Male	56	Married	Investment counsellor	⑤	>5000	6	A	Yes
P12	Male	54	Married	Jobless	③	<3000	120	ABCD	Yes
P13	Male	57	Married	Retiree	⑤	>5000	72	—	Yes
P14	Male	46	Married	Worker	②	<3000	60	ABC	Yes
P15	Male	42	Married	Company employee	④	3000–5000	2	—	No
P16	Male	47	Married	Teacher	⑥	3000–5000	96	A	Yes
P17	Female	51	Married	Farmer	②	<3000	0.2	—	No
P18	Male	38	Married	Company Manager	⑤	>5000	0.2	A	Yes
P19	Male	49	Single	Jobless	③	<3000	0.5	AE	No
P20	Female	52	Married	Jobless	③	<3000	6	—	No

Notes: ① Illiteracy; ② Primary school education; ③ Junior high school education; ④ Senior school education; ⑤ Associate degree; ⑥ Bachelor's degree. A, Hypertension; B, Diabetes mellitus; C, Hyperlipidemia; D, Heart failure; E, Overweight. —, No information.
Abbreviation: CNY, China Yuan.

Attitude

According to the TPB, attitude predicts behavioral intentions; that is, young and middle-aged CHD patients' attitude towards HBCR predicts their willingness to participate in HBCR. We divided the participants' attitudes in this study into three categories: positive, negative, and neutral.

Positive Attitude

Fifteen participants expressed positive opinions of HBCR, confirming its value in enhancing physical and mental well-being, increasing cardiorespiratory fitness, and promoting doctor-patient contact.

> Definitely can benefit. Exercise definitely has the potential to improve cardiopulmonary capacity and blood circulation. Additionally, by adjusting diet and changing detrimental habits, it can significantly improve our overall physical and mental health. It's also more convenient to be able to communicate with the doctor at any time if I encounter any problems. (P11)

Negative Attitude

Three participants had negative attitudes about HBCR, believing that they would not benefit from it.

> I don't think there's much benefit. I think people live it; they do not necessarily have to understand too much, so I don't want to know about this CR either. Go with what you feel is the best. You have to make yourself into what kind of what; it's too tired. (P13)

Neutral Attitude

Two participants expressed uncertainty about the benefits of HBCR and expressed neutrality towards it.

> I can't discuss this because, first, I've never heard of HBCR; second, I haven't been exposed to it. So that means I won't be able to just comment. (P12)

Subjective Norm

Subjective norm can influence individual behavioral intentions, according to the TPB. According to this study, the attitudes and actions of doctors, family members, and peers influenced the willingness of young and middle-aged CHD patients to participate in HBCR.

Doctors and Official Authorities

Medical experts hold authority in the treatment of disease in CHD patients, and participants were more likely to accept their doctors' opinion, and their willingness to participate in HBCR was substantially connected to the strength of their doctors' recommendations.

> If our directors, Sun and Yan, say, "Ah, you participate in this", then I will undoubtedly participate actively. I'm sure I'll believe it when I get a recommendation from an authoritative doctor. I don't believe my family yet; I have my own ideas and won't listen to others, but if an authoritative doctor says it, I will definitely believe it. (P4)

Some participants demonstrated a high level of trust in official decision-making, citing the government and officials as symbols of authority and credibility. Official decision-making support can increase their willingness to participate in HBCR.

> Given that both experts and the government endorse it (HBCR), how could it possibly harm you? If you don't trust the government, who else can you trust? (P8)

Family Views and Behaviors

According to the participants, their willingness to participate in HBCR and follow the rehabilitation program was greatly influenced by the views and behaviors of their family.

> My family's viewpoint is crucial, and they all encourage me to visit the doctor. In general, I don't give much thought to life's habits; my lover is more concerned with this and typically cooks more. Since receiving my CHD diagnosis, he has made it a point to use less salt in our meals. He also frequently encourages and accompanies me for workouts in the park, so having him along would make me more likely to participate in this rehabilitation program. (P7)

Peer Experiences and Feedback

The participation experiences and feedback from those around them influence participants' willingness to participate, with participants indicating that they would consider participating if trusted peers around them had successful experiences with HBCR.

