

A MOBILE HEALTH APPLICATION TO PREVENT UPPER LIMB DYSFUNCTION (ULD) AMONG BREAST CANCER POST TREATMENT (Chemotherapy, Radiotherapy, and Surgery): A LITERATURE REVIEW

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Abstract

Breast cancer is the most common cancer which attacks 2.1 million women annually. The high incidence of *Upper Limb Dysfunction* is a negative impact that affects the quality of life of patients. m-Health Application is a tool that can facilitate the process of service or health care. To determine the effectiveness of m-Health Application usage in preventing *Upper Limb Dysfunction* (ULD). Relevant articles that were published between 2008 and 2018 were retrieved from EBSCOhost, Scopus, ScienceDirect, ProQuest, and SAGE databases, using keywords like mobile health application, breast cancer, physical activity, upper limb dysfunction. This study uses nine kinds of literature, including three journals with randomized controlled trial (RCT) design, one quasi-experimental journal, one cross-sectional journal, one journal using a pilot study, and one journal using qualitative design alongside with focus group method. Almost all literature show positive results of mobile health application in increasing physical activity of breast cancer patients. Mobile health application can significantly prevent the occurrence of ULD by expanding the practice of patients' physical activity through application features, such as video, games, SMS, telephone, e-mail, and the internet web.

Keywords: mobile health application, breast cancer, upper limb dysfunction.

1. Introduction

In the health care setting in many countries, cancer continues to be a significant issue, with more than 14 million new cases and more than 8 million cancer mortalities each year (1). Cancer mortality rate in developing countries is higher than it is in developed countries. It indicates that there are some different risk factors and the success of treatment, detection, and availability of treatment (2). Cancer is one type of disease that requires continuous monitoring and treatment. It also needs high financing, which becomes one of the negative impacts that decreases the productivity of cancer patients (3).

Breast cancer is one of the most common cancers diagnosed in women, attacking 2.1 million women annually and causing the highest mortality rate in women (4). Referring to the data of the Ministry of Health of Indonesia in 2014, the most common types of cancer detected in Indonesia, aggregated by sex, are breast cancer and

cervical cancer in women, while in men, the most frequent diseases are lung cancer and colorectal cancer.

Breast cancer can be treated using a combination of chemotherapy, radiotherapy, and surgical procedures (5). Treatment of breast cancer has several side effects, such as fever, nausea, vomiting, fatigue, decreased appetite, diarrhea, and pain (6). Also, lymphedema, a decrease in cardiopulmonary function, and limited activities that will reduce the patients' quality of life might also occur (7).

In Holmes' study, using a prospective observational method in 3000 breast cancer patients, it was found that physical activity carried out by patients can reduce their mortality risk, improve their mental health and their quality of life (8). According to Patterson's research, it can be concluded that physical activity carried out by breast cancer patients can reduce the risk of mortality and recurrence of breast cancer (8).

Physical exercise therapy is one of the recommended rehabilitation programs for post-treatment breast cancer patients, primarily as rehabilitation of the upper limb and chest parts of patients (9). Physical exercise plays a vital role in improving cardiopulmonary function, muscle strength, and endurance of breast cancer patients (10). However, there are many factors that can inhibit the implementation of this program, such as the location of health care facilities which is quite far (accessibility), lack of family support, and physical activity habits did by patients (11). The high incidence of upper limb dysfunction in breast cancer patients significantly impacts the productivity and patients' life quality.

As the time passes, the use of technology in health care has developed, and it shows a positive effect, for example increasing patient knowledge and health, improving the quality of health service delivery in which it becomes easier and faster (e-care, e-services, e-surveillance, and e-learning) (12). Furthermore, a tool that can facilitate healthcare or healthcare provider according to the needs of patients named Mobile Health (m-Health) was created (8). Mobile Health is one of the solutions that can be applied to give intervention in breast cancer patients after leaving the hospital. The purpose of this literature study is to determine the effectiveness of m-Health Application to prevent the occurrence of Upper Limb Dysfunction/ULD by increasing physical activity after breast cancer treatment.

2. Objective

This study is aimed at exploring and describing narratively related studies toward a mobile health application to prevent *Upper Limb Dysfunction* in post-treatment breast cancer.

3. Methods

This literature study was conducted to identify the effectiveness of Mobile Health Application for the prevention of Upper Limb Dysfunction in patients after breast cancer treatment. Articles were retrieved from EBSCOhost, Scopus, ScienceDirect, ProQuest, and SAGE databases. The keywords used a mobile application, mobile health, breast cancer, upper limb dysfunction. The articles were limited based on the inclusion criteria including english language articles have been published from 2008 to 2018, the researchers also included several types of study design including a survey study, qualitative research, a quasi-experimental study, a randomized control trial (RCT), and mix method design in the screening process.

