Review Article

Telerehabilitation and Monitoring Physical Activity in Patient with Breast Cancer: Systematic Review

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Abstract

Background: Timely rehabilitation in patients with Breast Cancer (BC) has a great impact on improving their physical and mental conditions. Thus, the appropriate follow-up method is essential especially during the Covid-19 pandemic. The aim of this study was to review the different technology-assisted interventions for improving physical activity in BC patients. **Materials And Methods:** In this systematic review, the original studies were extracted from the beginning of indexing in databases including PubMed, Scopus, Google Scholar, and Web of Science until 2019. Finally, 45 papers were included in this study based on the inclusion criteria for before the Covid-19 pandemic and 3 articles extracted for the Covid-19 period. **Results:** The most widely used technologies for BC patients were in the United States (46.67%). Telephone, mobile application, and web with 28.89%, 15.56%, and 8.89% frequencies were the most common technologies, respectively. Although the majority of the participants were satisfied with the intervention method, in some cases, the patients were unsatisfied due to the complexity of the technology. These technologies were used for various purposes, such as physical activity and functions, control of pain severity, fitness, quality of life, diet behavior, fatigue, muscle strength, cardio-respiratory capacity, as well as arm and shoulder exercises. **Conclusions:** In conclusion, virtual communication can improve the health of BC patients and also increases patients' desire and hope to continue treatment. It is worth noting that in the Covid-19 pandemic, with the strengthening of virtual communication infrastructure, more attention was paid to BC patients due to their sensitive conditions.

Keywords: *Breast neoplasms, Covid-19, exercise, telemedicine, telerehabilitation*

Introduction

The incidence and mortality of Breast Cancer (BC) have increased in recent decades. According to the latest GLOBOCAN statistics, BC is the second most common cancer in the world (11.6%). In women, it is the leading cause of cancer deaths with 6.6%.[1] Appropriate policy and solution should be considered in order to the early detection, diagnosis, treatment, and follow-up of these patients.[2]

The follow-up is performed either by direct contact with healthcare providers or through the review of medical records or technology-based methods. BC patients have many problems in hand-grip strength, physical activity, social interactions, and Quality of Life (QoL), especially after surgery.[3] Studies have shown that physical activity in these patients can be improved by rehabilitation programs and interventions. Conventional healthcare due to time constraints, distance restrictions, high cost, and even disease transmission in the current situation imposes some limitations in the follow-up of BC patients. On the other hand, Covid-19 has a greater effect on vulnerable groups such as cancer patients. According to categorizing BC patients into priority levels (A, B, C) for emergency care, patients in priority C can receive some services at home.[4]

Actually, the increasing availability of technology and smart-phone make the opportunity to create real-time virtual communication between health care providers, especially nurses and patients. This leads to increased access to health care services when there are problems in face-to-face communication. Assistive technologies, such as telehealth are suitable and convenient solutions for providing care, regardless of time and distance constraints to improve the physical activity and functional capacity of BC patients.[5] It is important to note that, Covid-19 has also disrupted the provision of health care

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services to most patients, especially BC patients. Actually, they are at high risk of infection and have a complication, thus some patient cancels the face-to-face appointments due to the fear of infection and travel restrictions. The use of technology in special situations such as the Covid-19 pandemic has increased significantly due to its many benefits for managing different diseases especially cancer.[6] Telerehabilitation can be applying to help breast cancer patients, due to the high risk of face-to-face appointments. Therefore, the purpose of this study was to review the different Telerehabilitation technologies and the results of their interventions that are associated with physical activities and the quality of life of BC patients. All types of Telerehabilitation technologies were included in this study such as telephone, internet, videoconferencing, and other approaches. Authors review technology type and purpose, population, and result of the intervention.