> For instance, a child excels in learning at this school, and as you can see, the neighborhood is teeming with parents who want their children to attend this school. Because there are positive examples around, people feel benefitted and are eager to follow suit. They believe that if others have tried something and found success, they should also give it a try. This is also the case with participating in the rehabilitation program. And I don't necessarily believe in random people, but if there are people around me that I trust that have benefitted, hey, I'll believe and be intentional about it (HBCR). (P9)

Social Roles of Patients

Young and middle-aged CHD patients play significant roles in their work and personal lives, and the ensuing role conflict greatly influences their intention to participate in HBCR. Participants perceived time conflicts between their personal lives and rehabilitation treatment as influencing their willingness to participate in HBCR.

> For those of us who are busy with work, have family, and need to go out and socialize, the time we have to exercise definitely does not align with the regular working hours of a rehabilitation physician. (P6)

Some of the retired participants stated that their frequent travel plans prevented them from having the time to participate in HBCR. Time conflicts between travel plans and rehabilitation were a barrier to their participation in HBCR.

> I am going on a trip on the 3rd, and I have already purchased my ticket and am prepared to go. My retirement life is too rich, after travelling to see a doctor, after seeing the doctor, and then travelling. There is no time available to participate in this project. (P13)

Female participants took the initiative to take care of their families and raise their offspring, which placed significant limitations on their participation in HBCR.

> I would like to participate in anything you ask me to do. I can do it here (the hospital), but when I get home, I have too many things to do, like looking after my grandchildren, cleaning the house, and other things, so even if I wanted to, I couldn't take part in HBCR. (P17)

Face-to-Face Professional Guidance

HBCR provides support to patients primarily through remote means, and participants prefer to receive professional guidance from medical staff face-to-face as a way of obtaining more reliable support and a sense of security. This barrier specific to HBCR is also one of the factors influencing patients' willingness to participate.

> There is also no doctor's face-to-face guidance for HBCR, so you can only contact them online. You see, if I go to our regular hospital, I can interact with a real person and communicate directly with the doctor, which will put me at ease. (P4)

Perceived Behavioral Control

The TPB suggests that perceived behavioral control influences an individual's behavioral intentions. Participants in this study perceived challenges to their participation in HBCR in terms of economic conditions, self-efficacy, risk perception, and emotional state.

Economic Conditions

Sufficient resource conditions and adequate medical insurance are the primary requirements for the full development of the CR program. Some participants thought that the unequal distribution of resources and incomplete medical insurance caused by the current economic disparity between regions severely limited the development of HBCR, preventing most patients from participating.

> The distribution of economic levels in our nation's regions is not uniform. For instance, CR may still have some value if it is located in developed southern areas and the capital of the northern provinces, but it will be too difficult to implement in county townships due to two factors: first, the economic conditions cannot be met, and second, the skills, technology, and equipment cannot be reached. Additionally, medical insurance is crucial, but it doesn't cover as much, so it's unlikely that you'll get paid for all of your rehabilitation expenses. (P6)

Participation in HBCR entails specific costs, including the salary of rehabilitation personnel, the cost of physical assessment, and the cost of equipment, among others, which disproportionately impacted participants with limited income. Therefore, the cost of rehabilitation and medical insurance reimbursement correlated with participants' willingness to participate in HBCR.

> Given that there is no such thing as free, I would be hesitant to participate in this rehabilitation program if medical insurance did not cover the costs. Additionally, the cost of rehabilitation is somewhat higher because you still need to purchase a variety of equipment, correct? A prerequisite for HBCR is economic conditions. If it can be reimbursed more, I'll consider it; if not, I can't participate. (P12)

Self-Efficacy

Self-efficacy significantly influences patients' willingness to participate and adherence to rehabilitation. Participants with higher self-efficacy had a greater willingness to participate in HBCR because they felt more confident in their skills and thought they had enough tenacity.

> I can insist; surely, I can insist. I have always been a person of willpower. I've already stopped drinking, and I'm going to stop smoking next. I'll be able to stick to it, and as long as the exercise is healthy for me, I'll be able to insist on doing it. (P11)

Participants with low self-efficacy lacked confidence in their own abilities and reported difficulty adhering, which could significantly hinder their participation in HBCR.

