Patient Preference and Adherence

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ORIGINAL RESEARCH

Exploring the Needs and Preferences of Athletes in Cardiac (Tele)Rehabilitation to Enhance Rehabilitation Outcome: A Qualitative Study

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Purpose: To define the user needs and preferences of the athletic population in cardiac (tele)rehabilitation (CTR).

Patients and Methods: In this qualitative study, we included athletes with established coronary artery disease (CAD) who participated in a cardiac rehabilitation (CR) program and health care professionals involved in CR. All athletes engaged in sports for at least four hours per week. Fourteen male and one female athlete (mean age 63 ± 10.6 years) participated in CR after an acute coronary syndrome, percutaneous coronary intervention and/or coronary bypass surgery. The twelve healthcare professionals invited included cardiac nurse practitioners, cardiologists, sports physicians, physiotherapists, and a clinical psychologist. This study consists of four phases: a stakeholder identification session, twenty-five semi-structured individual interviews, six card-sorting focus groups and a data analysis phase with thematic analysis.

Results: User needs for athletes in CR encompass personalized exercise plans featuring clear and quantifiable exercise recommendations and limitations. Additionally, there is a need for monitoring health and exercise data; measuring progression and performance longitudinally; easy-to-use, and reliable healthcare information systems with accurate sensors and data; as well as clinical supervision and validation of information and data. Social support from both peers and family is also identified as a crucial need. The preferred technological features for a CTR system tailored for athletes include periodic digital consultations with clinicians, home-based training specific to one's sport, utilization of technology to monitor workouts, data sharing and remote feedback, personalized exercise recommendations and online educational materials.

Conclusion: This research explored the user needs and preferences of athlete patients in CR. The findings indicated that enhancing CR for athletes necessitates a personalized and sport-specific methodology. The integration of various technological features within a CTR program can play a pivotal role in assisting athletes with CAD to maintain an active lifestyle and regain their previous athletic performance levels.

Keywords: interview, focus group, telerehabilitation features, highly active individuals, coronary artery disease

Introduction

Cardiac rehabilitation (CR) is the core strategy in the secondary prevention of coronary artery disease (CAD). It results in improvements in cardiovascular risk factors and exercise capacity, leading to significant reductions in hospitalizations, adverse cardiovascular events and mortality.[1,2] To better fit the needs and preferences of patients, and to ensure high participation and adherence, CR interventions should be personalized for individuals and specific populations. One group where meaningful improvements can be made are athletes with CAD. In literature, athletes are defined as individuals who engage in at least four hours per week of exercise.[3] Their needs in CR often significantly differ from the needs of the sedentary population. The current European Society of Cardiology guideline states that individuals with CAD who were

Received: 31 December 2024
Accepted: 12 March 2025
Published: 20 March 2025

already engaged in sports may start CR with performing low- to moderate-intensity recreational sports activities in parallel with a progressive exercise programs. Careful individual evaluation is required before starting high-intensity competitive sports.[4] This necessitates a customized approach that is tailored to individual goals.

With the exception of a limited number of case reports, research on the contents of CR in athletes is scarce.[5–7] These case reports argue for a more sport-specific CR program that enable athletes to return to their former level of sport. However, current exercise-based CR programs are not designed accordingly. The exercise programs offered at CR-centers are typically uniform and group-based and do not align with the athletes' preference for a swift return to their sport. Additionally, there is a demand for more personalized guidance to achieve this objective.

Cardiac telerehabilitation (CTR) is a promising approach to rehabilitate athletes individually using a more sport-specific approach. CTR has proven to be a safe and effective alternative to center-based CR for patients with CAD, with a very low incidence of severe adverse events in both CR and CTR.[8–12] In CTR, one or more therapies of CR are delivered outside the environment of the hospital or CR center, using monitoring devices and remote communication with patients. This facilitates the need for more individual guidance, instead of training in a group. At the same time, it provides more flexibility to select a specific sport and workouts can be scheduled at convenient times for the athlete. Therefore, exercise recommendations can be more individualized and tailored to the athlete's current level and sports habits. In addition, many athletes are already familiar with the use wearables needed for remote monitoring. However, little is known about how to design CTR for this group. Therefore, the purpose of the study is to define the user needs and preferences in athletes who participate in CR and identify requirements for CTR.

Materials and Methods

Study Design

This qualitative study consisted of a stakeholder identification session, semi-structured individual interviews, card-sorting focus groups and a data analysis phase. The target study population consisted of athletes with established coronary artery disease who participated in a CR program and other stakeholders in this area of expertise, such as health care professionals. Individual interviews were conducted to define the user needs of the athletes. Focus groups were held to identify their preferences for a cardiac telerehabilitation program. The study complied with the principles of the Declaration of Helsinki. Ethical approval was waived by the Medical Ethics Review Committee of Máxima Medical Centre Veldhoven, the Netherlands, as the rules laid down in the Medical Research Involving Human Subjects Act do not apply to this research. Written informed consent was obtained from all study participants when they were enrolled in this study and separately for publication of their details.

