Exploring the barriers and facilitators experienced by patients with heart failure when using popular exergaming platforms for self-management—a systematic review

**Elham Ravani[1], Fai Ali[1], Sara Albuainain[1], Sara Flamarzi[1], Tuqa Dirar[1],
Michelle O'Brien[1] and Linzette Morris[1]** (iD)

Abstract

Objective: To systematically explore the barriers and facilitators experienced by patients with heart failure when using the most popular commercially-accessible digital exergaming platforms for self-management.

Methods: A systematic literature search was conducted in: *Embase, SCOPUS, PubMed*, and *ProQuest*. Qualitative/mixed methods studies published in English between 2000 and 2024, including adults >18 years with heart failure using digital gaming platforms for exercise as self-management (i.e. Microsoft Xbox/Kinect, Sony PlayStation®, Nintendo™ Wii) were considered. Risk of bias was assessed using the Critical Appraisal Skills Program. The grounded theory method was used to extract, analyze, and synthesize the data.

Results: Three articles which qualitatively reported on the experiences of the patients with heart failure when using Nintendo™ Wii for self-management were included. Seventy-nine participants (male and female, age 32–81 years) were included in the studies. The three included studies were of high quality. Extracted qualitative data were grouped into subthemes, which were grouped into main themes, namely, *Engagement, Apathy, Convenience, Health-related benefits* and *Gaming Platforms*. The main themes were categorized into *Barriers* and *Facilitators*. Patients reported that gaming platforms were simple, easy to use, interesting, and motivating (*Facilitators*). Boredom while playing specific games, preferring other activities and technical issues were reported as *Barriers*.

Conclusion: This review provides the first insights into the barriers and facilitators patients with heart failure experience when using popular digital exergaming platforms to participate in exercise programs in the self-management of their condition. However, few high-quality studies exist which limits the conclusions made and warrants further research in this area.

Keywords

heart failure, gaming platforms, perceptions, experiences, perspectives, barriers/facilitators

Submission date: 5 September 2023; Acceptance date: 10 April 2024

Introduction

Heart failure is a chronic debilitating condition which has a significant effect on a person's life and is often linked to poor prognosis, excessive healthcare utilization, and frequent hospitalization.[1–3] People with heart failure typically

[1]Department of Rehabilitation Sciences, College of Health Science, QU Health Sector, Qatar University, Doha, Qatar

Corresponding author:
Linzette Morris, Department of Rehabilitation Sciences, College of Health Science, QU Health Sector, Qatar University, Doha, Qatar.
Email: lmorris@qu.edu.qa

have shortness of breath, decreased physical ability, decreased quality of life, fatigue, and moderate to severe difficulties performing activities of daily living, which worsen over time.[4] Categorized as a global pandemic, the number of people living with heart failure reached approximately 64.3 million worldwide in 2020 with the estimated global economic burden of heart failure reaching approximately $108 billion per annum.[2–4] The impact of heart failure on society, individuals, their families, the healthcare system, and the economy of a country is therefore significant and concerning.

The management of heart failure requires continuous symptom self-monitoring, adherence to prescribed medications, changes to diet and lifestyle, regular participation in exercise regimens, and overall symptom management.[4,5] Cardiac rehabilitation programs are often prescribed to patients with mild to moderate heart failure and other cardiac conditions, and are effective in improving and maintaining symptoms, preventing further complications, reducing hospitalization and healthcare utilization, and improving quality of life.[5,6] Typically consisting of different components of education, behavior changes, and psychological counseling and support, cardiac rehabilitation programs mainly consist of exercise regimens which can be home- or hospital/clinic-based.[5,6]

However, despite the benefit of cardiac rehabilitation programs for patients with heart failure, only 14% to 30% of patients reportedly engage in these programs, whether they are home- or hospital-based.[6–8] For the hospital-based programs, lack of transportation, lack of motivation, inability to travel long distances, lack of resources, lack of cardiac rehabilitation specialists, lack of accessibility and long waiting periods to see a rehabilitation specialist, are reported as reasons for nonadherence to such programs.[6–8] Clinical practice guidelines for patients with heart failure therefore highly advocate in order to maintain patient outcomes, self-management should form a large part of a patient's management plan, and cardiac rehabilitation programs should extend to the home.[5,9] However, patients with heart failure typically do not well adhere to self-management programs, especially exercise programs, and for patients who are less motivated, simply prescribing a regular and traditional exercise program for them to participate in at home, may not be as enticing.[9]

For this reason, digital platforms using gaming technology, and also referred to as "exergaming," have emerged as an alternative to providing traditional home- and hospital-based exercise programs and other self-monitoring programs and offers a new and exciting avenue to engage in cardiac rehabilitation at home and between hospital visits.[10,11] Exergaming is typically defined as, "*the playing of video games that requires rigorous physical exercise, that is intended as a work-out and during which the participant moves large muscle groups in response to cues.*"[10] The most popular and commercially available digital gaming systems used to deliver exercise programs for patients

with heart failure and other cardiac conditions, are Nintendo™ Wii, Sony PlayStation®, and Microsoft Xbox/Kinect,[10–13] mobile applications, virtual reality (VR) headsets, PC games, and specifically-designed sensor-controlled digital games.[12,13] These digital gaming platforms can be employed in the hospital and supervised by a clinician, or can be used at home by the patient, unsupervised.

Although the evidence reporting on the effect of exergaming on patients with heart failure is still limited, there seems to be agreement that the use of exergaming for self-management, is safe and feasible, and superior to conventional cardiac rehabilitation programs.[10,11] Nonetheless, in conjunction to confirming the effect of exergaming on patient outcomes, a systematic understanding of the barriers and facilitators experienced and perceived by patients with heart failure toward exergaming, is also required. Qualitative systematic reviews can uncover new insights, often clarifying the "why" and assists in theory development.[14] In clinical practice, qualitative data can be used to assist decision making, enhance patient-provider communication, and improve patient educational resources and clinical quality metrics by identifying and thereby addressing typical barriers and facilitators, which may affect patient outcomes.[14] Accordingly, understanding patients with heart failure's experiences and beliefs about exergaming in the self-management of their condition can help clinicians better engage with patients and provide care that meets the patient's needs. To our knowledge, there has not been a qualitative synthesis of experiences (with emphasis on barriers and facilitators) of patients with heart failure when using popular commercially-available digital gaming (exergaming) platforms, such as Nintendo™ Wii, Sony PlayStation® or Microsoft-Xbox, in the self-directed monitoring and management of their condition. The focus on these "off-the-shelf," commercially-available gaming platforms in this review is due to the fact that although exergaming is gaining popularity and is showing promise, if the intended population experiences barriers in using exergaming platforms, then the effect of the intervention will not be realized.[15] This systematic review aimed to synthesis the qualitative literature which explores the barriers and facilitators experienced and perceived by patients with heart failure using the most popular commercially-available digital exergaming platforms, that is, Nintendo™ Wii, Sony PlayStation®, or Microsoft Xbox/Kinect, for self-management of their condition through exercise. It is envisaged that this qualitative synthesis will provide insights into the barriers associated with using exergaming platforms in the self-management of people with heart failure and also identify the strategies to facilitate the use of exergaming platforms in the intended population.