Material and Methods

This systematic review was conducted based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). Figure 1 displays the process of PRISMA for data collection and analysis. The papers were searched from the following databases including PubMed, Scopus, Google Scholar, and Web of Science from the beginning of the activity of databases to 2019. The Population (P), Intervention (I), Comparison (C), and Outcome (O) (PICO) criteria were used to define the search string. The population was BC patients. Interventions had to be designed to improve physical activity, fitness, exercise, weight loss, and diet. The employed technologies included mobile application, telephone, web, email, smartwatch, pedometer, social media, tele-video, internet, and wearable device. In comparison criteria, groups without any intervention were compared with groups with technology-based interventions. In the outcome, the health status of BC patients' was reported. The search string was: "breast cancer" OR "breast neoplasms" OR "mastectomy" AND "exercise" OR "exercise therapy" OR "physical fitness" AND "blog" OR "telephone" OR "telemedicine" OR "social media" OR "internet" OR "wearable technology". Moreover, search for studies after Covid-19 was conducted separately with a time limit of 2019-2020. In addition to the keywords listed above, these words were also added in the manual search including (Covid-19 OR Coronavirus 2019 OR SARS-CoV-2 infection OR COVID-19 pandemic OR Coronavirus disease 2019 OR COVID-19 virus infection).

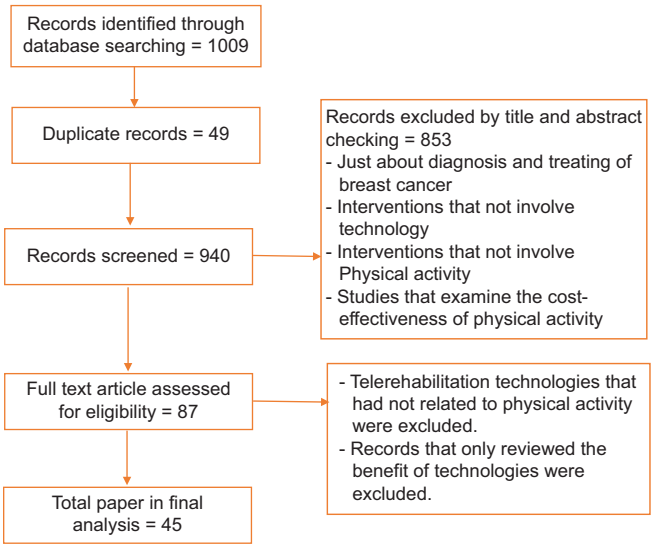

Figure 1: The process of preferred reporting items for systematic reviews and meta-analysis for data collection and analysis

The selection process was done in 4 stages. Firstly, the papers were screened based on the title by two reviewers. The screened articles were divided into three groups; i.e., zero groups did not have inclusion criteria. Another group that definitely had the inclusion criteria was assigned the number 1. The last group was assigned the number 2; reviewers were skeptical about selecting it. Moreover, the reviewers discussed papers that did not receive the same number and decided about them. All the papers which receive the same number (one or two) were included for the next phase. Finally, the full text of the included papers was obtained for the second-stage screening and then assessed by two reviewers. Then, variables were extracted in order to answer the research questions. These variables were the population, type of technology, time and type of intervention, their purposes, and the result of improvement.

This review responds to the following research questions: RQ 1: Which results have been reported after applying different technologies for these patients? RQ 2: For which countries, states, or cities, physical rehabilitation technology in order to physical activity have been designed? RQ 3: Which technological interventions have been used to promote the health of BC patients? RQ 4: What are the main purposes of using the technology in this disease?

RQ 5: Which research methods have been used for representing technological interventions among BC patients? RQ 6: What was the duration of each intervention?

Ethical Considerations

In this study, all relevant ethical codes have been observed. The author conducted a comprehensive search that identifies all eligible studies in this area. The content review has been done without bias. The principle of fidelity and the rights of authors in the use of the content have been observed.

Results

Pre-Covid-19 period

A total of 45 articles were extracted for the pre-Covid-19 period according to the criteria mentioned in the method section. The six variables including population, type of technology, time and type of intervention, their purposes, and the result of the intervention of the selected papers are presented in Table 1.