Key Stakeholder Identification and Recruitment

A stakeholder identification session was conducted using the IGOHcaps method.[13] According to this method, healthcare actors are defined as humans or organizations that provide, control, support or accept health care services. The stakeholder session was performed by an eHealth designer and five clinicians working in CR: a cardiac nurse practitioner, two cardiologists, a sports physician and a sports physician in training. After identification of all possible stakeholders in each category (providers, controllers, supporters, accepters), the key healthcare stakeholders were approached for participation in the study.

Based on the outcomes of the stakeholder identification session, actors fitting the following criteria were selected:

1. Patients that are recreational athletes who participate in moderate or high-intensity exercise for at least four hours a week, and participated in cardiac rehabilitation in the past year following acute coronary syndrome, percutaneous coronary intervention and/or coronary bypass surgery.

2. Health care professionals (HCPs) in multidisciplinary CR that are in direct contact with the patients and directly impacted by CTR technologies: cardiac nurse practitioner, cardiologist, sports physician, physiotherapist and clinical psychologist.

Semi-Structured Individual Interviews

Fifteen individual interviews with athletes and ten interviews with HCPs were conducted. Each interview was conducted following two variations of a semi-structured interview script, one for athletes and one for HCPs. The interview explored themes such as the value of physical activity in the lives of highly active patients, current experiences of CR, information flows and relationships with HCPs, social support, and technology use for managing sports and health. LF and BS conducted the interviews, which lasted for 60–70 minutes, and were audio recorded. The recordings were used for verbatim transcriptions and translations from Dutch to English.

Card-Sorting Focus Groups

To further explore the user needs of the athletes and identify CTR features that could potentially support them in CR, six focus groups (FG) were conducted. All FGs consisted of three to four participants to ensure good cooperation and participation of each individual. Thirteen athletes who participated in the interviews took part in four FGs (FG 1–4). Seven HCPs were divided into two additional FGs (FG 5–6), given that they have a different level of healthcare literacy than the athletes.

Each FG lasted 60–100 minutes and was facilitated by a clinician and an eHealth designer. A card-sorting activity with CTR interventions was performed to help understand the CTR features that are most important and useful. Therefore, the HCPs were asked to respond from the athletes' perspective.

Features from recent studies reviewing CTR technologies were extracted,[14–16] as well as reviews of cardiac self-management eHealth and telemonitoring.[17,18] The extracted features were divided into four main categories: Education and assistance; consultations, coaching and guidance; monitoring behaviors for supervision and oneself; and co-experience (social aspect). Each of these categories was divided into sub-categories for easy understanding and card maneuvering. Additionally, empty cards for each category were provided for extra suggestions.

The four categories were presented on posters containing individual cards depicting technology features. Participants were asked to work together to sort cards one by one on a canvas divided into three sections: must have, nice to have and not needed. Participants were asked to motivate their choice for each card, encouraging group discussions. The interactive session was audio and video recorded with the consent of the participants.

Data Analysis

Thematic analysis was applied to the interview data using NVivo (14.0) qualitative data analysis software. Athletes' user needs were identified by LF and BS through in-depth analysis and inductive coding of the data.[19] The results of the card-sorting activity were sorted based on the preference of each focus group: each feature received a score: not needed = 0, nice to have = 1, must have = 2. The features were ordered from highest-scoring to lowest-scoring. The defined needs and preferences were verified by the diverse group of authors, including both clinicians and healthcare design researchers, ensuring the clinical validity of the derived conclusions.

Results

A total of fifteen athletes and twelve healthcare professionals participated in this study. All athletes completed cardiac rehabilitation in Máxima Medical Centre in Veldhoven, the Netherlands, between August 2022 and July 2023. All HCPs belong to the stakeholder group identified in the stakeholder identification session. Interviews and focus groups were conducted in August and September 2023.

Participant Characteristics

All athletes participated in both interviews and focus groups except for P1 (absence due to injury) and P9 (lack of time availability) who only took part in interviews. The median age of the athletes was 63 years (range 44–79). Relevant patient characteristics are presented in Table 1.

Table 2 presents the HCPs with their different roles in CR. All have extensive experience in cardiac care. HCPs 1, 2, 3, 7 and 8 participated in both focus groups and interviews; HCPs 11 and 12 only participated in focus groups; the other HCPs participated only in the interviews.

Table 1 Patients' Characteristics (n = 15)