Methods

This systematic review follows the Grounded theory (GT) method that consists of five stages, namely: (1) identifying the key research questions, appropriate sources, and search

terms; (2) searching for potential papers; (3) defining the filter for the selection of papers and refining the sample for review; (4) conducting a comparative and in-depth analysis of the papers through three coding levels; and (5) representing the emerging categories and concepts.[16] Key assumptions of the GT method include: "simultaneous data collection and analysis; an inductive approach to analysis, allowing the theory to emerge from the data; the use of the constant comparison method; the use of theoretical sampling to reach theoretical saturation; and the generation of new theory."[17] PROSPERO was searched to identify any similar systematic reviews in progress. None were found. The protocol for the current systematic review was registered with PROSPERO (registration number: CRD42022311149).

Search procedure and strategy

To develop the research question, the SPIDER (Sample, Phenomenon of Interest, Design, Evaluation, Research type) framework was used.[18] A systematic search strategy was developed using a combination of Medical Subject Headings (MeSH) and controlled vocabulary (see Supplemental Appendix A). The selected keywords used to develop the search strategy were: *congestive heart failure, heart failure, Nintendo™ Wii, Sony PlayStation®, Microsoft Xbox, digital gaming platforms, video games, virtual reality, gaming platforms, perceptions, experiences, views, perspectives, barriers, facilitators*. A comprehensive search using the developed search strategy was conducted in the following databases: *Embase, SCOPUS, PubMed*, and *ProQuest*, available through the Qatar University Library website between mid-January 2022 and mid-February 2022. An updated search was conducted in February 2024. For a study to be considered, the selected keywords had to be present in the title, abstract, or keyword list of the publication. Where necessary, authors of potential papers were emailed for additional information. However, no responses were received prior to finalizing this manuscript. All the reference lists of the eligible studies were checked for any additional relevant articles not found in the databases.

Study eligibility criteria

This review was concerned with the barriers and facilitators patients with heart failure experienced or perceived when using popular commercially-available digital platforms for exergaming, namely, Nintendo™ Wii, Sony PlayStation®, Microsoft Xbox/Kinect for the self-management of their condition. Research published between 2000 and 2024, which focused on adults >18 years old with heart failure, examined perceptions/experiences of patients with heart failure toward using digital platforms (i.e. Nintendo™ Wii, Sony PlayStation®, Microsoft Xbox/Kinect, etc.) for self-management, and published in the English language were all considered for inclusion. Qualitative studies, or

mixed methods studies which included a qualitative component, were deemed eligible to include. Grey literature such as published conference proceedings were considered if they were peer-reviewed and indexed in either PubMed, Embase, Scopus, or ProQuest. Studies which included patients with other cardiac conditions (but did not provide separate date for patients with heart failure) or reported on the use of digital gaming platforms for cardiac rehabilitation in the clinic or hospital, and not as a self-management tool, were excluded. Studies reporting on the use of mobile applications or digital platforms which were not exercise focused or not commercially-available, were excluded.

Screening and data extraction

Four authors (SA, SF, TD, and ER) conducted the search and screening processes in the four databases (PubMed, Embase, ProQuest, and Scopus). The authors divided themselves into two groups, and each group searched two databases. The search results were pooled, and duplicates were removed. After removing duplicates, the authors screened the retrieved papers based on title and abstract. Protocols, systematic reviews, workshops, and papers involving pediatric populations were excluded at this stage. In the final screening process, the studies which all the reviewers agreed upon were subjected to the full-text review. The authors explored the potential papers if they applied qualitative methods or included any qualitative data if they were mixed methods, or pilot studies. A fifth reviewer (FA) was consulted when there were any discrepancies between reviewers at any stage.

For the data extraction process, articles were divided among the four reviewers (SA, SF, TD and ER), with two reviewers assigned to each study. Qualitative data were independently extracted by two reviewers for each study, independently. After all data extraction was completed, the two reviewers compared their findings to identify any discrepancies. Data were extracted using the following categories: *country, year of publication, study aim, study design, study setting, study population, study population age, number of participants, digital gaming platform employed, method of heart failure classification, methods used to collect* and *analyze qualitative data*. Qualitative data were extracted and collected using the GT method.[16]

Quality assessment

Qualitative studies that met the eligibility criteria were subjected to a methodological quality (risk of bias) assessment. The quality appraisal of each included article was conducted independently by the two groups of reviewers (SA/SF and TD/ER) using the Critical Appraisal Skills Program (CASP) checklist.[19] The results were further discussed to ensure consistency between groups. This CASP

checklist for qualitative studies consists of ten questions with three choices that can be answered with "yes," "no," and "can't tell." In case of disagreement between the reviewers, a fifth reviewer (FA) was consulted to make the final decision.

Data handling, analysis, and synthesis

Prior to data synthesis, the completeness of the qualitative information presented in the included studies was checked and data were organized and prepared for analysis. Qualitative data were handled, analyzed, and synthesized according to the GT method.[16] Each studys data was systematically tabulated, with major findings and relevant outcome indicators collected and grouped in a structured format. Thematic analysis was conducted to find recurring patterns and themes in the included studies. Three levels of coding including *open coding, axial coding*, and *selective coding* were applied in the analysis process of the data, as outlined in the GT method by Wolfswinkel et al.[16] During the *axial coding step*, excerpts extracted from the included studies were articulated to form insights. Reviewers performed an affinity mapping exercise using these insights which resulted in the establishment of subgroups and groups of themes. During the *selective coding step*, groupings were then compared followed by reviewer discussions to develop themes. Themes were modified iteratively via continual comparison and discussion among reviewers until a final consensus was obtained. The results were synthesized using a narrative method, with findings organized into broad themes and reinforced by illustrative quotations or data snippets from included studies to provide context and depth to the findings. The synthesis themes were analyzed with respect to the study question and objectives, with a focus on the implications for practice, policy, and future research prospects.

Through this comprehensive process, specific themes could be identified and classified as either a *Barrier* or *Facilitator* when using digital gaming platforms for exergaming in the self-management of heart failure. *Barriers* were defined as aspects which hindered patients' experiences either by making the use of these platforms difficult or by decreasing the appeal of the technology. *Facilitators* were defined as the factors that contribute to increasing the adherence to and the appeal toward using gaming platforms in self-management of heart failure. The subthemes that emerged from the included studies were further grouped into main themes, which were broadly categorized into *Barriers* and *Facilitators*.

Results

The comprehensive database search yielded an initial total of 1663 articles. After the duplicates were eliminated and articles were removed for other reasons, 735 articles remained for screening. Following the screening, 714 articles were excluded from the title alone and 11 articles were excluded after reading the abstracts. The final list of eligible studies included ten articles that entered the full-text review stage. An updated search of the literature in February 2024, yielded an additional study. Of the 11 studies, eight studies were excluded[20–27] as they were found to not include qualitative data,[20,21,23] were duplicates,[24] did not specify the gaming platform used or reported on other types of digital platforms which were not popular and commercially-available,[20–22,26,27] and did not provide separate data for patients with heart failure.[25] Three qualitative articles met the eligibility criteria and were therefore included in the systematic review.[28–30] Figure 1 illustrates the screening and selection process followed in this review using a PRISMA diagram.