Population

The countries that used technology interventions to rehabilitate patients were the United States, Australia, South Korea, and Canada, respectively [refer to Table 1]. Figure 1 depicts the frequency of Telerehabilitation in different countries.

Intervention technologies

As presented in Table 1, various technologies were used in order to rehabilitate BC patients including telephone, web, mobile health application, etc. In 36.35% of the studies, the combinations of these technologies including phone plus mobile application, phone plus web, and phone plus internet were used to improve the physical activity of BC patients. The types of these technologies with their frequency are reported in Figure 2.

Purpose of technologies intervention

According to Table 1, technologies used in BC patients for physical activity by different purposes were summarized as global health status, physical, cognitive functioning, pain severity, pain interference, physical activity, fitness, quality of life, emotional state, eating behavior, fatigue, physical function, muscle strength, cardiorespiratory capacity, self-management of arm and shoulder exercises, diet quality, Body Mass Index (BMI), and exercise behavior.

Time and type of intervention

As shown in Table 1, researchers have applied technologies in various times intervals in order to evaluate the physical activity of BC patients by several types of methods. In most of the studies in different time periods, technology interventions have had a positive effect on the population. The maximum time of using the intervention was eight years in the Australian population and the majority of the studies have applied Randomized Controlled Trial (RCT).

Results of intervention

Although, in very few cases, patients complained about the complexities of some technologies, almost all the studies have shown patient satisfaction and have yielded positive results. The next point was that they tended to interact with health care providers.

Different age ranges

Various technologies have been employed to improve physical activity in diverse age ranges and different stages of the disease.

Studies during Covid-19 outbreak

Although the time period of this article was until 2019, since cancer patients are generally at greater risk during the Covid-19 period, keywords according to the criteria mentioned in the method section, with Covid-19 (Coronavirus disease) were searched in the specified databases**.** The detailed information extracted from the articles is shown in Table 2.

Discussion

In studies before Covid-19, after categorizing different variables in the physical rehabilitation of BC patients based on technology, authors answered the question in this field. Intervention technologies were mainly used in the United States (46.67%). Telephone (28.89%) and mobile application (15.56%) were the most frequent intervention technologies used for the physical rehabilitation of BC patients. The maximum intervention time was eight years.[41] One of the notable points in the selected studies was using RCT to evaluate the result; it means that the impact of interventions was carefully measured.

