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Review

Research Progress of Mobile Health APP in Cancer Patients

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Abstract

Malignant tumor is the second leading cause of death in the world. In addition to the suffering of patients, cancer also imposes a large economic burden on families and society, and affects the health outcomes of patients. With the rapid development of the Internet, people's demand for online and mobile health applications (Apps) is further increasing. At present, there are many clinical studies on mobile health APP outside China, but relatively few in China. In this study, the definition, development status and intervention effects of mobile health APP were comprehensively reviewed, so as to provide a reference for more studies on mobile health APP in cancer patients.

Key words: mobile health APP, cancer patients, nursing intervention.

Introduction

Mobile health (mHealth) is defined as the delivery of healthcare information or services via mobile communication devices that have been successfully used to improve a variety of patient health outcomes (1-2). Mobile health APP is the main form of mobile health. The US Food and Drug Administration defines mobile health APP as medical and health related software on mobile communication platform (3). Mobile health APP is based on intelligent products terminal, which is based on mobile communication technology, provide service for patients and medical staff of the health management platform, support a variety of forms, including audio, video, images, and both can provide patients with disease management and education of knowledge, and can help nurses nursing work . This paper reviews the impact of mobile health APP on health outcomes of cancer patients, mainly including improving treatment compliance, reducing negative emotions, relieving cancer pain, strengthening health education, improving quality of life, strengthening diet management and enhancing physical activity. Mobile health apps can improve health outcomes to varying degrees, enhance treatment effects and nursing service quality, and reduce nursing costs.

The role of mobile health apps in health outcomes of cancer patients

1. Adherence

Progress in oral chemotherapeutic drug compliance among cancer patients in China, there are great differences in oral chemotherapy drug compliance among cancer patients, with the overall medication compliance of patients ranging from 20% to 100%, and the complete compliance rate ranging from 14.2% to 57.4%. Differences in medication compliance also exist in patients with different types of tumors. Krok-Schoen JL et al. (4) tested compliance of adjuvant hormone therapy prescription (AHT) in 27 breast cancer survivors, and conducted 3 months of daily SMS medication reminder and weekly interactive survey through mobile health APP. The results before and after the intervention showed that self-reported medication compliance was significantly improved. Lawitschka A et al. (5) compared the after-care of St. Anna Children's Hospital in Vienna with the use of Interacct, A custom-made mobile health APP for 52 adolescents with cancer, and user satisfaction of participants, acceptability, and investigate the improvement Suggestions for mobile applications, for five consecutive days use INTERACCT reported health data show that INTERACCT self-report health data in adherence to the quality is superior to the traditional pen and evaluation. To sum up, there are many studies on the compliance of mobile health APP for cancer patients. However, the impact of mobile health APP on compliance needs to be studied with multi-center and large sample for different countries, different educational backgrounds and other factors.

2. Negative emotions

2.1 Anxiety and depression

Anxiety and depression are the most common mood disorders. Chow Pi et al. (6) recruited 40 breast cancer patients at the American Clinical Cancer Center and treated them with the IntelliCare for 7 weeks, showing a significant decrease in depression and anxiety symptoms. Chow Pi (7) conducted the intervention on 28 female cancer survivors in the United States through the application software iCanThrive. After the intervention, the symptoms of depression and sleep disorder were significantly reduced compared with those before the intervention. Park S et al. (8) conducted a 12-week intervention study on lung rehabilitation of 90 patients based on a smart phone APP, and the study showed that the patients had significant improvement in depression (P=0.048) and anxiety (P=0.01). There is also the use of 317 nursuing mobile phones in china to reduce levels of anxiety and depression. In conclusion, existing studies have applied mobile health APP to improve anxiety and depression of cancer patients. Although the use of mobile health apps is effective, their anxiety and depression status should be assessed in time, and professional psychological treatment should be provided if necessary.

2.2 Fatigue

The American Comprehensive Cancer Network (NCCN) published the "Practice Guidelines for Cancer-Caused Fatigue-related Practice" in 2007, pointing out the cancer correlation Fatima (CRF) is a persistent, painful, subjective fatigue or fatigue, which is not proportional to activities, but is associated with tumor treatment, often accompanied by certain dysfunction, and the incidence of CRF in tumor patients is up to 34%~ 76%. Spahrkas SS (9), such as recruitment of Australia, Canada, Britain and the United States of 164 in the social media experience cancer patients, moderate to severe fatigue by Unteal APP provides self-management program, can immediately access Untear intervention group, control group at 12 weeks after initial follow-up, to assess previously inaccessible Untear, 12 weeks after intervention assessment Unteal of cancer-related fatigue. Huberty J et al. (10) recruited 128 patients with myeloproliferative tumor (MPN) and divided them into 4 groups. 2 groups received a different sequence of application, and the other 2 groups received a separate application for the second 4 weeks after the 8-week intervention. Participants performed 10 minutes of

daily cellphone-based meditation, which MPN patients identified after the intervention as an app to enjoy calmness and improve fatigue. Napoles AM et al. (11) conducted a 2-month intervention for 23 breast cancer patients. Through written bilingual survival care plan and pamphlet, Spanish mobile phone application(trackC) with integrated activity tracker and telephone instruction, fatigue was significantly improved after 2 months of intervention. To sum up, mobile health APP is applicable to people in different countries and can improve their fatigue status.