> To put it plainly, I really do not have the perseverance; if I did, I would not be so fat. For me, it's okay if someone else keeps an eye on me, but when I'm left alone, it's really hard to follow through. I am aware that eating a balanced diet and exercising more are important, but when it comes to doing it, it's harder to stick to it! (P19)

Risk Perception

Perceptions of the unknown risks of HBCR, including safety and efficacy, influence patients' willingness to participate. Due to a combination of factors, such as the disease itself and comorbidities, some participants felt their health was poor and were hesitant to exercise, fearing that it would exacerbate their condition or lead to negative consequences. Patients' fear of exercise significantly impacts their willingness to participate in HBCR.

> All I'm worried about is having a myocardial infarction after engaging in exercise inappropriately. (P2)

> The symptoms of my condition are more pronounced because it's acute; well, it hurts all of a sudden if it's going to hurt, so I'm still more worried about the dangers if I exercise at home. (P5)

> I rarely exercise due to my health issues, including high blood pressure, diabetes, CHD, and poor vision. I also don't dare to work out. (P12)

Participants' perceptions of the safety of HBCR also stemmed from concerns about the form and intensity of the exercise, which they feared would be too complex and too intense to tolerate. This worry influenced participants' willingness to participate in HBCR.

> The second is convenience; if this activity is too cumbersome and complicated, people will not want to do it. Therefore, it is best to conduct it in a simple and convenient way. In fact, if the exercise is as simple as taking a stroll and performing certain exercises, people are more likely to cooperate. (P9)

> The primary issue is that I don't know my intensity or what the highest level of intensity my body can withstand, and I just don't know where my point is. (P16)

Participants doubted the effectiveness of HBCR and worried that they would not receive appropriate feedback for their efforts. This psychological expectation partially influenced their willingness to participate in HBCR.

> People will also worry that they have spent the money; what if it is not beneficial to them? Hey, everyone has that mindset. (P19)

Emotional State

Another aspect that influences participants' willingness to participate in HBCR is their emotional state. Some participants' willingness to participate in HBCR was positively impacted by their cheerful outlook on life.

> Every day I am cheerful, positive, and optimistic, and I want to be among joyful people. I enjoy engaging in things that contribute to my happiness and well-being. It's great to work out and stay healthy with my neighbors, so I usually enjoy going on walks and dancing with them. (P17)

Some participants developed emotions such as skepticism, anxiety, and negative coping due to morbidity experiences and attitudes toward life, which negatively influenced their willingness to participate in HBCR.

> Society doesn't monitor the internet very well, so the internet is full of beneficial and bad stuff. Even if something is truly beneficial, such as CR, people may remain skeptical due to widespread internet deception, leading to a lack of trust in it. (P4)

> Well, this heart problem I have is that it's hard every day; there's not a day that I can say it's not hard. I probably have a bit of anxiety on the mental side as well, because I'm uncomfortable every day, and I think about it every day, so that makes me not really dare to exercise. (P2)

> It's difficult enough to stay alive in my condition; there's no need for rehab. I'm also diabetic and have weak lungs, so I'm barely alive. (P10)

Knowledge Mastery Level

Furthermore, we find that knowledge mastery level also influences the willingness of young and middle-aged CHD patients to participate in HBCR. This mainly includes patients' level of awareness of the disease, their knowledge of HBCR, and their knowledge of rehabilitation.

Disease Awareness Level

Patients' level of disease awareness influences their willingness to participate in HBCR; a lack of knowledge about the condition and insufficient awareness of it frequently result in a decreased willingness to participate. We conducted interviews for this study with young and middle-aged CHD patients who had low awareness and cognitive misconceptions about the disease. Some participants thought that they were still young and that CHD would only cause them problems as they became older. This misperception can negatively influence their participation in HBCR.

> People of my age in their 30s who don't have this disease may think: 'I'm still young; I think this disease is far away from me; I can't possibly get it, and if I do, I'll get it when I'm older.' (P18)

When the condition first appeared, several participants were unaware of it and disregarded its symptoms. These patients may downplay the severity of their illness and be unaware of the necessity of rehabilitation therapy, which makes them less willing to participate in HBCR.