Study characteristics

The study characteristics for the included studies are presented in Table 1.[28–30] One of the included studies were conducted in the United States,[28] while two studies were conducted in Sweden.[29,30] The study population included in all the studies were patients living with heart failure.[28–30] All the studies aimed to understand the experiences of patients living with heart failure when a commercially-available digital gaming platform was used as a self-management tool for exercise.[28–30] All three included studies focused on using Nintendo™ Wii and used the Wii Sports packages.[28–30] No studies reported on employing Sony PlayStation®, Microsoft Xbox/Kinect, or any other popular commercially-available digital gaming platform. A total of 79 patients with an age range of between 32 and 81 years were included in the studies.[28–30] Male and female participants were included in all three studies.[28–30]

Only two of the three included studies provided details of the specific type of heart failure according to the New York Heart Association (NYHA) classification.[28,29] Cacciata et al.[28] reported that patients included in the study were mainly diagnosed with class II of heart failure, while Jaarsma et al.,[29] included patients mainly diagnosed with classes I–II of heart failure.

All three included studies were qualitative descriptive,[28–30] and data were collected using semistructured interviews or via protocolized phone calls. Content analysis approaches were used to analyze the data in all three included studies.[28–30]

Quality assessment

The three included studies were evaluated using the CASP tool, and the results of the evaluation indicated that the included studies were of high quality, with a score ranging from 7 to 9 out of 10.[28–30] There was no cut-off score to exclude studies and no disagreement occurred between the reviewers during the appraisal process of the included studies.
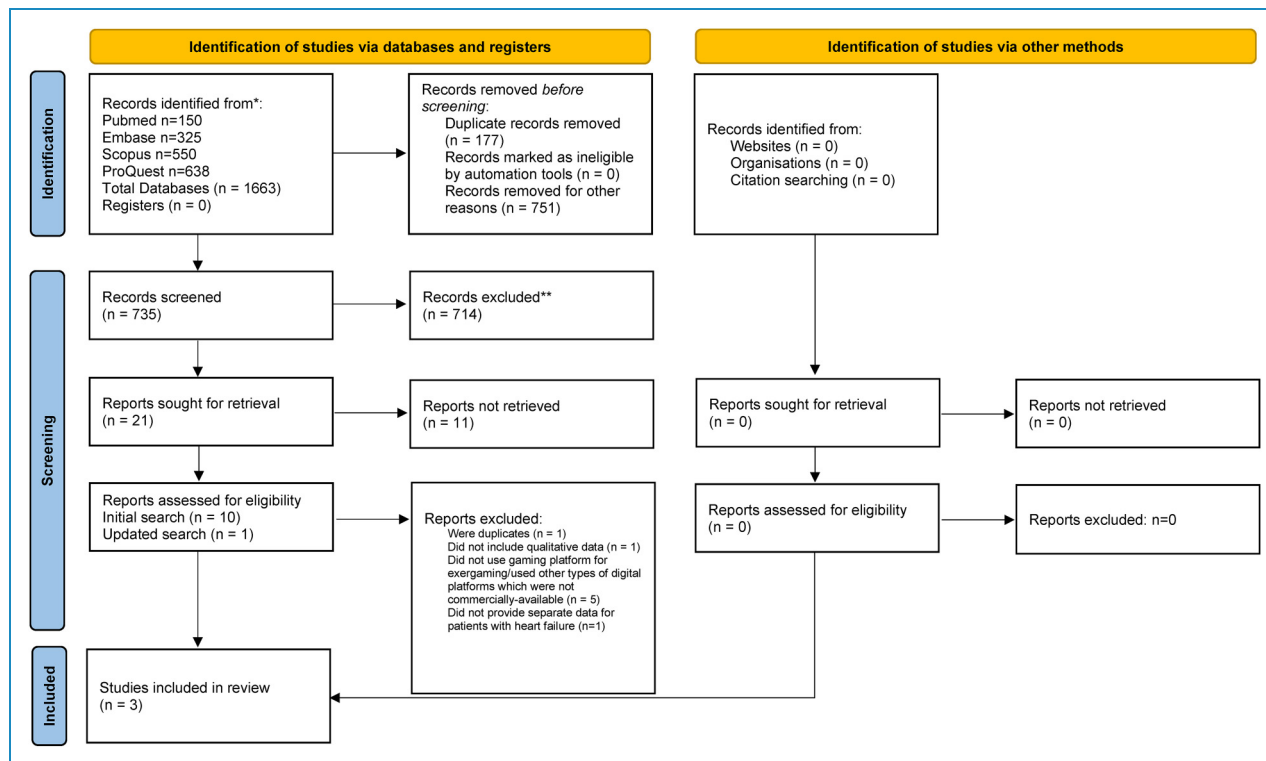
Figure 1. PRISMA flow diagram. *From:* Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/.

Emerging themes identified from included studies

The findings identified various aspects categorized into sub-themes. *Boredom, Other preferences, Game-related issues,* and *Technical challenges* which were further categorized under the main theme *Apathy.* Aspects related to *Physical fitness, Psychological health,* and *Self-monitoring* were further categorized under the main theme *Health-related benefit.* Aspects related to *Accessibility* and *Simplicity* were categorized under the main theme *Convenience.* Aspects related to *Interest, Motivation,* and *Family involvement* were categorized under the main theme *Engagement.* The main themes were classified as *Barriers* or *Facilitators.* Figure 2 illustrates the categorization of the findings into the subthemes and main themes, etc. Tables 2 and 3 presents the summarized findings of the *Barriers* and *Facilitators* for each subtheme and provides example quotations extracted from the included articles which summarizes the subtheme most accurately.

Discussion

To our knowledge, this is the first systematic review to synthesize qualitative research on the *Barriers* and *Facilitators* of using popular commercially-available digital gaming platforms, specially the Nintendo™ Wii, for exercise in the self-management of patients with heart failure. This review identified five main themes and 12 subthemes that were broadly classified into two main categories: *Barriers* and *Facilitators.*

Barriers when using gaming platforms in the self-management of heart failure

One category related to *Apathy* identified in the included studies as a *Barrier* was *Boredom.* According to the included studies, although the use of the Nintendo™ Wii led to an increase in the adherence rate to physical activity, adherence progressively declined over time. Feelings of *Boredom* were reported as the main factor causing decreased appeal to exergaming by most of the studies. The included studies reported that *Boredom* was significantly related to the lack of game diversity, as well as decreased challenge and competitiveness.[28,29] This finding is similar to the findings of a study conducted to implement exergaming in a school's physical education curriculum.[31] It was found that multi-exergaming formats appeared to combat boredom in their participants.[31] According to the authors, game diversity must be considered to assure that games are tailored to people's interests and capacities. It is therefore suggested that clinicians