No.	Gender	Age	Cardiac Condition and Intervention	Weekly Sports Pattern Before CR	Weekly Sports Pattern After CR	Type of Used Technology
P1	Male	76	ACS; PCI	Tennis 3 hours, fitness 3 times, mountain biking	Cycling with e-bike	Chest strap HR monitor
P2	Male	70	OHCA; CPR + PCI	Cycling 2 times, table tennis 2 hours	Same sports and intensity	Chest strap HR monitor, bike computer, BP monitor
P3	Male	44	OHCA; PCI + ICD	Mountain biking 1–2 times, boxing 2–3 times, fitness 3–4 times	Running 2 times, fitness 4 times, swimming once	Smart watch, ChatGPT (for running schemes)
P4	Male	65	ACS; PCI	Cycling 3–4 times 25–60km	Cycling once 30–50km	Smartwatch, chest strap HR monitor, bike computer, tracking app, BP monitor
P5	Male	75	ACS; CABG	Tennis/padel 3–4 times, golf 3 times 18 holes	Golf 9 holes	Smartwatch for distances in golf
P6	Male	79	ACS; PCI	Running 10km every day	Less intensive running every day	Smartphone for counting steps
P7	Male	46	ACS; PCI	Fitness (cardio and strength) 2–4 times, cycling 5–6 hours	Fitness 2–3h, cycling 4h	Smartwatch
P8	Male	57	ACS; medication treatment	Running 2 times 12–15km, tennis 1–2 times, running half marathons competitively	Tennis, mountain biking 2 times	Smartwatch, bike computer
P9	Male	54	Stable AP; CABG	Running 4–5 hours	Running 4–5 hours	Smartwatch
P10	Male	57	ACS; PCI	Mountain biking and indoor cycling 3–5 times	Mountain biking and indoor cycling less intensive	Smartwatch, chest strap HR monitor
P11	Male	58	ACS; PCI	Fitness (cardio and strength), indoor cycling 6 times	Same as before	Smartwatch, BP monitor
P12	Male	65	ACS; medication treatment	Running half marathons competitively, mountain biking, padel	Less intensive and no competitive running anymore	Smartwatch
P13	Female	73	ACS; CABG	Fitness (cardio and strength) and indoor cycling 8 hours	Fitness and indoor cycling 4 hours	Bike computer
P14	Male	62	ACS; PCI	Fitness (strength) and bodybuilding 3 times, cycling once	Same as before	Smartwatch
P15	Male	68	Stable AP, CABG	Ultra running 50km and cycling 200km, running marathons competitively	Less intensive and less kilometres of running and cycling	Smartwatch, chest strap HR monitor

Abbreviations: ACS, acute coronary syndrome; AP, angina pectoris; BP, blood pressure; CABG, coronary artery bypass grafting; CPR, cardiopulmonary resuscitation; CR, cardiac rehabilitation; HR, heartrate; ICD, implantable cardioverter defibrillator; PCI, percutaneous coronary intervention; OHCA, out of hospital cardiac arrest.

Semi-Structured Individual Interviews

The different themes explored during the interviews are described below.

Table 2 Health Care Professionals (n = 12)

No.	Gender	Years of Experience	Title
HCP1	Male	27	Sports physician[a]
HCP2	Female	3	Physiotherapist[b]
HCP3	Female	6	Sports physician in training[a]
HCP4	Female	16	Clinical psychologist[c]
HCP5	Female	14	Nurse practitioner[d]
HCP6	Male	13	Exercise instructor[b]
HCP7	Female	27	Primary care physiotherapist[b]
HCP8	Female	20	Physiotherapist[b]
HCP9	Male	12	Cardiologist[e]
HCP10	Male	10	Nurse practitioner[d]
HCP11	Male	19	Cardiologist[e]
HCP12	Female	8	Nurse practitioner[d]

Notes: Role in cardiac rehabilitation. a. Conducts cardiopulmonary exercise testing, provides exercise training recommendations, and offers consultations on test results and related advice. b. Supervises personalized exercise training programs and promotes an active lifestyle. c. Assesses psychiatric conditions, leads psycho-educational prevention modules (group sessions), and provides individualized treatment. d. Acts as case manager, conducts intake sessions to discuss lifestyle behaviors and individual goals, performs risk assessments for anxiety and depression, and carries out final evaluations of the CR program. e. Serves as the treating physician for cardiac patients, refers patients for CR, optimizes medication, and conducts risk assessments.
Abbreviations: CR, cardiac rehabilitation; HCP, health care professional.

Value of Physical Activity

Many of the included athletes have been exercising for years. Sports has become more than just a hobby, it is a part of who they are as a person, something they identify with. Athletes of older age are proud of being physically fit and, despite their advanced age, they want to stay active. Some participants use sports as a way to cope with everyday worries.

Once athletes started cardiac rehabilitation, they were eager to return to their former fitness levels.

Several participants have struggled to accept the diagnosis. Because of their healthy and active lifestyle, they did not expect to develop a heart condition. For some, it even felt unfair.

> There was nothing wrong. So that's why I ask myself 'did I do something wrong with sports? How come I got this while I'm a sports fanatic? (P13)

Experiences in Cardiac Rehabilitation

Overall, athletes were very satisfied with the CR and the support they received. A nurse practitioner CR was involved in all participants. Thirteen of fifteen athletes participated in the exercise training program. Six participants received dietary intervention, three consulted the clinical psychologist and one was referred to the occupational therapist.

> For me it were definitely the first steps to be able to do something again, so it was really important. My motivation was very high. I didn't miss a single training and I was always there. […] In the beginning I was walking on the treadmill and after I did more intervals, the intervals became longer and more intensive and that is incredibly motivating. (P9)

Several athletes found the exercise training not intense enough, they would like exercises that push and challenge them. Consequently, some participants even found the program not useful for their recovery.