> Some people do have symptoms; they will assume that they are simply fatigued. They won't even recognize that they are ill because they lack the awareness and knowledge that this is a sign of CHD. (P9)

Knowledge of HBCR

Given that HBCR is a novel rehabilitation approach, participants' willingness to participate is correlated with their familiarity with its concepts and content. Individual participants knew about HBCR and were able to recognize the benefits of HBCR to their health, which made them more willing to participate in HBCR.

> I have some knowledge about CR because I previously participated in our hospital's CR center. It seems that there are several stages of CR, and HBCR should be the latter stage, which involves going home to exercise, adjusting our diet, and various lifestyle habits. I think HBCR is beneficial for the disease and our health. (P11)

Most participants lacked knowledge of HBCR or had misconceptions, which made them unwilling to participate in it.

> Does the heart have rehabilitation? I used to know that there was a rehab unit for brain attacks, but I didn't know there was one for the heart. HBCR? I have absolutely no idea. (P13)

> CR? It's CPR, isn't it? I've never heard of this program at all. (P19)

Some participants showed a lack of awareness and acceptance of HBCR due to low literacy or insufficient publicity.

> Some people in less developed areas lack sufficient education; they likely haven't heard of these rehabilitation programs and are unable to accept or comprehend them. (P18)

Knowledge of Rehabilitation

Knowledge of rehabilitation respectively influences the willingness of new-onset patients and patients with longer durations of illness to participate in HBCR. Some of the new-onset participants lacked adequate rehabilitation knowledge, which might have caused them to become confused about the rehabilitation program and afraid to participate in HBCR.

> I don't know much about this disease and have never had it before. I'm not quite sure how to exercise, how to adjust my diet, and how to go about rehabilitation. (P20)

Some of the participants had been suffering from CHD for a long time, but they were unaware of or misunderstood illness rehabilitation. Such patients lacked attention to their health management and showed a low willingness to participate in HBCR.

> I have no knowledge; it has been over a decade since I was diagnosed with this disease. I don't even remember the medication I take; I don't know anything. (P13)

> I'm not going to quit smoking. I don't think smoking has much to do with CHD. Many people who have smoked and drunk all their lives don't develop this disease ! (P12)

Discussion

Based on the TPB, this study explored the factors influencing the willingness of young and middle-aged patients with CHD to participate in HBCR from their perspective. The study included four main themes: attitude, subjective norm, perceived behavioral control, and knowledge mastery level. Although 75% of the participants in this study had favorable opinions about HBCR, a variety of factors still influenced their willingness to participate.

The results of the interviews indicated that economic conditions are the fundamental factor influencing the successful implementation of HBCR and the willingness of young and middle-aged patients with CHD to participate in the program. Sufficient medical resources and adequate medical insurance are key to the successful implementation of HBCR programs. Regional economic conditions in China vary greatly, and primary hospitals in comparison to tertiary hospitals have fewer medical resources.[35] This has resulted in limited HBCR development, with a large number of eligible patients unable to participate even if they wanted to. Participants in this study shared this viewpoint. This developmental dilemma has become a significant barrier to participating in HBCR for patients. Furthermore, the HBCR program incurs certain costs, and the majority of participants stated that they were unable or unwilling to pay for their rehabilitation out of pocket, and they pinned their hopes on reimbursement from medical insurance. However, HBCR is currently not fully integrated into the medical insurance system.[36] Rehabilitation costs are more burdensome for low-income patients, severely influencing their willingness to participate in HBCR. Some participants in this study had a high level of trust in official decisions. Official policies must support and encourage the development of HBCR. Firstly, efforts should be made to broaden the scope of medical insurance in the CR field and reduce the economic burden on patients. Secondly, a clear referral system should be established to encourage cardiologists to refer patients to HBCR programs, improving patients' access to HBCR. This will increase the motivation of healthcare providers to conduct HBCR and the confidence of patients with CHD to participate in rehabilitation. In addition, the community should be actively involved in the field of CR, and the tertiary hospitals should continue to support the community-driven family self-help model of CR.[37]