Table 1. Study characteristics of included studies (n = 3).[28–30]

| Study reference	Title	Year	Country	Study aim	Study design	Digital gaming platform	Program	Population	Sample age	Sample gender	Sample size	Data collection tools/outcome measures	Analytical approach	Quality of the study
Cacciata et al.[28]	Facilitators and challenges to exergaming: Perspectives of patients with heart failure	2022	USA, Southern California	To analyze factors that facilitate and hinder the use of exergame platforms at home for patients with heart failure.	Qualitative descriptive study	Nintendo Wii	Wii Sports	Adults with heart failure	34–69 years (mean age 57 years)	Both male and female (62% were males)	13	Semistructured interviews	Content analysis	High
Jaarsma et al.[29]	Exploring factors related to nonadherence to exergaming in patients with chronic heart failure	2021	Sweden	To investigate factors associated with nonadherence to exergaming in patients with heart failure in order to improve future interventions.	Qualitative descriptive study	Nintendo Wii	Wii sports	Patients with heart failure >18 years	Mean age 66 ± 12 years	72% male	52	Protocolized phone call	Content analysis	High
Klomptra et al.[30]	Exergaming through the eyes of patients with heart failure: A qualitative content analysis study	2017	Sweden	To explore perceptions of patients with heart failure regarding using exergaming at home.	Qualitative descriptive study	Nintendo Wii	Wii sports	Adults with heart failure (purposive sampling)	54 and 81 (mean age 70 years)	6 women and 8 men participated	14	Semistructured interviews	Content analysis	High
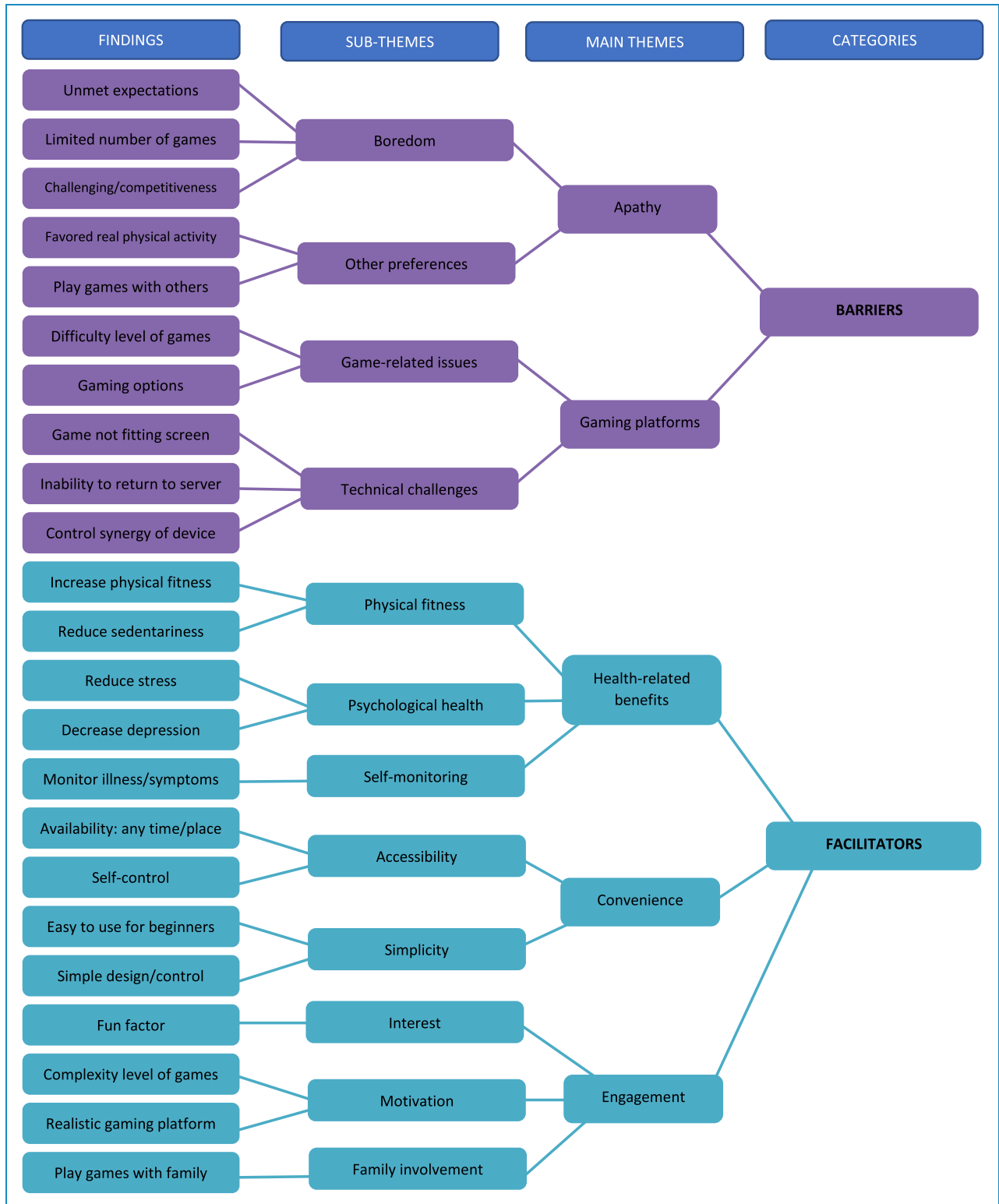
Figure 2. Mapping of findings, subthemes, main themes, and categories.

who prescribe exergaming as a tool to manage their patients, or as a self-management tool, should provide individuals with a diversity of games to promote engagement and prevent boredom. In addition, in practice, individual cultures, preferences, and capabilities should be considered when prescribing a game. Games used on these platforms

Table 2. Facilitators—summarized findings of subthemes from included studies.[28–30]

Theme	Category	Summarized findings	Example Quotation(s)
Convenience of gaming platforms This theme focuses on how participants viewed the usage of gaming platforms in terms of the ability and ease to proceed with it. All of the studies included discussed convenience of gaming platforms as a facilitator in the utilization of gaming platforms.[28–30] This theme included two subcategories including *accessibility* and *simplicity*.	*Accessibility*	There was consistency in the findings across the studies regarding the *accessibility* of the gaming platforms. The patients reported that gaming platforms were accessible to use at home on demand regardless of any external circumstances. Patients across studies perceived that exergaming enabled them to play and perform their exercises at any time, during harsh weather conditions, or when they were concerned to exercise outside because of their heart condition.[28,30] Furthermore, patients reported that the accessibility of these gaming platforms offered them a sense of control, which increased their engagement.[28]	*"It was probably useful at the beginning when I was at home using the game instead of going out for a walk alone. Because then I was a bit worried to go out and walk alone. with my heart in the beginning. But I have come to realize that it is not dangerous. Gaming is now a great addition to some other activities."*[30]
	Simplicity	Studies concurred on the simplicity of these gaming platforms which made it convenient for users who had no prior experience with videogames.[28] Participants found that the gaming platforms were user-friendly especially after the initial orientation to the gaming system.[28]	*""Exergaming was easy due to the introduction".*[30]
Engagement This theme explores participants' experiences which encouraged and facilitated their participation and involvement in the gaming platforms. This theme included three subcategories including *interests, motivation, and family involvement*. All of the studies included discussed engagement as a facilitator for the utilization of gaming platforms.[28,30]	*Interest*	Two studies reported that participants described exergaming as an interesting platform for the management of patients with heart failure.[28,30] In one study it was reported that the "fun factor" behind this game drew the participants' attention towards exergaming.[28]	*"I love it, it's fun, it's competitive... it's always fun to have games and things like that...it's engaging"* [28]
	Motivation	Two studies showed that participants were committed to use gaming platforms due to motivation.[28,30] Most of the participants motivated themselves by setting specific aims that they wanted to achieve after each game such as improving their previous score. For some participants, the challenge and complexity of a games lead to encouraging participants to play more. Additionally, it made	*"I fantasized I was out on the tennis track. When I lived in Spain for a while. I lived near a tennis court. And I heard people playing tennis. So, I went there in my thoughts (during exergaming)."*[30]

Table 2. Continued.