> I think it's still too much uniformity. You go to the physiotherapist and you train like the rest of the group. You will get a different resistance […] But I think that the fit, active man or woman may need something different than the over eighty. So maybe a little more challenged, just a little more tailored. (HCP9)

Therefore, more personalized exercise recommendations and training schedules are often mentioned. Earlier guidance and supervision after referral is also mentioned as potential improvement, as well as easy communication options with the clinicians.

Information Flows and Relationships With HCPs

There was a need for reassurance through progress reports, feedback and encouragement from the HCP.

> We had a half-way conversation after about seven sessions. It was pretty good. They said 'you're doing really well in the group!' […] It was so nice to hear that. (P4)

Some athletes do not trust random sources of information, but only the information received from the hospital or provided by clinicians. They value the insights from the hospital educational materials.

> But if it [i.e, information from the hospital] focuses on athletes and certain heart problems and rehabilitation, then it might be useful. [.] In the beginning, when the rehabilitation had not yet started, I already googled about sports. But then you get a lot of different websites saying different things. (P3)

Social Support

Some athletes benefit from the social and competitive aspects of sports, while others prefer exercising alone and challenging themselves. However, preferences in some athletes change after experiencing a cardiac event.

> We didn't have to say anything to each other during sports, but especially the idea that you are together is important. And even if something happens, there is always someone there. (P6)

Support and reassurance from the patient's social environment is crucial during the rehabilitation process. The needs between patients differ, but all of them are looking to regain self-confidence.

> I was outside and hyperventilated, I was afraid. I called my sister-in-law, she is also a cardiac patient, and she got me through it. After a week at home, I went to the gym, just to talk. I asked a friend of mine who is a personal trainer 'Can you please help me?' He said 'okay, no problem'. We started with 10 minutes of walking and build that up every week. Now I exercise six days a week, so I asked my cardiologist 'is that okay?' He said, 'yes, perfect.' (P11)

Some athletes reported that their family members were more anxious than themselves, especially in terms of resuming their exercise training. Both athletes and their caregivers need to learn how to deal with this. It may be helpful to involve caregivers more in the rehabilitation process.

Technology Use for Managing Sports and Health

Athletes are used to working with wearables and sport apps in their daily sports practice. They use data in order to measure performance and generally look at time, distance, speed and heart rate. Several participants indicated that the use of data has changed after their cardiac event, they are now looking at it from a health perspective as well.

Athletes are eager to share data reports with their clinicians and get insightful feedback based on it.

> [Interviewer: Do you see advantages or disadvantages in sharing data with clinicians?]
>
> I only see advantages. That there is a bit more guidance. Because I have a limitation of 130 [maximum heart rate]. I would like to take that step, so that I can go a bit further. I sometimes think about joining an athletics club again. (P15)

All but two athletes use a smartwatch or other heart rate monitor. Most endurance athletes use a chest strap for heart rate monitoring.

The Perspective of the Health Care Professional

Healthcare providers recognize the high motivation in this population, commenting that athletes want to return to their former level. They want to know how far they can go and whether there are any limitations when exercising.

Most HCP indicate that many athletes experience anxiety, especially if the cardiac event occurred during sports. They need reassurance to rebuild their confidence.

> Rebuilding confidence is often an important component in the recovery. Maybe supervised rehabilitation in the outpatient clinic the first few times and then just remotely. Or maybe even closer to home, if it can be arranged in such a way that a patient can simply train at the physiotherapist around the corner, where they may already be familiar. (HCP5)

> Often, they do the first few training sessions under supervision. Just on the treadmill, just running, just cycling, just experiencing those peaks. And then they can translate that into practice themselves. But they really like that first piece of guidance. (HCP7)

Standard cardiac rehabilitation not always fits the highly active participants. Methods for a more personalized and sports-specific approach are already being explored.

> I don't think it is always beneficial sending physically fit people to normal rehabilitation. Because they actually need a completely different approach. Sometimes I do send those people for a shorter rehabilitation program and try to set it up a bit differently. Working together with the sports physician to see how we can best guide such a person. (HCP10)

The potential use of technology for more remote guidance in this population is also recognized by the caregivers.

> I would immediately make a bridge to technology. Almost all of them have smartwatches or other devices. They are very driven by numbers, so they prefer to train at a certain intensity. (HCP5)

> I think that quite a lot of people have a smartwatch nowadays. Especially those athletes. And they can use their own smartwatch or heart rate monitor. I think that really adds value. Not giving them another one they don't know. (HCP2)