3. Pain

Pain by the international association for the study of pain (IASP) associated with actual or potential tissue damage is defined as unhappy, sensory and emotional experience, or related to the damage of the description standard treatment stopped and adherence to reduce, hospital patients is associated with increased incidence of cancerous pain, cancer pain or pain associated with cancer pain experienced by patients with cancer and not apart from the pain experienced by patients with malignant tumor (12). Yang J et al. (13) recruited 58 patients with cancer Pain in Fujian and randomly divided them into the Pain Guard APP nursing experimental group or the traditional pharmaceutical care control group. After 4 weeks, the Pain relief rate in the experimental group was significantly higher than that in the control group ($P<0.001$), indicating that Pain Guard APP is effective in Pain management of patients with cancer Pain after discharge, highly operational and easy to be accepted by patients. Pain coping skills training (PCST) interventions have been shown to be effective in reducing pain and providing other benefits for cancer patients. Somers TJ et al. (14) recruited 225 patients with breast, lung, prostate or colorectal cancer for four courses of intervention using mHealth technology for PCST. There were significant differences in pain, somatic symptoms, psychological distress and pain disaster before and after intervention. Smith K et al. (15) recruited 122 adult breast cancer survivors with chronic pain and randomly divided them 1:1 into the ReImagine APP intervention group or the routine care group. After 18 weeks of intervention, it was found that ReImagine had an effect on the fatigue symptoms of breast cancer survivors, suggesting that ReImagine may be a feasible and effective alternative to face-to-face support. Sun Y et al. (16) recruited 46 patients with cancerous pain symptoms in the Oncology Center of Xinhua Hospital and randomly divided them into experimental group and control group. After 14 days of intervention, the average pain score of the experimental group was significantly lower than that of the control group ($P<0.001$), and the improvement of pain management knowledge score of the experimental group was significantly better than that of the control group ($P<0.001$). In conclusion, the application of mobile health APP in the management of cancer pain has achieved good results. Mobile health APP can effectively alleviate the degree of cancer pain and improve the knowledge of cancer pain management.

4. Health education

Health education throughout the treatment of patients, is another treatment plan. Lee H et al. (2) used a randomized controlled trial to randomly assigned 120 Korean-American breast cancer patients aged 40-77. The intervention group received cultural and personal customized multi-level multimedia information through mobile phone applications and health navigation services for health education, while the control group received printed pamphlets for health education. After 6 months, there were significant changes in breast cancer knowledge scores and screening guidelines scores in the intervention group ($P=0.01$). To sum up, there are few studies on the effects of mobile health apps on health education, and they focus on the cancer field.

5. Quality of life

As an important indicator for evaluation of treatment and rehabilitation, quality of life has gradually received attention. Kim HJ et al. (17) recruited 76 patients with metastatic breast cancer who planned to receive cytotoxic chemotherapy. The subjects were randomly divided into a 1:1 ratio between the mobile game group and the regular education group. Prospective follow-up of 3 weeks showed that using mobile games for education can better educate patients and improve quality of life. Xiaosheng D. (18) conducted a randomized controlled trial on 52 subjects in Jinan. The program of exercise intervention in the research group included: completing target steps through the mobile step-counting recording APP, 4 times a week; Face-to-face remote video instruction for individual muscle training, 3 times a week; Exercise knowledge of breast cancer rehabilitation is regularly pushed through social media APP every day. The control group received routine treatment and rehabilitation treatment according to the hospital's daily standard. After 12 weeks of intervention, the effect of combined exercise intervention based on Internet and social media software on the quality of life of patients after breast cancer surgery was evaluated. Zhu J. (19) conducted a multicenter, single-blind, randomized controlled trial to recruit 114 women with breast cancer who had started chemotherapy and had access to the Internet by mobile phone from the clinics of two affiliated universities in China. Women were randomized to either an intervention or a control group. The intervention group received breast cancer electronic support on a care-as-usual basis. After 12 weeks, the breast cancer electronic support program was found to improve the women's quality of life during chemotherapy. In conclusion, there are many studies on the impact of mobile health apps on quality of life in China, mainly focusing on breast cancer patients, and there is a lack of research on other types of cancer.

6. Catering management

Catabolism and tumor-specific treatments lead to reduced nutrient intake and weight loss in cancer patients, and maintaining a specific personalized diet may be a challenge for patients (20). Orlemann T (20) recruited 39 cancer patients, all of whom received nutrition review, nutrition analysis and nutrition counseling. Twelve patients in the intervention group received APP additionally. After 4 weeks, weight and body composition of each group were measured, and significant weight gain was found in APP group (P=0.045). To sum up, mobile health APP can improve the diet management ability of cancer patients. However, the sample size of the above studies is small, and further studies with large samples are needed.