This study identified the subjective norm as a significant factor influencing young and middle-aged CHD patients' willingness to participate in HBCR; that is, the attitudes and behaviors of doctors, family members, and peers influence patients' willingness to participate in HBCR. Consistent with our findings, research has demonstrated that cardiac patients who receive more social support and positive doctor's recommendations are more likely to participate in CR.[38] Patients who received strong recommendations from their healthcare professionals to participate in CR are more likely to do so due to their high level of trust in their expertise, particularly doctors. However, in reality, medical staff may be less likely to recommend HBCR to patients because they are not familiar with CR knowledge.[39] As a result, patients lack an understanding of HBCR, not to mention their willingness to participate. Participants also reported a correlation between their willingness to participate in HBCR and the support of their family members. Family support boosts patients' motivation to engage in HBCR, and family members' actions influence patients' adherence to their rehabilitation, particularly in terms of exercise and diet. The participants also emphasized the importance of the rehabilitation experiences of surrounding peers. Although some patients may be hesitant to participate, if a close friend has a successful participation experience, this positive feedback can enhance their trust and willingness to participate in HBCR.[40] In order to guarantee that patients receive prompt and accurate recommendations and guidance on HBCR, healthcare organizations should further enhance CR education and training for medical staff in future clinical practices by hosting conferences, lectures, and training assessments. With their own specialized medical knowledge, medical staff can systematically popularize the correct knowledge of HBCR to patients and provide accurate and professional rehabilitation guidance to patients. Secondly, we encourage family members to attend health education lectures about HBCR to better understand its significance and implementation methods, thereby motivating the patients to actively participate in it. At the same time, the unreserved emotional encouragement from family members, along with accompanying patients to keep up with exercise and carefully arranging their diets, is the key driving force that promotes patients to actively participate in HBCR. Lastly, communication meetings and support groups can be organized for patients who have experienced HBCR participation to share their experiences. Their personal experiences can provide valuable feedback and encouragement to other patients as well as inspire more patients to participate in HBCR.

According to the study's findings, young and middle-aged CHD patients' social roles have a significant impact on their willingness to participate in HBCR. As the "pillars" of the family and society, young and middle-aged patients experience serious role conflicts. According to the participants, their inability to find a balance between work, family, and rehabilitation greatly decreased their willingness to participate in HBCR. One study also discovered similar outcomes among heart failure patients.[41] In addition, some of the retired participants had frequent travel plans and felt that the conflicting schedules of travel plans and rehabilitation prevented them from participating in HBCR. Moreover, previous studies have demonstrated that gender is also a major factor influencing patients' participation in CR, as evidenced by the fact that barriers to participation in CR are more complex and varied among female patients with CHD, stemming in part from women's personality traits and social roles.[42] Our study had the same finding that some of the female participants said they did not have enough time for HBCR since they volunteered to care for their families. Family responsibilities became one of the social role barriers to HBCR participation for female patients. Responding to these issues can be accomplished by creating individualized HBCR programs. To accommodate the schedules and unique requirements of young and middle-aged patients, there is a need to develop more flexible rehabilitation training schedules and forms of exercise rehabilitation and to provide multiple modes of tele-rehabilitation, including synchronous, asynchronous, and hybrid. Additionally, rehabilitation programs can be conducted based on online video conferencing to eliminate time and location constraints on patient rehabilitation; virtual applications can also be used to plan individualized rehabilitation schedules and programs for patients.[43] Health practitioners should create specialized HBCR programs for female patients, taking into account their risk factors and psychosocial concerns, in order to encourage widespread participation.[44]

The results of the interviews in this study revealed a high correlation between self-efficacy and willingness to participate in HBCR in young and middle-aged CHD patients, as indicated by Foster et al's findings.[45] Participants in this study who had high self-efficacy were highly confident in their ability to participate in HBCR, which encouraged them to do so. In contrast, participants who had low self-efficacy were less confident in their ability to follow the exercise and diet plan, which decreased their willingness to participate. Participants in this study expressed a preference for in-person medical staff supervision and guidance. Considering that HBCR provides supervision primarily in a remote format, although remote video and periodic feedback can greatly encourage patients to perform rehabilitation exercises, it is less effective than face-to-face real-time feedback. The lack of direct supervision will reduce patients' sense of responsibility and self-efficacy, thus hindering their participation in HBCR.[46] Firstly, patients should be informed that HBCR offers a form of tele-guidance and a regular follow-up system. HBCR enables video interaction and real-time monitoring of the rehabilitation process through tele-rehabilitation technology, providing adequate guidance and supervision for patients. Secondly, community-based rehabilitation groups are one of the potential strategies to leverage the role of group strength in enhancing patients' self-efficacy, thereby increasing patients' confidence in participating in HBCR. Finally, we should not undervalue the role of family support and accompaniment in boosting self-efficacy and motivation to participate in HBCR.