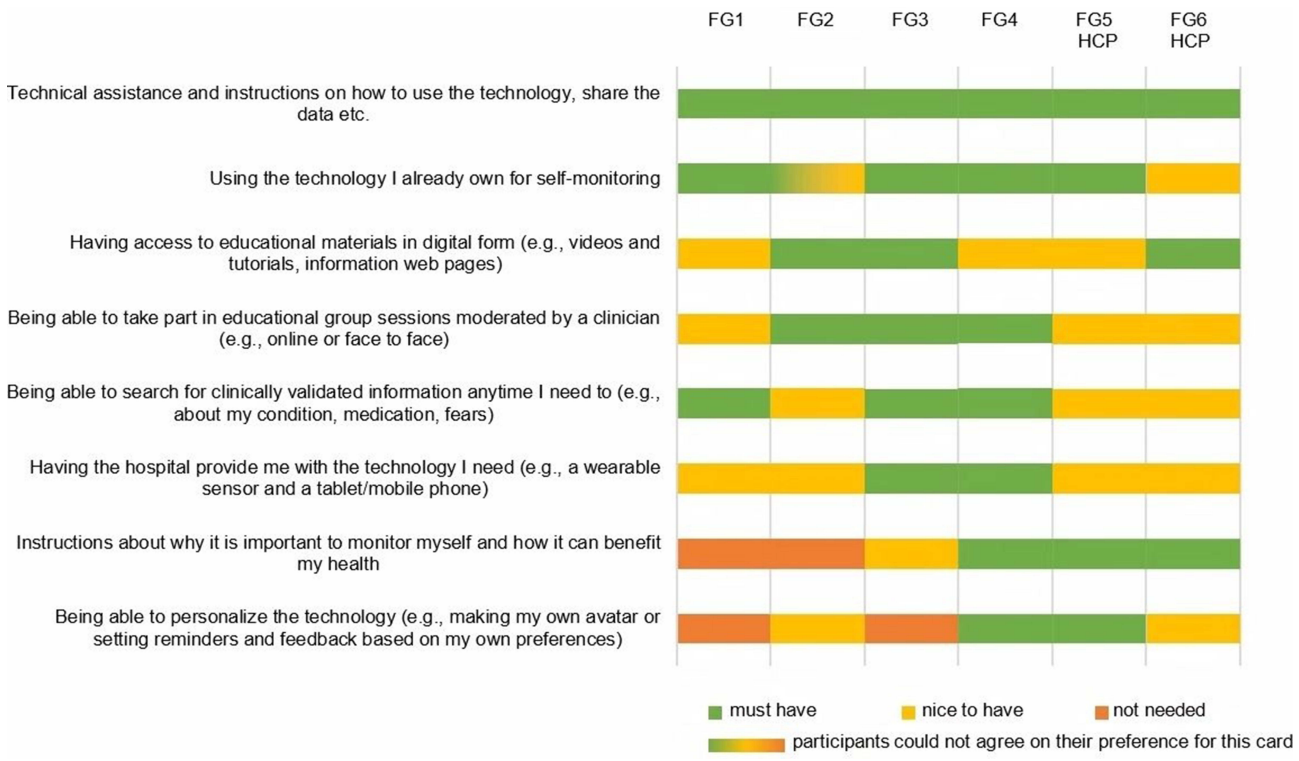

Figure 1 Cardiac telerehabilitation features in the Education and assistance category, sorted from most to less preferred.

https://doi.org/10.2147/PPA.S498408

Identified User Needs

Based on the analysis of the interviews with patients and HCPs, the following user needs were identified for athletes in CR:

- Personalized exercise plans with clear and quantifiable exercise recommendations and limitations
- Monitoring of health and exercise data and measuring progression and performance over time
- Easy-to-use and reliable healthcare information system with accurate sensors and data
- Clinical supervision and validation of information and data
- Social support from peers and family

Card-Sorting Focus Groups

Preferred Features of Cardiac Telerehabilitation Systems for Athletes

Six FG sessions were held with three (FG 2, 3, 4 and 5) or four (FG 1 and 6) participants.

Preferences regarding design features of a CTR solution for the athletic population are presented by category in Figures 1–4. Features are characterized as must have, nice to have or not needed. In each figure, the preferred features are sorted from most to less preferred.

Figure 2 Cardiac telerehabilitation features in the Consultations, coaching and guidance category, sorted from most to less preferred.