7. Physical Activity

Health behaviors of cancer survivors have the potential to improve long-term health[21].M Quintiliani L. (21) invited 10 overweight women breast cancer survivors to a ten-week intervention, including MHealth components (selected via SMS daily self-monitoring eating behavior, weight and number of wireless automatic tracking) based on motivational interviewing and four technical support telephone conference, at the end of the self report says participants increased physical activity. Delrieu L et al. (22) conducted a single-center, single-arm trial in 60 breast cancer patients, in which the patients received a 6-month unsupervised and personalized physical activity program, including the activity tracker Nokia Go. The effects of Nokia GO on physical activity in breast cancer patients were assessed after 6 months of intervention. Phillips S.M. (23) recruited 256 breast cancer survivors. Participants will receive a core intervention, including a Fitbit and standard self-monitoring Fit2Thrive app, to explore the possibility of more scalable and effective physical activity interventions for breast cancer survivors by observing physical activity through 12 and 24 weeks of the app. In conclusion, there are many studies on the impact of health apps on physical activity. However, some studies are still in the

intervention stage, and specific data are needed to explain the impact of mobile health apps on physical activity.

Problems and Suggestions in the Application of Mobile Health APP in Cancer Patients

The advantage of mobile health APP is that patients can easily obtain information, that is, the application is required to be easy to operate, simple and diverse forms of information transmission, and meet the preferences of different groups of people. Analysis of cancer incidence trend and age change in tumor registries in China from 2000 to 201. Cancer in China generally presents a trend of advanced age of onset, and the trend is more obvious in women than men. In general, cancer patients are slightly older. On the one hand, due to the influence of traditional concepts, coupled with the stigma caused by the disease, cancer patients are reluctant to express their feelings and cooperate with intervention. In addition, patients have different levels of education or acceptance, so they are not familiar with or skilled at using mobile health APPs in the rapidly developing Internet. On the other hand, with the deepening of the treatment, the side effects brought by the treatment will lead to the decline of patients' physical function, which will hinder the use of mobile health APP. Therefore, the mobile health APP that supports cancer patients should be designed with simple and clean interface to avoid rejection by cancer patients due to complicated operation. Secondly, mobile health APPs may run on their own data or wireless communication networks, which may cause worries about data costs or personal information leakage. Therefore, it is important to build free and secure mobile health apps.

Conclusion

To sum up (Table 1), in recent years, Internet apps have become the most important carrier of mobile health. These apps mainly intervene in the negative emotions of cancer patients in order to find ways to alleviate the negative emotions of cancer patients. However, there are more attempts in this field in Western countries, possibly because cancer patients in Western countries are more willing to express their feelings and needs.

At the same time, Internet APP has become the fastest developing information technology with the greatest market potential, and wearable devices have also become the focus and hot spot of our research. How to combine mobile phone apps, mobile Internet technology and wearable devices to apply to cancer patients will arouse people's thinking, and care based on this will also show great potential.

Table 1. Application of APP in cancer patients.

APP Name	Quantity	Cancer type	Country	Time	Object	Ref
App-based intervention program	27	Post-menopausal breast cancer	USA	Three months	Adherence	4-5
INTERACCT	52	Hematopoietic stem cell transplant	Austria	Five days		
IntelliCare	40	Breast cancer	USA	Sever weeks	Anxiety depression	6-8
iCanThrive	28	Women's cancer	USA	Six weeks		
Smartphone APP	100	Lung cancer	Korea	Twelve weeks		

Unteal	164	Cancer	Australia/ Canada/B ritain/US	Twelve weeks	Fatigue	9-11
10%Happier /appCalm	48	Myeloproliferativ e tumor	USA	Eight weeks		
trackC	23	Spanish-speaking Latina Breast cancer	USA	Two month		
Pain Guard	58	Cancer	China	Four weeks	Pain	14-16
MHealth	225	Breast cancer Lung cancer Colorectal cancer Prostate cancer	USA	four 30-45 minute		
ReImagine	122	Breast cancer	USA	Eighteen weeks		
Intelligent Pain Management System	46	Cancer	China	Fourteen days		
Mobile app	120	Breast cancer	USA	Six months	Health education	2
ILOVEBREAST	76	Breast cancer	Korea	Three weeks	Quality of life	17-19
Step-recording app/social media apps	52	Breast cancer	China	Twelve weeks		
e-support (BCS)	114	Breast cancer	China	Twelve weeks		
OncoFood	39	cancer	Germany	Four weeks	Catering manageme nt	20
MHealth	10	Breast cancer	USA	Ten weeks	Physical activity	21-23
Nokia Go	60	Breast cancer	France	Six months		
Fit2Thrive	256	Breast cancer	USA	Twelve /twenty-four weeks		

Declarations

1) ***Consent to publication***

We declare that all authors agreed to publish the manuscript at this journal based on the signed Copyright Transfer Agreement, and followed publication ethics.

2) ***Ethical approval and consent to participants***

Not applicable.

3) ***Disclosure of conflict of interests***

We declare that no conflict of interest exists.

4) ***Funding***

None

5) ***Availability of data and material***

Not applicable.

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None

7) ***Authors Contributions***

Authors contributed to this paper with the design (XW), literature search (XW), drafting (XW), revision (XW and HJ), editing (XW and HJ) and final approval (HJ).

8) ***Authors biography***

None.

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