This study found that among young and middle-aged patients with CHD, risk perception and emotional state are key variables of HBCR participation. Perceived risk included concerns about the safety and efficacy of HBCR. The core of CR is exercise rehabilitation, and patients' worries regarding HBCR's safety are mostly based on their fear of exercise risk.[47] Despite being told that exercise rehabilitation is safe, some participants were unwilling to participate in HBCR because of poor health conditions brought on by the disease or comorbidities. They subconsciously thought that exercise would easily cause accidents or exacerbate their condition. Fear of exercise was also a result of participants' concerns about its form and intensity. They felt that the exercise equipment needed for HBCR was more complex and that the intensity was intolerable, which made them lose interest in participating. Additionally, we discovered a correlation between patients' psychological expectations regarding the efficacy of HBCR and their willingness to participate in it. The participants had doubts regarding HBCR's efficacy and were concerned that its results would fall short of their own. Furthermore, patients' emotional state can also have an impact on their health-related behaviors.[48] Positive emotions increase patients' motivation to participate in HBCR; emotions like skepticism, anxiety, and negative coping decrease patients' interest in doing so. To allay patients' worries about the safety and efficacy of HBCR, medical staff should give them comprehensive information on the program's professional telerehabilitation team and successful cases. Personalized rehabilitation programs that incorporate easy and calming types of exercise, such as Tai Chi and walking, can be tailored to patients with a variety of physical conditions and comorbidities to ease their anxieties and encourage active participation in HBCR. Finally, in order to motivate young patients to participate in HBCR, psychological therapies are required to boost their intrinsic motivation and reduce psychological distress through motivational interviewing.[49]

The study's findings showed that patients' knowledge mastery level, including disease awareness level, knowledge of HBCR, and knowledge of rehabilitation, significantly influences young and middle-aged CHD patients' willingness to participate in HBCR. The interview subjects in this study were young and middle-aged patients with CHD who lacked the correct knowledge of the disease and tended to ignore its symptoms.[50] A few participants indicated that they were young and had never imagined developing CHD. These patients are less likely to be eager to participate in HBCR because they have poor disease awareness and tend to ignore the importance of rehabilitation treatment. In addition, a study of cardiac patients found that most patients refused to participate in HBCR because they did not understand its fundamentals and benefits, which is consistent with our findings.[51] If patients lack knowledge about HBCR, they may be skeptical about its content and thus lack confidence in participating. Participants in this study indicated that patients with lower literacy levels had weaker intentions to participate in CR; this conclusion is corroborated by comparable research.[52] Such patients are less receptive to knowledge about rehabilitation; they are unable to understand what HBCR is all about and are less likely to accept rehabilitation treatment. In terms of rehabilitation knowledge, some participants with a recent onset of the disease lacked rehabilitation knowledge and might have been unsure about the rehabilitation process, which would make them fearful of HBCR and lower their willingness to participate, while others with a long history of the disease still lacked knowledge of rehabilitation or even had misunderstandings, which indicated that they did not pay attention to their own health management and implied a lower willingness to participate in HBCR. Health professionals should focus on patient education during hospital stays, such as utilizing social media and conducting lectures to enhance patients' understanding of HBCR while ensuring the content is easily comprehensible. In addition, community organizations can also conduct popularization activities about CHD and self-management and establish specific incentive mechanisms to draw in large patient participation so as to enhance their level of knowledge mastery and awareness of health management.

In conclusion, young and middle-aged CHD patients have an overall positive willingness to participate in HBCR, though there are still a number of factors that influence this willingness. There is a need to develop effective strategies to address the aforementioned factors in order to meet the unique needs of the patients, enhance their knowledge and self-efficacy, and reduce their unnecessary anxiety and psychological distress, all of which are critical in boosting their willingness to participate in HBCR.