4. Results

This study uses nine journals relevant to mobile health, breast cancer, upper limb dysfunction, physical activity, and exercise. From 9 journals that have been analyzed, all show positive results regarding the use of m-Health to increase the patient's physical activity so that it can prevent the occurrence of upper limb dysfunction (ULD) in breast cancer patients. Nine journals used in this study consist of 3 journals with randomized controlled trial design, two journals with RCT protocol studies, one journal using quasi-experiment, one journal using cross-sectional study design, one journal using a pilot study, and one journal using qualitative design followed by a group focus method. All research samples used in this journal are breast cancer survivors who have received chemotherapy and radiotherapy and undergone surgery.

Total participants from this study are 1257. All studies involve adults >20 years of age, and all participants are female. Sample size ranges from 9 to 356, and the mean duration of the intervention is 9.8 weeks. Locations of the study are three sites in the USA and Spain, two sites in Korea, and one site in the UK. Each study has a different best duration of time to influence patients, but recommended use of mobile health for physical exercise immediately after 1-3 days of treatment. More details can be seen in table 1.

4.1 Mobile Health Application

Mobile Health (mHealth) is a tool that can facilitate health care by the needs of patients (8). This application is one of the interventions that can be implemented in breast cancer patients after leaving the hospital. The most widely used method is demonstration video, in which is as many as four studies. Two other studies use play applications, and the rest use telephone, SMS, and email.

4.2 Mobile Health Application Interventions

There are several types of mobile health applications used in these nine journals, namely bWell (demonstration videos and documentation), Smart After Care, Smart goal (games application), BrightArm duo rehabilitation system (games application), e-CUIDATE system, telephone, Short Message Service, web-based internet, and m-Health BENECA application. The main focus of 9 journals used in examining the contents of Mobile Health application is physical exercise (ROM, arm and shoulder movements, resistance and muscle strength) for breast cancer survivor, although there are other variables also measured by these journals, such as quality of life, level of pain, cognitive function, and level of patient depression (8,12-19). The duration of application from journals used averaged 8-12 weeks which then evaluated until six months, except in 1 journal which uses the cross-sectional method

4.3 Physical Activity Exercises

From 9 journals that have been analyzed, there are six studies have a positive effect of mobile health application used in increasing physical activity training in post-treatment in breast cancer patients. The other two journals only discuss what mobile health application which is suitable for post-treatment in breast cancer patients. A journal written by Galiano-castillo (2017) showed that there was no significant difference in patient's motor function improvement variable which measured by TMT (trail making test) between the intervention group and the control group with a ratio ($F = 2.25$, $P = 0.11$) (16). Research conducted by Noelia (2016) using the e-CUIDATE

system showed a significant increase in physical function in the intervention group, compared to the control group (12).

The same thing happened to the study conducted by House et al., in 2016, which showed the increase of patients physical endurance. The endurance initially lasted only for 20 minutes, but it increased to 50 minutes after eight weeks. Also, there was also an increase of ability to perform daily activities significantly with an increase in the average value of 8.5 from 41.8. An increase of arm and hand grip exercises is also shown by patients independently. Each patient can reach 1300 repetitive arm movements and 850 hand grip movements.