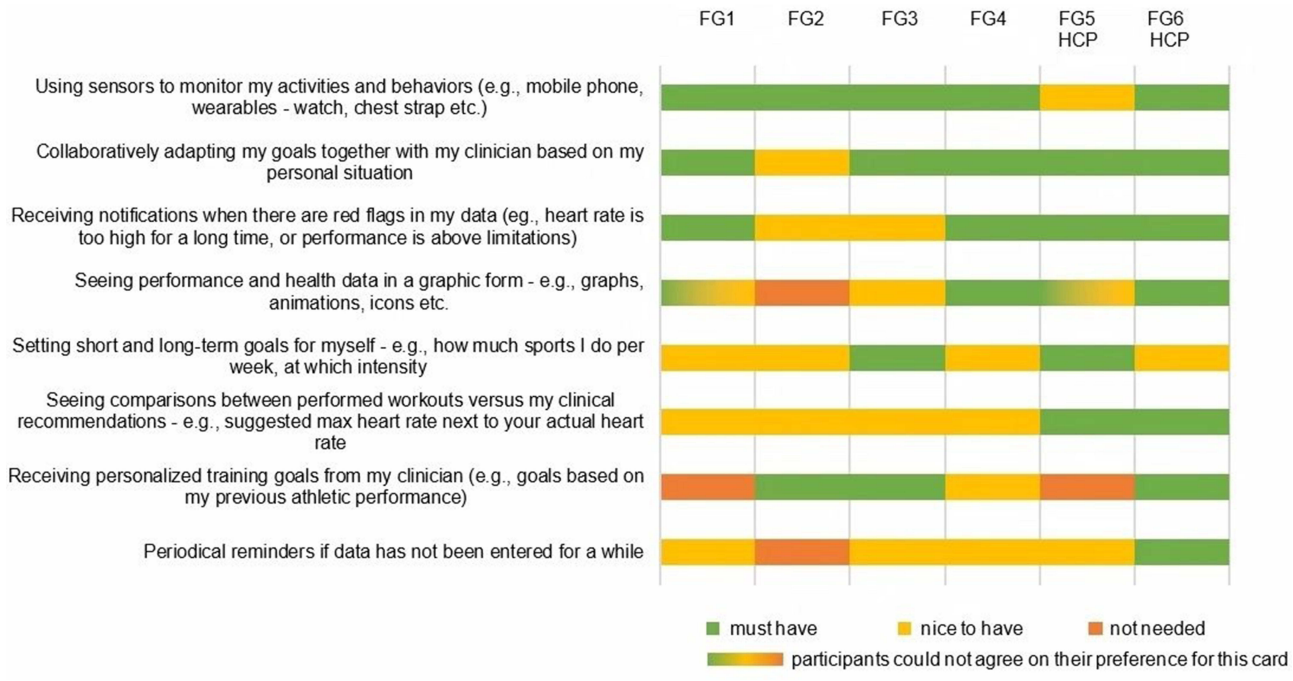

Figure 3 Cardiac telerehabilitation features in the Monitoring behaviors for supervision and oneself category, sorted from most to less preferred.

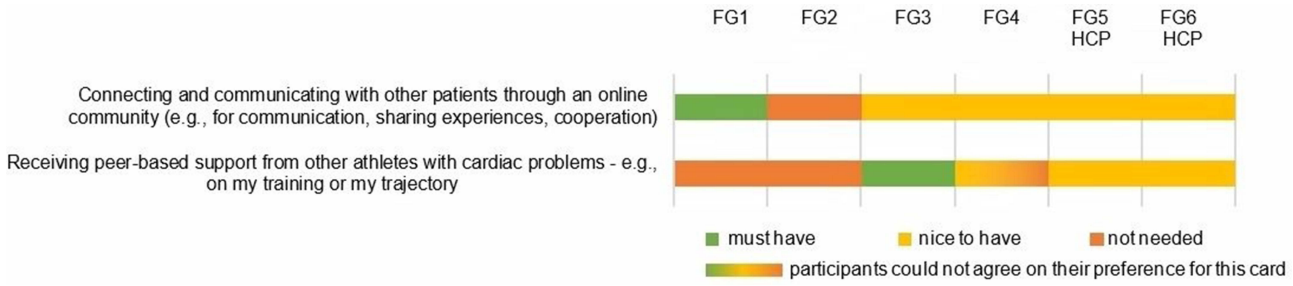

Figure 4 Cardiac telerehabilitation features in the Co-experience (social aspect) category, sorted from most to less preferred.

Education and Assistance

To use a CTR platform, instruction and technical assistance is a must. Preferably, athletes use their own wearable sensors, but both athletes and HCPs agree that the hospital should provide the right devices if the athlete does not have them. Educational group sessions and online access to clinically validated information are also important elements. Where some athletes would like to personalize the technology, this is not needed for others.

Consultations, Coaching and Guidance

Periodic consultations with their clinician are a must have for all participants. The preference for face-to-face or online consultations varies and also depends on the stage of rehabilitation. For the initial consultation, an in-person appointment is preferred.

A shift toward more home-based training with remote supervision is preferred. A more personalized approach with recommendations, schedules and limitations can contribute to this. Sharing data is required, although it has been suggested that athletes can decide which collected data to share with the HCP. Bilateral feedback loops between the athlete and HCP should be possible for sharing experiences, reflections and questions. Athletes want to receive notifications or feedback from clinicians when there are any red flags in their data.