Strengths and Limitations

Young and middle-aged patients with CHD have specific social roles and attitudes toward the disease; therefore, the results from their perspective are illuminating, especially since there are not many qualitative studies on the factors influencing their willingness to participate in HBCR. The use of the TPB for data analysis and outcome description improves the application of this theory in the field of CR. However, the study has several limitations. Firstly, the main limitation of this study was the small sample size, which limited the generalizability of the findings. Secondly, we only recruited one single participant and one widowed participant, which constrained transferability. Finally, we used only one hospital in northern China to gather qualitative data. Given that young and middle-aged patients from different socio-economic and cultural backgrounds will have different experiences and perspectives, generalization of the results to populations from other backgrounds needs to be done with caution. In the future, we will conduct multi-center, large-sample studies and comprehensively apply quantitative and qualitative research methods to further validate the generalizability of the research results and improve their effectiveness.

Conclusion

This qualitative study deeply explored the factors influencing young and middle-aged CHD patients' willingness to participate in HBCR. TPB served as the foundation for this study. Semi-structured interviews were used to collect the data, and content analysis was used to perform an in-depth analysis. The influencing factors, summarized from the patients' perspective, included attitude, subjective norm, perceived behavioral control, and knowledge mastery level. The results of this study can provide a basis for the formulation of targeted intervention measures in the future. Fundamentally speaking, economic conditions are a crucial factor influencing patients' willingness to participate in HBCR. Besides, social support, self-efficacy, emotional state, and knowledge mastery level also significantly influence patients' willingness to participate in HBCR. Patients' participation in HBCR is significantly impeded by the lack of face-to-face professional guidance and the risks of HBCR perceived by them. It is worth noting that the unique social roles of young and middle-aged CHD patients play a non-negligible part in their decision to participate in HBCR. Successful implementation of HBCR requires strong public policy support and the active engagement of health care organizations. In terms of policy, it is necessary to broaden the health insurance coverage for CR and establish a clear referral system. Meanwhile, health care organizations are expected to strengthen CR education for patients through social media and lectures. It is crucial to emphasize the value of social support networks and community organizations. They play an important role in enhancing patients' knowledge and self-efficacy. The informational and instructional support from medical staff, the emotional and practical support from family members, as well as the positive feedback from peers, can establish a solid and comprehensive social support network for patients, promoting patients' participation in HBCR in all aspects. Community-based rehabilitation groups and health promotion activities are also important strategies to increase patients' motivation to participate in HBCR. Furthermore, it is necessary to establish professional rehabilitation teams and formulate personalized HBCR plans. Rehabilitation exercises such as walking and Tai Chi can be arranged for patients with different physical conditions and comorbidities. At the same time, it is essential to develop rehabilitation plans exclusive to the female population. Finally, to accommodate the social roles of young and middle-aged adults, rehabilitation programs should be flexible enough. This flexibility can be achieved through online video conferences, virtual applications, or through adopting a hybrid model, so as to attract patients to participate widely in HBCR. In conclusion, identifying these influencing factors and implementing corresponding interventions based on them is of great significance. This can not only enhance the willingness for rehabilitation and effectiveness of young and middle-aged patients with CHD, help them return to society, relieve social pressure, but also promote the clinical application of HBCR, optimize the CR grading system, and bring new development to the field of CR.

Abbreviations

CVD, Cardiovascular Disease; CHD, Coronary Heart Disease; CR, Cardiac Rehabilitation; ESC, European Society of Cardiology; CBCR, Center-Based Cardiac Rehabilitation; HBCR, Home-Based Cardiac Rehabilitation; TPB, Theory of Planned behavior; COREQ, Consolidated Criteria for Reporting Qualitative Research.

Data Sharing Statement

All data related to the results are included in the manuscript and its supplementary information files. The interview transcripts are not publicly available because of individual privacy concerns.

Ethics Approval and Consent to Participate

The study was approved by the Ethics Committee of the Second Hospital of Shanxi Medical University (No. 2024-YX-269). All participants signed a written informed consent after being fully informed of the study purpose and procedure prior to the interview. All procedures involving human participants in this study were conducted in accordance with the Declaration of Helsinki.

Consent for Publication

All participants involved in the study signed an informed consent form for the publication of their anonymized responses and direct quotes.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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