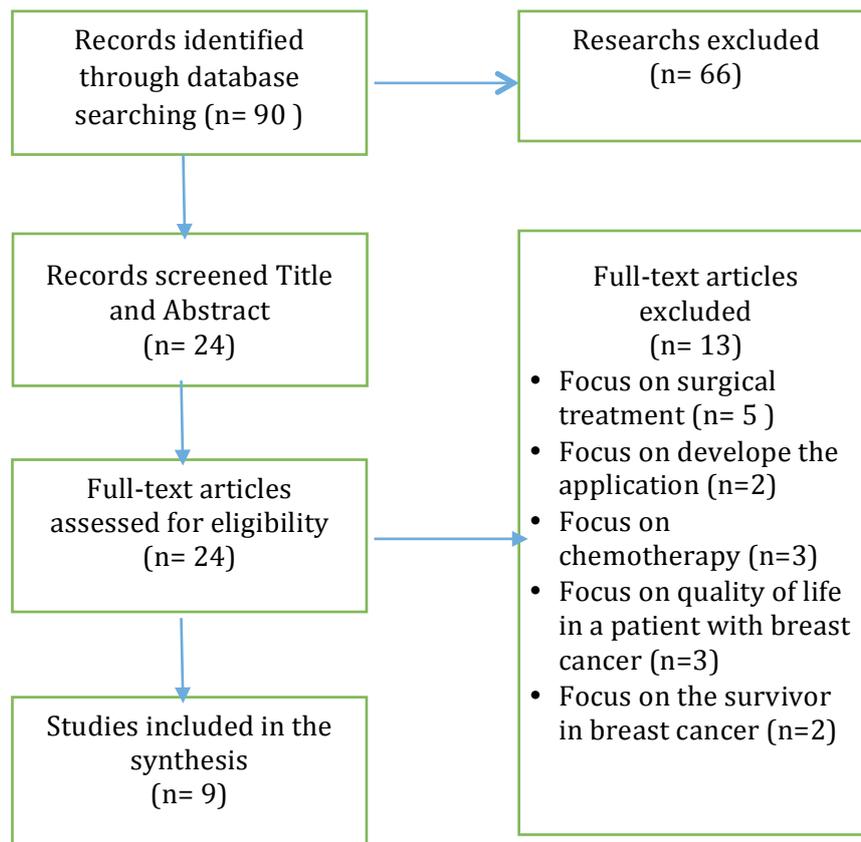


Figure I. Diagram of the search process

4.4 Upper Limb Dysfunction

Symptoms of ULD are a pain, decreased range of motion of the shoulder joint, decreased strength, decreased sensation, lymphoedema, and axillary web syndrome (13). The leading causes of ULD are usually posted mastectomy, axillary lymph node dissection, axillary radiotherapy, and an abnormal increase of BMI (20). Some journals show positive results from mobile applications usage. In the research conducted by Noelia (2016), there was a significant decrease in the level of pain in the group using the e-CUIDATE system. This also happened to the research conducted by House et al., (2016) which, found out that the reduction in pain, measured using NRS (18).

Meanwhile, in the study of Uhm et al., (2016), it was found that BMI and arm circumference had no significant differences in both groups Even on the strength of the

hand grip, both BMI and arm circumference experienced an increase but not statistically significant (8). The study of House et al., (2016) showed a rise of 10 ranges of motion in the shoulder area of patients, an increase in flexion 20.2 °, abduction 16.5 °, adduction 10.0, external rotation 10.8 ° and 9.8 ° internal rotation and increase of strength and functional upper extremities with anterior deltoid values 7.4 N T1 to 9.6 N T2 (14).

5. Discussion

This Literature review is intended to analyze the effectiveness of mobile health application usage to prevent upper limb- dysfunction (ULD) by increasing exercise and physical activity of breast cancer patients. Nowadays, mobile applications are one of the solutions needed to overcome many health issues, for example, the adverse effects that occur in breast cancer patients after undergoing treatment, either chemotherapy, radiotherapy or surgical procedures (21). Arm and shoulder movement disorders are a common complication in breast cancer patients, whether they have undergone surgical procedures or not (14).

The problems that occur in patients after breast cancer treatment must be addressed immediately because it can reduce the productivity and quality of life of breast cancer patients (3). From the literature study conducted, there are many types of mobile health that have been developed to improve the physical exercise of patients by offering different features, ranging from demonstration videos, games, telephone, SMS, e-mail, web, documentation, and reminder applications for patients. All of these are aimed to increase the duration, frequency, and quality of physical activity training performed by patients so that the patient's health will improve and reduce costs and time (22). More than 50% of the studies analyzed show a positive impact of the application of mHealth on patients' physical activity and exercise that can prevent the occurrence of ULD in breast cancer patients.

The study from Harder et al., (2017) and Testa A (2014) recommends the physical exercise of patients to begin in 1-3 days after surgery (13,23). By doing so, it will avoid decreasing ROM levels from the patient's shoulder that can delay the range of arm motion of the patient. The American Cancer Society and the American Society of Clinical Oncology suggest breast cancer patients implement physical exercise program which can improve the development of patients' physical and psychological abilities so that their quality of life will also improve (14). In the research conducted by Shin et al., (2017), several significant factors can influence the increase of breast cancer patients' physical activity, such as the stage of cancer, age, and the type of physical exercise performed. Also, it is also necessary to pay attention to the ability of health provider, facilities, the supply of equipment, and the patient's ability to use mobile health application (24).

6. Conclusions

Based on the literature used in this literature review, the use of mobile health application can significantly prevent the occurrence of ULD by increasing patients' physical activities using application features, such as video, games, SMS, telephone, email, and the internet web. The treatment success is determined by the collaboration between healthcare providers, patients, policyholders who are then supported by mobile applications that are appropriate for patients.

7. Strength and Limitation

This review explains the treatment's effect that occurs on breast cancer patients and the role of mobile health application in the rehabilitation process of breast cancer patients to prevent complication after treatment, especially ULD so that the patients' quality of life who have been treated will increase. However, the limitations are still found in this study because we decided result in a narrative form rather than a systematic review or meta-analysis.