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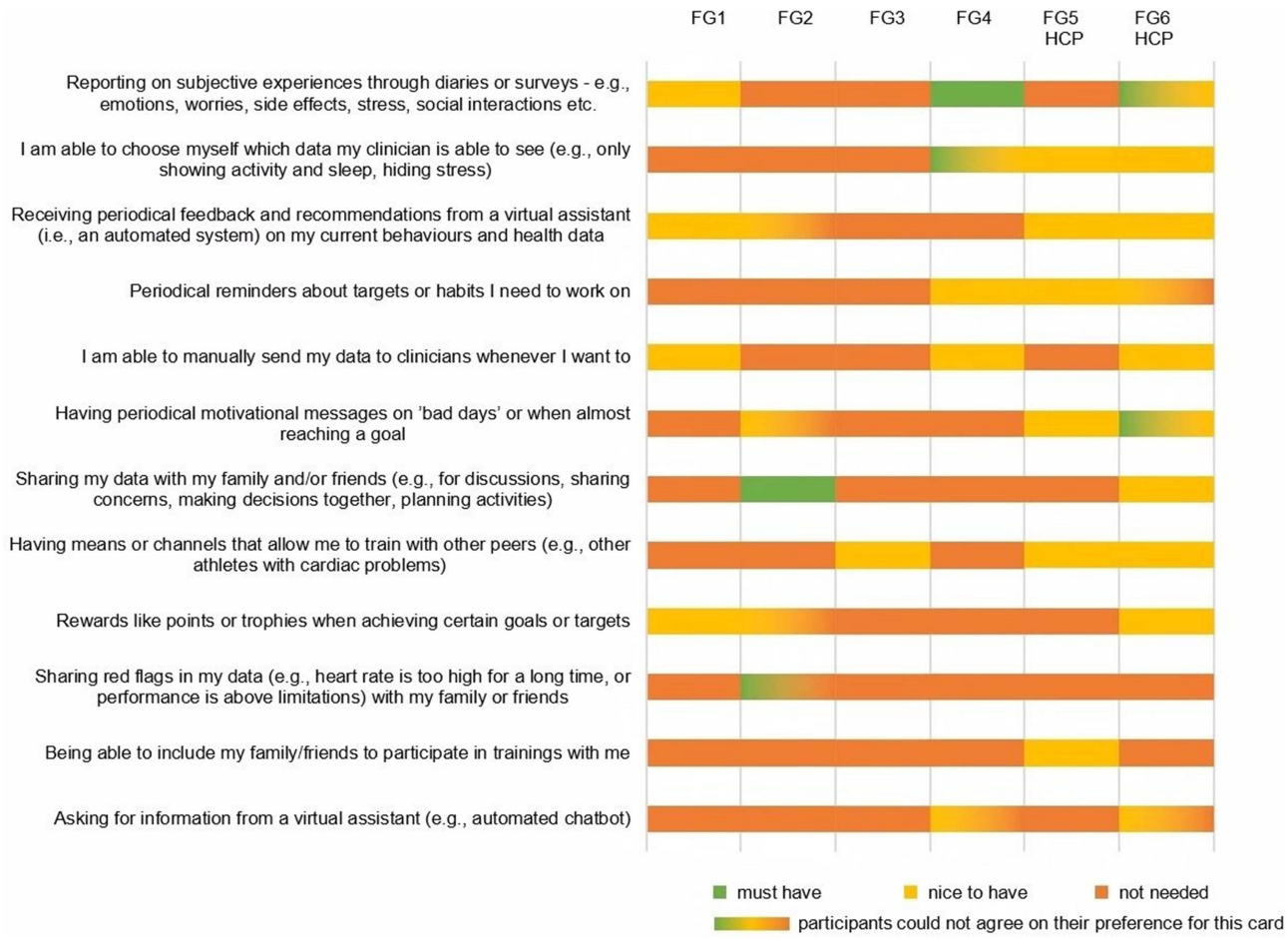

Figure 5 Less relevant cardiac telerehabilitation features, sorted from most to least preferred.

Monitoring Behaviors for Supervision and Oneself

The telerehabilitation system must be connected with sensors that can monitor activities and health parameters. A goal-oriented approach is preferred, where it is beneficial to set goals together with a clinician.

The representation of data in graphical form was rated as must have or nice to have, and comparison between actual data and clinical recommendations would be helpful. It would be nice to add periodical reminders if data has not been entered for a while.

Co-Experience (Social Aspect)

Evaluations about social support and communication with other patients varies between focus groups. It is mentioned that contact with peers can be offered, but that this should be optional.

Less Relevant Features of CTR Systems for Athletes

The CTR features classified as less relevant based on the FGs are presented in Figure 5. As athletes are highly motivated, there is no need for motivational messages. Data sharing options with relatives is not necessary, but can be optional. Some like to share the information with family or friends. The use of virtual assistants or chatbots is not preferred.

Discussion

Findings

Athletes participating in CR have different needs compared to less active patients, they face other goals and challenges in their rehabilitation process. The purpose of this qualitative study was to (i) identify the user needs and preferences of athletes in CR, and (ii) outline the technological features for a telerehabilitation platform tailored to this subgroup.

Key user needs encompass personalized exercise plans with clear and quantitative recommendations, monitoring of health and sports data, and measuring progress and performance over time. In addition, reliable healthcare information systems, clinical supervision and validation of data, and social support are important. The preferred technological features for a CTR system tailored for athletes align well with these needs and include periodic digital consultation with clinicians, home-based and sport-specific training, monitored workouts, data sharing and remote feedback, personalized exercise recommendations, and online educational materials. Less relevant features according to athletes are motivational messages, sharing data and alerts with family and friends, and engaging their support system in sports activities.

Interpretation Of Findings

Our findings emphasize the need to enhance CR for athletes and can provide guidance for developing a more sport-specific CTR solution. Some findings of this study are consistent with key features identified in previous research on CTR. A recent systematic review also revealed that personalized recommendations, bi-directional interaction between HCPs and participants, and reliable health information systems are crucial for telehealth-delivered CR to optimize cardiovascular health in individuals with CAD.[20] In the present study, we provide additional evidence that this is also the case in athletes with established CAD. Other features such as goal setting and remote monitoring of exercise have also been previously described in CTR in general populations.[20] Some athletes in the present study expressed anxiety in relation to exercise after their cardiac event, this has been similarly described in the study by Nilsson et al.[21] That study also described the need for a HCP with expert knowledge to provide clear instructions, encouragement and social interaction with the patient, which is in line with our findings. Because sports is something athletes identify with, it is even more important to guide this group in their exercise behavior. Whether or not being allowed to reach their maximum exercise intensity has greater consequences for highly-active individuals then for the average patient. In fact, it is known from other cardiac diagnoses that exercise restrictions can cause significant psychological distress in athletes.[22] Identifying these individuals and providing adequate support could help them better cope and adapt to this situation.