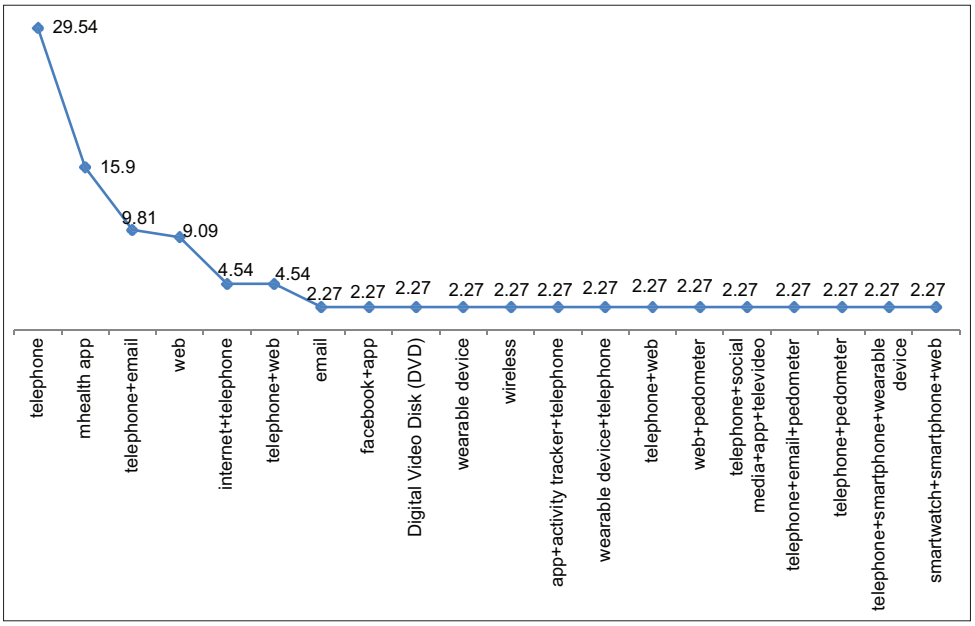

Figure 2: Frequency of used technology in telerehabilitation of breast cancer patients

Table 1: Some examples of studies about applying telehealth technologies to follow-up of breast cancer patient

Author/year	Setting/ population	Purpose of intervention	Type of intervention	Intervention in control group	Method/time	Results
Vallance *et al*. (2019)[7]	Alberta/ Canada	Physical activity, fatigue and QoL*	Wearable device (Actigraph® and activPALTM accelerometers**)	Non	RCT***/4 M****	The fatigue profile was improved. But effect not seen in QoL.
Lynch *et al*. (2019)[8]	Australia	Physical activity (PA)	Wearable technology*****, telephone counseling	Non	RCT/12W******	Increase of PA******* was proved.
Kokts-Porietis *et al*. (2019)[9]	Canada	PA	Wearable technology (Polar A360® activity tracker********)	traditional treatment and rehabilitation according to daily specifications of the hospital	RCT, interview/12W	Technology was as a facilitator to physical activity, but technologic difficulties created a barrier to physical activity adherence.
Nápoles *et al*. (2019)[10]	United States	PA, health behavior	Booklet-Spanish-language mobile phone app - activity tracker-telephone counseling	Non	Sampling/2M	The PA and health behaviors of participants increased significantly.
Dong *et al*. (2019)[11]	China	PA	Phone, social media apps, tele-video	Traditional treatment and rehabilitation according to daily specifications of the hospital	RCT/12W	Positive effect on quality of life, muscle strength and cardiorespiratory capacity.
Pope *et al*. (2018)[12]	Minneapolis, USA	PA	Facebook- and mobile app (MapMyFitness)	Facebook	RCT/10 W	Increasing physical activity by Facebook, Impact of the smart watch was not proven (due to difficulty).
Lozano-Lozano *et al*. (2018)[13]	Spain	Diet and PA, body composition, muscular strength, upper body functionality and physical fitness	mHealth (BENECA)-tri-axial accelerometer	BENECA app for 8 weeks and usual care information	RCT/1M	It can be effective tool for managing breast cancer patient's diet and PA behaviors.
Anderson *et al*. (2018)[14]	Scotland	PA, diet behavior and weight loss.	Telephone counseling and web support	Usual care	RCT/12W	Desired results were obtained from the intervention.
Lee *et al*. (2018)[15]	South Korea	Exercise	Mobile application	-	Retrospective/ 12W	Scores of patients with intervention were significantly higher than patients without intervention. Mutual feedback will increase user loyalty and motivational technology.
Van de Wiel *et al*. (2018)[16]	Netherlands	Physiotherapy counseling	Internet-based Physical Activity Support program (IPAS) and Telephone Support (TS)	Non	RCT/6 & 12 M	The effectiveness on IPAS********* alone or with TS********** in improvement of PA, QoL and fatigue was proved.

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Table 1: Contd...