Theme	Category	Summarized findings	Example Quotation(s)
		participants excited to improve their previous score after each game, which lead them to become experts in using the platforms.[28,30] Furthermore, some of the participants reported that the games were like the games played in the real world, which motivated them to play more.[30]	
	Family involvement	One study described that the participants who did not use gaming platforms at all were living alone in comparison to participants that used this platform.[29] It was therefore recommended that platforms which provide options for involvement of others may increase engagement of these individuals. Two studies showed that participants who involved their family members were delighted when using this platform.[28,30] Also, most of the participants reported that it increased family bonds.	*"They thought (the grandchildren) it was fun to beat the grandmother of course. I have always liked to play different stuff. We have always been a family that liked to play games. Of course, it's fun, better than to play alone."[30]*
Health related benefits This theme focuses on patients' experiences on the benefits of using the platforms on their health. It is further subcategorized into *physical fitness, psychological health,* and *self-monitoring.* Three of the included studies discussed the health-related benefit of the use of the gaming platforms.[28,30]	*Physical fitness*	Of the three included studies, only two studies reported gaming platforms as a facilitator to increasing physical fitness.[28,30] Gaming platforms were found to assist patients in a successful transition from sedentary to active lifestyles. Patients claimed gaming platforms improved their physical fitness and helped them remain healthy.	*"Doing something in front of the TV... It helps create an environment where you are more active even if I'm just using my arms."[28]*
	Psychological health	The positive impact of exergaming on multiple psychological dimensions has been highlighted in one study.[28] It was reported that spending time on gaming platforms helped to reduce stress and ease depression.	*"It got me motivated a bit. It's a good stress reliever."[28]* *"With the Wii, you turn it on, play something, and all of a sudden next thing you know, half an hour's gone...time goes by, and stuff it takes care of depression".[28]*
	Self-monitoring	One of the three included studies highlighted the impact of gaming platforms on monitoring disease through exercise capacity.[30] It was mentioned that gaming platforms were found to be effective in monitoring improvement and tracking achievements. Furthermore, patients were pleased that the system tracked their daily performance.[30]	*"Gaming is now a great addition to some other activities."[30] I have got a little competitive spirit too, and try to win as much as possible. It was also a challenge all the time... In terms of winning every day... Playing games and setting a new record every time. It was a challenge to constantly improve yourself, to get better and gain better results".[30]*

Table 3. Barriers—summarized findings of subthemes from included studies.[28–30]

Theme	Category	Summarized findings	Example quotation(s)
Apathy lack of interest This theme highlights the lack of interest as a major hurdle for using gaming platforms. The theme is further categorized into *boredom* and *other preferences*. Three of the included studies reported apathy as a barrier to using gaming platforms.[28–30]	*Boredom*	Most studies showed that the participants had a strong initial interest in gaming platforms. However, due to the limited number of games available on the platform, several participants expressed boredom. In addition, it was reported that diminished challenge and competitiveness within the computerized-based gaming system reduced interest in the games. Consequently, most of the research revealed that boredom influences exergaming adherence, which steadily declines over time. Cacciata et al. (2022) and Jaarsma et al. (2021) reported a decreasing trend in exergaming adherence throughout the duration of the program, which was evident after 10 days and 4 weeks, respectively.[28,29] According to the studies included, overplaying a single game in a short period, or playing a game that is easy to anticipate, generates a prediction toward how to perform in the game. This, in turn, leads to boredom. Unmet expectations, on the other hand, can lead to disappointment and, ultimately, lack of interest.[28] The participants' boredom levels increased with time due to the constraints on the gaming platforms. Participants became bored due to a lack of tough levels, award points, competitiveness, and improved versions on gaming platforms.[28]	*"Wii was good, but it gets boring after a while...it's the same game I play over and over again...you anticipate the moves... I already beat the game."*[28]
	Other preferences	Some participants expressed their preferences, in which extroverted personalities preferred to play games with others to increase the amount of fun and enjoyment. On the other hand, others favored traditional physical activity over virtual games, such as walking outdoors. Patients preferred to be active in another way than exergaming (e.g. walking, gardening, or being physically active outside).[29]	*"I'm probably more a group person than I am an 'alone' person. I do not like it that much to be alone. I'm alone almost all the time and physical things are more fun to do with someone. It is much more fun if you have someone to talk to.'*[28]
The gaming platforms This theme describes participants' experiences with challenges that arose from the gaming platforms themselves. Gaming platform-related challenges were further	*Technical issues*	The users faced problems while using the gaming platforms in terms of the device, controller, and/or the connection between the two. Participants expressed frustrations regarding the game not fitting the screen, inability to	*"I don't like it when it doesn't fit the screen and I have to scroll.", "I don't like the controller stick."*[28]

Table 3. Continued.

Theme	Category	Summarized findings	Example quotation(s)
divided into two subcategories including *technical issues* and *issues related to the games.* The three included studies discussed barriers specifically related to the gaming platforms.[28–30]		return a server, and the controller stick synergy with the device.[28] These issues hindered the patient's experiences and shifted their interest away from using the platforms. Jaarsma et al. (2021) identified technical challenges with exergaming as one of the main reasons for patients' nonadherence to exergaming.[29] This was the only study reporting patients facing difficulties in following the instructions and lacking confidence with using technology.	
	Game-related issues	Patients expressed that some of the games were difficult to play which affected their self-efficacy.[28] Others suggested that adding more gaming options to match different interests would enhance the users' motivation to use the platforms.[28]	*"Bowling was not particularly difficult when you started. Golf on the other hand could be a little troublesome. It was more difficult. In boxing you try to not get hit. You had to move your arms very much. So, it was pretty tough actually."* [28]

should therefore contain a diverse selection of activities and sports for people of various fitness and functional levels to keep the interest of patients and reach the desired outcomes.

Another aspect to consider in relation to reducing *Boredom* is the time spent within the programs and how to ensure patient adherence. Cacciata et al.[28] and Jaarsma et al.[29] reported that the adherence to exergaming while using the Nintendo™ Wii, declined within ten days and four weeks, respectively. This finding needs to be considered since these programs are aimed at self-management and adherence is critical to ensure the best health outcomes for the patients. Therefore, keeping this in mind, clinicians should ensure that within the self-management program regular follow-up sessions are arranged to assess the motivation of the patient and adjust where required to prevent boredom and nonadherence.