This study adds new insights about the perspective of the more active participants in CR, such as the need for very clear recommendations and limitations for exercise, monitoring of both health and sports data, and measuring progress of fitness level and sports performance. This sports-specific approach is relevant for the athletic population and can enhance the quality of rehabilitation in this group. These findings are in line with general recommendations in case reports focused on CR in athletes and help to define the user needs even more specifically.[5–7] A French study compared the outcomes of CR between an athletic population and a low- or inactive active population, and they concluded that CR is also beneficial in active patients.[23] Their subpopulation of athletes represented approximately 6.4% of the total CR population, with this group exercising at least once a week with an average of 3.8 hours per week. This percentage may very between different CR centers and countries. Although physical activity is associated with a reduced risk of CVD, it is known that athletes are not immune to atherosclerosis. CAD is the most common cause of adverse cardiovascular events in middle-age and older athletes, stressing the clinical relevance for optimal rehabilitation in this group. Recent studies also show an association between exercise volume and intensity and the development of coronary artery calcifications and atherosclerotic plaques.[24–26] Endurance athletes show an increased prevalence of calcified plaques compared to the general population. Although the clinical relevance of these findings and the best management strategies are not well established, it requires a more individualized approach to guide these athletes during their rehabilitation. Collaborative decision-making concerning the type and intensity of sports activities is crucial in the management of this group.[27]

Future Perspectives

The results of this study can be used for designing a tailor-made CTR solution and improving the care pathway of athletes in CR. Innovative monitoring solutions and wearable technologies can be valuable in this process. Although this research included only athletes with established CAD, the results can also be useful for athletes with other cardiovascular conditions that are referred to CR.

The use of wearable sensors for remote monitoring is a preferred feature from the athletes' perspective, but can also support clinical management by the HCP and therefore potentially mitigate the risk for exercise-related adverse events. Compared to non-athletes, athletes with myocardial ischemia often have a lack of symptoms despite (subclinical) CAD

due to the greater coronary reserve.[27] In these athletes, other parameters such as a decrease in exercise capacity, may be a sign of disease progression. Integration of remote monitoring of key parameters, like maximum oxygen uptake, the chronotropic response to exercise and heart rate variability, could be beneficial during CTR.

Another important perspective from this study is the fact that athletes report anxiety among family members regarding exercise with a cardiac condition. Therefore, further research on the role of caregivers in CR is needed. Involving family members might help reduce anxiety and support the rehabilitation process. Moreover, not all athletes return to their former sports level, suggesting that more research is needed on the effectiveness of a more tailored approach in this group.

Strengths and Limitations

While CTR has been proven to be a good alternative to center-based CR, its effectiveness may vary among different patient subgroups. This qualitative study investigates the perspectives of athletes and other key stakeholders regarding optimization of (tele)rehabilitation in active patients. This study has yielded valuable insights that can be applied to enhance the CR in this subgroup. The study has a strength in terms of including interviews and focus groups with both athletes and experienced multidisciplinary HCPs, providing a broad perspective. This is consistent with the preferred principle of involving end users in early phase of design.[28,29]

This qualitative study has limitations. First, this research included only one female athlete. Although this is consistent with the fact that most athletes with CAD are men, women may have different goals, needs and preferences during rehabilitation.[24,30] Women are understudied in C(T)R research and their enrollment and adherence are lower than men.[31,32] More research is needed to optimize this, taken into account gender differences and preferences in both general and athletic CR populations. Secondly, a pre-selection of technical features for a CTR system was used as the basis for identifying the most preferred features. However, it was possible for participants to mention other functionalities as well.

Conclusion

This qualitative study defined various user needs and preferences of athletes participating in cardiac rehabilitation, adding new insights about the perspective of the more active participants in CR. A more personalized and sport-specific approach could enhance CR for athletes with established coronary artery disease. The integration of various technological features into a tailored CTR program could improve the care pathway of athletes in CR and support them to maintain a healthy lifestyle and regain their previous athletic performance.

Data Sharing Statement

Data are available from the corresponding author upon reasonable request.

Acknowledgments

We are grateful for the valuable collaboration with patients and clinicians who participated in this research. We thank Bibi van der Meulen for her assistance with transcription.

Funding

This work was supported by the ITEA INNO4HEALTH 19008 project.

Disclosure

Ms Irina Serban reports grants from ITEA, during the conduct of the study. The authors report no conflicts of interest in this work.

The abstract of this paper was presented at the ESC Preventive Cardiology Congress 2024 as a poster presentation with interim findings. The poster's abstract was published as supplement in European Journal of Preventive Cardiology: https://doi.org/10.1093/eurjpc/zwae175.202.

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