Author/year	Setting/ population	Purpose of intervention	Type of intervention	Intervention in control group	Method/time	Results
Hayes *et al*. (2011)[17]	Queensland/ Australia	Exercise (aerobic) and PA	Telephone counseling	Usual care	RCT/8 M	The intervention had positive effect on survival.
Uhm *et al*. (2017)[18]	South Korea	Exercise (Aerobic and resistance exercises), physical function, and Quality of Life (QoL)	mHealth app (Smart After Care) with In Body Band Pedometer**********	-	Prospective, quasi-randomized multicenter trial/6 &12W	Improve physical function, physical activity and QoL.
Lahart *et al*. (2017)[19]	United Kingdom	Cardiorespiratory fitness	Telephone	Usual care	RCT/6M	Increased cardiorespiratory fitness and self-reported PA.
Hartman *et al*. (2017)[20]	San Diego/ USA	Exercise	Telephone and emails	Usual care	RCT/12W	The intervention improved the physical activity
Krebs *et al*. (2017)[21]	United States	PA and Healthy Eating	DVD**********	Advice and counseling alone	RCT/12W	Greater improvement in eating behavior change than physical activity.
Valle *et al*. (2017)[22]	United States	PA, weight loss	Wireless scale with data transfer capability to Website/mobile app	Usual care	RCT/24W	Preventing of weight gain was positive in both groups.
Cox *et al*. (2017)[23]	USA	PA and weight loss	Internet or telephone	Internet	RCT/6M	The outcomes of intervention in telephone group were better than internet group.
Lawler *et al*. (2017)[24]	Queensland/ Australia	PA, diet and weight loss	Telephone	----	Pre-post study/6M	Positive effect on PA and weight loss of participants.
Harder *et al*. (2017)[25]	United Kingdom	Arm and shoulder exercises	Mobile app	-----	Focus group	Self-management of arm and shoulder exercises was proved.
Fazzino *et al*. (2017)[26]	United States	Weight management and PA	Group phone sessions mailed newsletters pedometer	------	RCT/6M	The PA of participants improved
Ritvo *et al*. (2017)[27]	Canada	PA	Telephone, Smart phone (iMovie), wearable technology	Only 12-week physical activity program	RCT/12W	Will assess
Ollero *et al*. (2017)[28]	-	Monitor heart rate, energy expenditure, arm mobility	Smart watch, smart phone, web server application	-	System design	The patients have not been evaluated. Only software and application were evaluated.
Ariza-Garcia *et al*. (2019)[29]	Spain	Exercise	Web-based (e-CUIDATE system)	Usual care	RCT/6-8 M	Global health status, physical, role, cognitive functioning, and arm symptoms, pain severity, and pain interference was improved.

Contd...

Table 1: Contd...

Author/year	Setting/ population	Purpose of intervention	Type of intervention	Intervention in control group	Method/time	Results
Reeves *et al*. (2016) Australia[30]	The University of Queensland	Weight loss	Telephone counseling, posted materials and text-message	Usual care	RCT/6 &12 & 18	The intervention had positive effect on PA, weight loss and other examined criteria.
Quintiliani *et al*. (2016)[31]	United States	Weight, diet and physical activity.	Text message-pedometer- phone counseling	Usual care	Pre-post study/10W	Weight of participants decreased. Dietary behavior improved. PA increased
Cadmus-Bertram *et al*. (2016)[32]	United States	PA	Telephone and web-based self-monitoring tools.	Usual care	RCT/12M	The PA and weight condition of participants improved significantly
Harrigan *et al*. (2016)[33]	United States	Weight loss	Telephone and in-person counseling.	Usual care	RCT/3M	The both interventions led to significant weight loss via increasing PA and favorable diet changes
Lyons *et al*. (2016)[34]	United States	Fitness and physical activity	Mobile application	Mobile application + narrative-based active video game.	RCT/6M	Improve breast cancer survivors' health
Forbes *et al*. (2015)[35]	Nova Scotia/ Canada	PA	PA tracking website UWALK	Usual care	RCT/9W	Intervention was successful in changing PA behavior.
McCarroll *et al*. (2015)[36]	United States	Control overweight.	Mobile app (LoseIt!) in website and mobile versions.	Usual care	Prospective/1M	The patients PA increased significantly.
Kyung Lee *et al*. (2014)[37]	South Korea	Promoting exercise (aerobic), dietary behaviors, and self-efficacy.	Web-based Self-Management Exercise and diet Intervention (WSEDI)	Booklet on exercise and diet	RCT/12W	Better results in the intervention group
De Cocker *et al*. (2014)[38]	Belgium	PA	Web and pedometer-based PA advice program	-	Pilot/3W	The usability and acceptability of program for PA proved.
Short *et al*. (2017)[39]	Queensland/ Australia	PA	Website	-	RCT/12W	Positive effect on increasing PA in breast cancer survivors.
Winger *et al*. (2014)[40]	United States	Exercise and diet.	Telephone and mailed print	Non	RCT/-1Y*********	more positive results of the telephone intervention
Rock *et al*. (2013, 2015)[41,42]	United States	Effect of intervention on weight loss.	Telephone counseling and tailored newsletters	Usual care	RCT/2Y	The intervention group had significantly weight loss comparing with control group.
Hatchett *et al*. (2012)[43]	The University of Mississippi/ USA	PA	email	Usual care	RCT/6 and 12M	Increased physical activity and exercise behavior.