Another category related to *Apathy* was *Other preferences*. According to the included studies which reported on patient preferences, some participants preferred exergaming in groups and with their families.[30] This finding is similar to a pilot study conducted on patients with heart failure which reported on the time patients spent on exergaming in the initial six weeks compared to the past six weeks.[32] It was reported that both male and female patients had decreased their time spent exergaming in the past six weeks. However, patients who played for a longer period often had grandchildren involvement compared to patients

who played for a shorter period.[32] It is well known that exercising with others gives social support, engagement, and connectivity, which may result in greater motivation to exercise and hence improve adherence.[30,32] Group play incorporates social interaction and connectivity, which is a motivating element to engage in physical activity.[32] Similarly, encouragement from friends and family, as well as playing with others, may enhance long-term exergaming participation.[30,32] Clinicians should therefore consider patients' preferences to use the platforms alone or with others/families, and how this might be structured within the home to produce the optimum benefits. The games available in the platforms that allow for group activities should be considered as well. In addition to patient preference, though not a finding in this review, gender preferences should also be considered when prescribing exergaming as a self-management tool for patients with heart failure. Klompstra et al.[32] found a variance in male and female interests, preferences, and time spent exergaming. According to the authors, men preferred exergaming more than women. It is therefore suggested that gender preferences should be evaluated and considered in research and in clinical practice. Future research should consider initial exergaming orientation sessions to assess participants' preferences, thus implementing a variety of games that address their preferences on gaming platforms and increasing patient adherence.

This review also identified challenges related to the Nintendo™ Wii that hindered patients' experiences of using digital gaming platforms in the self-management of heart failure. One of the subthemes related to this category was *Technical issues*. Studies included in this review reported technical difficulties such as delays in response and the game not fitting well on the screen.[28,29] These results were expected and consistent with the findings of the review by Bezerra et al.,[33] who reported technical issues as one of the main barriers of using mobile apps in the self-management of heart failure. This proves that technical issues remain a challenge for patients despite the differences in the type of technology used between the two reviews. Therefore, program developers should consider those technical challenges by subjecting the programs to more trials before providing them to patients. Regular check-ups and new updates for the programs should be available to maintain the quality of the program and "keep up" with the trends. Providing introductory sessions and practice for the patients before the implementation of technology at home is also recommended for the clinicians.

Facilitators when using gaming platforms in the self-management of heart failure

Sub-themes related to the convenience of using the Nintendo™ Wii and facilitated its use, were identified as *Simplicity* and *Accessibility*.[28,30] Patients with heart failure reported that the Nintendo™ Wii were simple and accessible to use when they are unable to leave their homes. This is consistent with the findings of other studies, reporting that exergaming can easily be utilized by elderly individuals in their homes who do not have access to transportation or gym accessibility.[34,35] In addition, the *Simplicity* and *Accessibility* elements of using Nintendo™ Wii is particularly useful for people with physical limitations who are unable to leave their house[34,35] or for whom transportation is problematic. Similarly, although a different population, Chan et al.[36] reported that exergaming can be a suitable alternative to traditional stroke rehabilitation since it is simple to use and easy to incorporate into home environment. However, the greatest advantage to the accessibility of these gaming platforms can be related to the effect the global COVID-19 pandemic had on healthcare accessibility and how access to healthcare was restricted in most countries. The COVID-19 pandemic and consequent lockdowns across the globe, restricted access to healthcare facilities and services, specifically outpatient rehabilitation services.[37] In addition, patients themselves were afraid to leave their homes and would rather risk not receiving healthcare than become infected. Considering the COVID-19 situation and other similar current or future situations, accessibility and the simplicity of gaming platforms becomes even more important to ensure the rehabilitation and self-management of chronic patients is not hindered significantly. Greater efforts are required to enhance the rehabilitation and self-management of chronic conditions through gaming platforms to reduce the burden on the healthcare system.

Based on the included studies, participants with heart failure experienced *Health-related benefits* that facilitated and promoted the usage of the employed gaming platform.[28,30] Participants with heart failure perceived that the Nintendo™ Wii increased their physical fitness. They found that gaming platforms increased their physical activity and reduced sedentary behavior. This concurs with a scoping review which reports that exergaming might be promising to enhance physical activity in patients with heart failure.[35] It is critical to emphasize that individuals with heart disease show a decline in fitness levels, which connects to being limited in day-to-day activities.[38,39] As a result, there is a considerable increase in cardiac mortality as sedentary behavior and physical inactivity have cumulative impacts on mortality in people with symptomatic chronic heart failure.[39] Gaming platforms, on the other hand, promote physical activity in this population by providing patients with a variety of games of varying intensity and energy demand from which to select their own preferences. Clinicians should take advantage of these gaming platforms and integrate them into patient rehabilitation and self-management, particularly to those who are more likely to be physically inactive, such as elderly adults.

Different studies have reported that the use of gaming platforms has a promising effect on enhancing psychological wellbeing. For older adults, the social connection that comes with the Nintendo™ Wii exergaming program is therefore valuable and beneficial. It resulted in a significant decrease in depressive symptoms and mental health-related quality of life.[34,35] Enhancement in the psychological benefit has also been reported in a different population. A study conducted on chronic obstructive pulmonary disorder patients found that a 12-week Nintendo™ Wii Fit training program resulted in substantial psychological and emotional improvements.[40] Despite various research supporting the use of gaming platforms to improve mental health, only one study in this qualitative analysis indicated an improvement in depressive symptoms and stress,[28] while other studies did not mention or address the mental health aspect.[29,30] This could be due to the nature of questions asked in the interviews conducted. Future qualitative studies should go further into participants' perspectives on their psychological wellbeing after using gaming platforms to learn more about how people perceived gaming platforms and how they relate it to their psychological wellbeing. Understanding the patients' mental health is very important, since people with chronic diseases are more likely to suffer from depressive episodes,[5] which can have a severe influence on clinical outcomes if left unrecognized.

It is reported that only 50% of patients with heart failure are committed and motivated to doing exercise.[41] A recent systematic review reported that exergaming improves motivation in patients with cardiovascular diseases, which leads to enhanced adherence to exercises.[11] Additionally, this result is similar to the finding of this review, where high motivation is a facilitator to exergaming.[28,30] It was expressed by patients in this review that what motivated them to exergaming was setting specific goals to achieve. In addition, the nature of gaming platforms that mimicked the environment of the real world also motivated the users. Clinical practitioners could therefore take advantage of exergaming and be more engaging with patients to increase adherence to exercises. This technology could be prioritized for patients who show low interest toward regular types of physical exercises to enhance their motivation toward exercises.