Table I. Characteristics of included studies

No.	Author, Year and Place of Research	Study Design	Number of Samples	Research Time	M-Health Intervention	Measurement of Results
1.	Helena Harder, et, al. (2017), Brighton UK.	Qualitative studies and focus group methods	Nine breast cancer patients	Eight weeks	bWell is a mobile health application that contains: <ol style="list-style-type: none"> 1. Information needed by breast cancer patients with ULD 2. Video demonstration related to the exercise that must be done by the patient 3. There is a classification of activities that the patient must do 4. Documentation of the practices that have been carried out by the patient 5. Reminder for patients in scheduling exercises 6. Weblink 	ll qualitative data are coded and will be analyzed using thematic analysis. The data obtained can be classified into: <ol style="list-style-type: none"> 1. The content of information submitted in the application 2. Navigation and structure of the application 3. Design and presentation of the application
2.	Kyeong Eun Uhm, et, al. (2016), Seoul Korea	A prospective, quasi randomized multicenter trial	356 breast cancer patient	12 weeks	Smart aftercare and inBody band pedometer are the mobile health applications that are used. Those applications serve to increase the physical activity of breast cancer patients by using: <ol style="list-style-type: none"> 1. Demonstration video containing aerobic exercises and arm exercises 2. Documentation of the patient's physical condition 	Measurement of physical activity using IPAQ-SF, quality of life using EORTC QLQ-C30, and using satisfaction surveys on patients
3.	Noelia Galiano-Castillo, et, al. (2016) Granada spanyol	<i>Randomized control trial</i>	81 breast cancer patients	Eight weeks	This application uses the e-CUIDATE system which is an online system aimed the patient's rehabilitation process. <ol style="list-style-type: none"> 1. Patients will get a training schedule which is sent online 2. Patients can do a video conference or 	The quality of life is measured using EORTC QLQ-C30, holding strength/handgrip using TKK 51011Grip-D, muscle strength using analog back dynamometer TKK 5002 Back-A, fatigue using R-FPS (the piper

					send a direct message for a consultation 3. Patients will receive follow-up by telephone	fatigue scale-revised)
4.	Si-Woon Park, et., al. (2018) Incheon, korea selatan	A prospective, quasi randomized multicenter trial	339 breast cancer patients	12 weeks	Smart After Care and inBodyband pedometer are mobile health applications that are used to increase the physical activity of breast cancer patients by using: 1. Demonstration video containing aerobic exercise and arm exercises 2. Documentation of the patient's physical condition	Measurement of physical activity using IPAQ-SF
5.	Mario Lozano-Lozano, et., al. (2016) Granada Spanyol	<i>Randomized control trial</i>	80 patients	Eight weeks	BENECA M-Health app contains: 1. Determination of activities and physical exercise that must be performed by the patient, taking into account the patient's condition (food intake, BB, and TB) 2. Education related to diet for cancer patients 3. Patients' energy imbalances detection	Measurement of quality of life using EORTC QLQ-C30, body composition using BMI, upper limb functionality using DASH, Active ROM using goniometer, cognitive function using WAIS-IV (Wechsler adult intelligence scale), anxiety and depression using HADS (Hospital Anxiety and Depression Scale), accelerometry, and VREM (Short of Minnesota Questionnaire).
6.	Elizabeth J. Lyons, et., al. (2016) Texas USA	<i>A randomized controlled intervention trial</i>	20 Breast Cancer patient	Six months	SMART GOAL is a mobile health application that uses game/game methods. There are two types of games named: 1. Runkeeper application (self-monitoring) 2. Zombies application, Run! (narrative game)	Physical activity is measured using actigraph wGT3X BT monitor, self-report (CHAMPS), FACT-B (functional assessment of breast-cancer therapy), PROMIS, Green and Colleagues Narrative Transportation scale.

7.	Siobhan M. Phillips, et., al. (2017) Chicago USA	<i>cross-sectional study</i>	279 Breast Cancer patient	-	Use telephone, short message service, email.	Use an online questionnaire.
8.	Gregory House., et., al. (2016) USA	<i>Pilot study</i>	12 breast cancer patients	Eight weeks	BrightArm duo rehabilitation system is a 3D game/game application that contains nine games for bimanual and unimanual motor skills (shoulder, arm, palm), emotions and cognitive functions (short-term memory)	Numeric pain scale rating, Full Meyer Assessment FMA, CAHAI-9 chedokee arm, and hand activity inventory-9, special hand function test (JHFT), mechanical goniometer, Jamar mechanical dynamometer, and UEFI-20 (upper Extremity functional Index-20)
9.	Noelia Galiano-Castillo, et., al. (2016) Granada spanyol	<i>Randomized control trial</i>	81 breast cancer patients	Eight weeks	This application uses e-CUIDATE which is an online system aimed the patient's rehabilitation process. 1. Patients will get a training schedule sent online 2. Patients can do a video conference or send a direct message for a consultation 3. Patients will receive follow-up by telephone	6MWT (6 min walk test), auditory Consonant Trigrams (ACT), TMT (trail Making test)

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