Contd...

Table 1: Contd...

Author/year	Setting/ population	Purpose of intervention	Type of intervention	Intervention in control group	Method/time	Results
Ligibel *et al*. (2012)[44]	United States	Exercise	Telephone	Usual care	RCT/16M	Increase PA, physical functioning, and fitness.
Demark-Wahnefried *et al*. (2012)[45]	United States	Diet-exercise to control overweight or obese	Telephone counseling and print materials.	Wait-list control	RCT/2Y	Diet quality, PA, Physical function and BMI were improved significantly.
Eakin *et al*. (2012)[46]	Australia, Queensland	Aerobic and resistance exercise	Telephone	Non	RCT/8Y	Improve the physical activity and fitness
Lee *et al*. (2011)[47]	South Korea	PA and diet behaviors	Telephone and workbook	Non	RCT/12W	The PA increased significantly. Diet behaviors and QOL was improved.
Hegel *et al*. (2011)[48]	Hanover, USA	Quality of Life	Telephone	Usual care	RCT/6 and 12 W	Increase quality of life, Increase emotional state
Morey *et al*. (2009)[49]	United States	PA and diet	Telephone counseling, Automated telephone messages and mailed materials.	Delayed intervention	RCT/4M	PA and health behavior increased significantly in intervention group
Pinto *et al*. (2015)[50]	United States	PA	Telephone	Usual care	RCT/12 W	Increased physical activity, improved fitness and some aspects of psychological well-being
Matthews *et al*. (2007)[51]	United States	PA behaviors, body weight and body composition	Telephone	Usual care	RCT/12W	The level of PA increased in intervention group. No significant change in body weight.
Vallance *et al*. (2007)[52]	Alberta/ Canada	PA and QoL	Wearable device and Print Materials	Print materials	RCT/7 M	Effectiveness of each intervention alone proved. Also, the combined approach produces better results.

QoL*: Quality of Life. Accelerometers**: Device that measures proper acceleration (the rate of change of velocity). RCT***: Randomized Controlled Trial. M****: Month. wearable technology*****: The electronic device that can be embedded in user's body or clothes. W******: Week. PA*******: Physical Activity. Activity tracker********: Device such as smart watches that monitoring fitness related indicators. IPAS*********: Internet-based Physical Activity Support Program. TS**********: Telephone Support. Pedometer**********: Electronic device that counts steps of a person by detecting the motion of the person's hands or hips. It measures and encourage physical activity in adults. DVD***********: Digital Video Disk. Y**********: Year

After the United States, Australians had the highest use of these technologies. Scotland, China, Belgium, and the Netherlands employed these technologies in equal proportions to rehabilitate BC patients. Different technologies were applied to various age groups and different stages of this disease. Although the phone was employed for patient rehabilitation alone and extensively, it was also used in combination with other technologies such as wearable devices and pedometers.[18,26,31,55] Our study did not exclude any intervention technologies and covered just BC survivors, while Haberlin *et al*.[56] excluded the interventions of telephone calls, SMS, or conference calls and covered all cancer types.