Furthermore, this review found that patients reported that family involvement made using this technology more joyful and engaging than playing alone. This finding correlated with the findings of other studies.[10,11,32] Blasco-Peris et al.[11] reported that playing with family members was associated with encouragement to play the game and enhanced adherence. In the study by Klompstra et al.,[32] patients played exergaming for only 28 minutes per day. However, having grandchildren was associated with increasing the period of playing. Since engagement of other individuals contributed to increased adherence, it is proposed that the gaming platforms might be developed in a way that allows patients with similar conditions to play together in a group and compete against each other. This could be devoted to encouraging and creating a competitive environment that could motivate patients to work harder to win against each other. Additionally, exergaming with others who have similar conditions allows patients to share their experiences, challenges, and learn from one another.

Limitations

This review faced with several limitations. Firstly, the review included a limited number of eligible studies, which restricts the conclusions that can be made. An understanding of patient's perspectives and beliefs related to the barriers and facilitators of using digital gaming platforms is as important to understand as the effect of the intervention, and therefore further research in this area is warranted. The effectiveness or realization of digital gaming platforms as a self-management tool is limited if the actual and perceived barriers are not understood. Furthermore, although the GT method used in this review is widely used, it has its limitations. For example, since open-coding is used, the process is often exhaustive which may lead to some inadvertent errors. In addition, due to the open-coding process, the results

may not also be easily generalizable.[42] It is also important to highlight that all studies included in this review were conducted in Sweden or the USA which makes the application of the results to the wider population challenging. For example, the perspectives, experiences, specifically the barriers and facilitators, in using digital gaming platforms, that is, the Nintendo™ Wii or other commercially-available platforms in lower-resource or lower-income countries is not captured in this review, and would be interesting to understand.

What this review adds

A patient's self-management of their chronic disease such as heart failure is paramount to ensuring a longer life, improved quality of life, taking responsibility, reducing hospital visits, reducing hospital costs, etc. Advances in technology have however redefined the way in which we approach healthcare and healthcare delivery and understanding how technology is received by patients before prescribing such technologies is vital. Though limited evidence was identified in this review, what this review does highlight is the fact that the incorporation of technology in some way or the other is inevitable. Clinical practice guidelines advocate for self-management of chronic conditions like heart failure,[5] especially in contexts where there are few cardiac rehabilitation specialists available or difficulties for patients to access healthcare.[6–8] Therefore, successfully prescribing technologically based self-management programs for any patient requires a deeper understanding of what obstacles they could potentially face, and to either pre-empt these barriers or address them. This review also highlights that there is interest in understanding the obstacles when using interventions such as digital gaming platforms, and although there are few studies conducted, there is a focus developing.

Although the limited number of studies in this review can be viewed as a major limitation, the limited evidence identified in this review around this topic does also highlight opportunities for future research direction. Systematic reviews which identifies none or few eligible studies, also known as an "empty review,"[43] does not necessarily mean that the review is invalid or of lesser value. In most instances, depending on the research question asked, an "empty review" can be quite insightful and can direct future research. In addition though limited evidence still exists for the effectiveness of digital gaming platforms on clinical outcomes in patients with heart failure, understanding the barriers and facilitators in using digital gaming platforms may in fact be more important as nonadherence for various reasons during a clinical trial exploring the effectiveness of an intervention may invalidate results. The study question in the review is deemed a valid clinical and research question, which addresses concerns in clinical practice and research, and warrants further research. The limited included studies therefore produce rich insights

into the beginning of understanding the experiences of patients with heart failure when using digital gaming platforms in the self-management of their condition.

Another added value of this review is that it highlighted the lack of studies into other popular commercially-available gaming platforms. No studies reported on the barriers and facilitators when using Sony PlayStation, MS Xbox, VR oculus or HTC VIVE. As these are also classified as popular commercially-available digital gaming platforms for exergaming, it would be interesting to understand the effect of these on patients with heart failure and what the barriers/facilitators are to using them. Furthermore, since Klompstra et al.[15] highlighted the low cost and feasibility of using off the shelf exergames in patients with heart failure, further quantitative and qualitative research in this area is warranted.

Conclusion

This is the first qualitative synthesis to summarize the barriers and facilitators experienced by patients with heart failure when using popular commercially-available digital exergaming platforms for self-management. The systematic review found that there were a limited number of high-quality studies available that examined patients' perceptions of using such technologies for the self-management of heart failure. A qualitative synthesis of the included studies found that participants reported that using the Nintendo™ Wii is simple, easy to use, interesting, challenging, motivated them, and assisted in improving their physical and psychological wellbeing. On the other hand, some patients reported various barriers that hindered the use of Nintendo™ Wii, such as feeling bored due to playing specific games for lengthy periods, technical issues, and preferring other types of activities to improve their fitness level. The limited evidence identified in this review should however be viewed as an opportunity to identify future research directions. For example, future studies could focus on ascertaining the barriers and facilitators to using other popular commercially-available digital gaming platforms like Sony PlayStation, Microsoft Xbox, etc. and also further explore the experiences of patients with heart failure when using gaming platforms in more challenging settings such as remote settings, low-resource settings, etc.

Consent: Since this study was secondary research conducted on published literature, obtaining informed consent was not required from the primary subjects.

Contributorship: All authors contributed to conceptualization of the study and writing the protocol. ER, FA, SA, SF, and TD were involved in the data collection and extraction, as well as analysis. LM and MO supervised the study procedures, and were involved in the analysis. All authors contributed to drafting and writing the final manuscript.

ORCID iD: Linzette Morris ⬦ https://orcid.org/0000-0002-2384-9707

References

1. Groenewegen A, Rutten FH, Mosterd A, et al. Epidemiology of heart failure. *Eur J Heart Fail* 2020; 22: 1342–1356.
2. Savarese G, Becher PM, Lund LH, et al. Global burden of heart failure: a comprehensive and updated review of epidemiology. *Cardiovasc Res* 2023; 118: 3272–3287. Erratum in: *Cardiovasc Res* 2023 119: 1453.
3. Bragazzi NL, Zhong W, Shu J, et al. Burden of heart failure and underlying causes in 195 countries and territories from 1990 to 2017. *Eur J Prev Cardiol* 2021; 28: 1682–1690.
4. Dunlay SM, Manemann SM, Chamberlain AM, et al. Activities of daily living and outcomes in heart failure. *Circ Heart Fail* 2015; 8: 261–267.
5. Heidenreich PA, Bozkurt B, Aguilar D, et al. 2022 AHA/ACC/HFSA guideline for the management of heart failure: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circ J* 2022; 145: e895–e1032.
6. Davies P, Taylor F, Beswick A, et al. Promoting patient uptake and adherence in cardiac rehabilitation. *Cochrane Database Syst Rev* 2010; 7: CD007131.
7. Imran TF, Wang N, Zombeck S, et al. Mobile technology improves adherence to cardiac rehabilitation: a propensity score–matched study. *J Am Heart Assoc* 2021; 10: e020482.
8. Ruano-Ravina A, Pena-Gil C, Abu-Assi E, et al. Participation and adherence to cardiac rehabilitation programs. A systematic review. *Int J Cardiol* 2016; 223: 436–443.
9. Toukhsati S, Driscoll A and Hare D. Patient self-management in chronic heart failure—establishing concordance between guidelines and practice. *Card Fail Rev* 2015; 1: 128.
10. Jaarsma T, Klompstra L, Ben Gal T, et al. Effects of exergaming on exercise capacity in patients with heart failure: results of an international multicentre randomized controlled trial. *Eur J Heart Fail* 2021; 23: 114–124.
11. Blasco-Peris C, Fuertes-Kenneally L, Vetrovsky T, et al. Effects of exergaming in patients with cardiovascular disease compared to conventional cardiac rehabilitation: a systematic review and meta-analysis. *Int J Environ Res Public Health* 2022; 19: 3492.
12. Finkelstein J and Friedman RH. Potential role of telecommunication technologies in the management of chronic health conditions. *Dis Manag Health Out* 2000; 8: 57–63.