In a large number of studies, the participants were satisfied with the intervention method. But in some studies, the patients complained about the complexity of the technology used.[9,12] Furthermore, the authors based on the comments of the patient stated that mutual feedback will increase user loyalty and motivation.[15] On the other hand, the time of intervention had no effect on patient satisfaction, as significant changes were observed in the situation of patients, even in the two-month period intervention.[10] But

Table 2: Examples of studies during Covid-19 period about applying tele technologies to follow-up of BC* patients

Author/year	Setting/ population	Purpose of intervention	Type of intervention	Intervention in control group	Method/time	Results
Mella-Abarca *et al*. (2020)[53]	Chile	Telerehabilitation	Phone calls and individual or group video calls	Non	Session was approximately 50 min, and frequency of session was different synchronous and asynchronous consultations	Both patients and physiotherapists had a high level of acceptance and satisfaction of tele-rehabilitation
Lytras *et al*. (2020)[54]	Greece	Telephysiotherapy	Skype	Non	15 days and one hour every day/case-study	Volume of the lymph was significantly reduced
Grazioli *et al*. (2020)[6]	Italia	Exercise for physical fatigue and QoL	Whats app video call	Non	Case study/16W	Positive effects of combined training CT** on QoL and fatigue perception

*BC: Breast cancer. **CT: Controlled trial

in the study by Demark-Wahnefried *et al*.,[45] no significant difference was observed in the first year of the intervention.

Last but not least, because these interventions were used at different stages of the disease, each had a specific purpose for enhancing physical activity. In some patients, the intervention was used mostly to increase arm and shoulder mobility,[25] whereas, in another group, the goal of the intervention was to lose weight and control or change diet behaviors.[57] According to the results of our review, physical activity intervention has been used in BC patients for various purposes. During the pandemic Covid-19, the use of telecommunications continued, with telephone, Skype, and Whatsapp to communicate and rehabilitate BC patients. The longest rehabilitation period for 16 weeks has been done through Whatsapp video for exercise BC patients.

Given the large number of studies conducted in pre-Covid-19 periods and also proved the effectiveness. The authors recommended that during the Covid-19 pandemic, the direct and routine visits should be suspended due to the special conditions of these patients, and they followed and treated with technological approaches as much as possible. For implementing effective rehabilitation services, health care providers should develop the appropriate online Telerehabilitation programs, which are usable and accessible for all. Like the experience in Chile, Greece, and Italy shows that it is possible to implement Telerehabilitation during the Covid-19 epidemic.

The current systematic review cannot be an up-to-date list of all articles due to the frequent publication of new articles in this field. Since the submission of the article to the journal and its final review, other articles may be published that are not included in our study.

Conclusion

This systematic review was designed to assist the decision-makers, clinicians, and nurses in order to introduce and select effective technology for the rehabilitation of BC patients. The research showed physical activity and exercise especially in the shoulder area is effective in reducing health problems in BC patient. Since it reduces their pain and improves disability. On the other hand, Telerehabilitation systems have shown effectiveness and usability for effective disease management in several studies compared with other interventions such as usual care. Therefore, these technologies can be used to manage pain, diet, physical activities, and quality of life in these patients.

It is important to note that, the different follow-up technologies may be applied in health care according to the condition, location, and available infrastructure. Since the duration and type of the intervention are not the same, it cannot be said which type of intervention was more effective. However, in some studies, patients have expressed that they tended to interact and receive feedback from nurses and other health care providers. In addition, using these technologies in remote areas and cost savings should not be overlooked.

During the Covid-19 pandemic, telehealth allows timely access to cancer care. But this requires establishing the appropriate infrastructures and prerequisites and also adequate training should be provided for both patients and health providers. Government should adopt laws to protect the information confidentiality and privacy issues regarding the use of these systems.

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Conflicts of Interest

Nothing to declare.

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