13. Radhakrishnan K, Baranowski T, Julien C, et al. Role of digital games in self-management of cardiovascular diseases: a scoping review. *Games Health J* 2019; 8: 65–73.

14. Tong A, Palmer S, Craig JC, et al. A guide to reading and using systematic reviews of qualitative research. *Nephrol Dial Transplant* 2014; 31: 897–903.

15. Klompstra L, Mourad G, Jaarsma T, et al. Costs of an off-the-shelf exergame intervention in patients with heart failure. *Games Health J* 2023; 12: 242–248.

16. Wolfswinkel JF, Furtmueller E and Wilderom CPM. Using grounded theory as a method for rigorously reviewing literature. *Eur J Inf Syst* 2013; 22: 45–55.

17. Barnett-Page E and Thomas J. Methods for the synthesis of qualitative research: a critical review. *BMC Med Res Methodol* 2009; 9: 59.

18. Cooke A, Smith D, Booth A., et al. The SPIDER tool for qualitative evidence synthesis. *Qual Health Res* 2012; 22: 1435–1443.

19. Critical Appraisal Skills Programme. Critical appraisal checklists [Internet]. Critical Appraisal Skills Programme. 2018. Available from: https://casp-uk.net/casp-tools-checklists/

20. Radhakrishnan K, Toprac P, O'Hair M, et al. Interactive digital e-health game for heart failure self-management: a feasibility study. *Games Health J* 2016; 5: 366–374.

21. Radhakrishnan K, Toprac P, O'Hair M, et al. Perceptions of older adults with heart failure on playing an interactive digital e-health game (IDEG) for learning about heart failure (HF): prototype development and usability testing. 2016 Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5995560/

22. Radhakrishnan K, Baranowski T, O'Hair M, et al. Personalizing sensor-controlled digital gaming to self-management needs of older adults with heart failure: a qualitative study. *Games Health J* 2020; 9: 304–310.

23. Masterson Creber RM, Hickey KT and Maurer MS. Gerontechnologies for older patients with heart failure: what is the role of smartphones, tablets, and remote monitoring devices in improving symptom monitoring and self-care management? *Curr Cardiovasc Risk Rep* 2016; 10: 30.

24. Finkelstein J and Wood J. Designing pervasive telemedicine applications using various gaming platforms. 2012. Retrieved from https://www.iadisportal.org/digital-library/designing-pervasive-telemedicine-applications-using-various-gaming-platforms

25. da Cruz MM, Grigoletto I, Ricci-Vitor AL, et al. Perceptions and preferences of patients with cardiac conditions to the inclusion of virtual reality-based therapy with conventional cardiovascular rehabilitation: a qualitative study. *Braz J Phys Ther* 2022a; 26: 100419.

26. Finkelstein J and Wood J. Delivering chronic heart failure telemanagement via multiple interactive platforms. In WMSCI 2011—The 15th World Multi-Conference on Systemics, Cybernetics and Informatics, Proceedings. (WMSCI 2011—The 15th World Multi-Conference on Systemics, Cybernetics and Informatics, Proceedings. 2011a (Vol. 2), pp. 207–212.

27. Finkelstein J and Wood J. Implementing home telemanagement of congestive heart failure using Xbox gaming platform. In: Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Annual International Conference, 2011b, pp.3158–3163.

28. Cacciata MC, Stromberg A, Klompstra L, et al. Facilitators and challenges to exergaming. *J Cardiovasc Nurs* 2021; 37: 281–288.

29. Jaarsma T, Klompstra L, Strömberg A, et al. Exploring factors related to non-adherence to exergaming in patients with chronic heart failure. *ESC Heart Fail* 2021; 8: 4644–4651.

30. Klompstra L, Jaarsma T, Mårtensson J, et al. Exergaming through the eyes of patients with heart failure: a qualitative content analysis study. *Games Health J* 2017; 6: 152–158.

31. Ennis CD. Implications of exergaming for the physical education curriculum in the 21st century. *J Sport Health Sci* 2013; 2: 152–157.

32. Klompstra L, Jaarsma T and Strömberg A. Exergaming to increase the exercise capacity and daily physical activity in heart failure patients: a pilot study. *BMC Geriatr* 2014; 14: 119.

33. Bezerra L, Tong HL, Atherton JJ, et al. Use of mobile applications for heart failure self-management: a systematic review of experimental and qualitative studies. *JMIR Cardio* 2022; 6: e33839.

34. Chao YY, Scherer YK and Montgomery CA. Effects of using nintendo Wii^{TM} exergames in older adults. *J Aging Health* 2014; 27: 379–402.

35. Verheijden Klompstra L, Jaarsma T and Strömberg A. Exergaming in older adults: a scoping review and implementation potential for patients with heart failure. *Eur J Cardiovasc Nurs* 2013; 13: 388–398.

36. Chan KGF, Jiang Y, Choo WT, et al. Effects of exergaming on functional outcomes in people with chronic stroke: a systematic review and meta-analysis. *J Adv Nurs* 2012; 78: 929–946.

37. Varghese MS, Beatty AL, Song Y, et al. Cardiac rehabilitation and the COVID-19 pandemic: persistent declines in cardiac rehabilitation participation and access among US medicare beneficiaries. *Circ Cardiovasc Qual Outcomes* 2022; 15: e009618.

38. Duruturk N, Tonga E, Karatas M, et al. Activity performance problems of patients with cardiac diseases and their impact on quality of life. *J Phys Ther Sci* 2015; 27: 2023–2028.

39. Doukky R, Mangla A, Ibrahim Z, et al. Impact of physical inactivity on mortality in patients with heart failure. *Am J Cardiol* 2016; 117: 1135–1143.

40. Albores J, Marolda C, Haggerty M, et al. The use of a home exercise program based on a computer system in patients with chronic obstructive pulmonary disease. *J Cardiopul Rehabil Prev* 2013; 33: 47–52.

41. Klompstra L, Jaarsma T and Stromberg A. Physical activity in patients with heart failure: barriers and motivations with special focus on sex differences. *Patient Prefer Adher* 2015; 9: 1603.

42. Hussein ME, Hirst S, Salyers V, et al. Using grounded theory as a method of inquiry: advantages and disadvantages. *Qual Rep* 2014; 19: 1–15.

43. Gray R. Empty systematic reviews: identifying gaps in knowledge or a waste of time and effort. *Nurse Auth Ed* 2021; 31: 42–44.