

## Effectiveness of smartphone-based e-health intervention to promote cancer patients' quality of life: A quasi-experimental study



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### ABSTRACT

Cancer significantly affects patients' quality of life (QoL), impacting their physical, emotional, and social well-being. Recently, smartphone-based e-health interventions have been investigated as a method to improve QoL for cancer patients by providing customized support. This study assesses the effectiveness of these interventions. Using a quasi-experimental design, the research involved pre- and post-intervention tests. A total of 106 cancer patients were recruited through convenience sampling. A structured questionnaire was used, covering socio-demographic characteristics, medical history, cancer knowledge, and a QoL scale. Data were collected initially and two months after the intervention, which included lectures, group discussions, and scenario-based activities. Results indicated significant improvements in patients' knowledge and QoL scores post-intervention. There were also notable differences in knowledge scores related to socio-demographic factors before and after the intervention. The findings suggest that smartphone-based e-health interventions effectively enhance cancer patients' knowledge and QoL. Successful implementation of these interventions can lead to better health outcomes. Continuous training for nurses and other healthcare providers is essential to maximize the benefits of e-health. This study highlights the potential of smartphone technology to support continuous care for cancer patients, potentially reducing hospital readmissions and improving self-care and health literacy.

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### 1. Introduction

Cancer is a significant global public health issue and is considered one of the main causes of death worldwide. It is anticipated that by 2030, there will be 26 million new instances of cancer and 17 million cancer-related deaths annually. Indeed, cancer patients' ability to deal with the disease is one of the most challenging issues. The valued Total Number of Cancer Cases in Saudi Arabia. The overall number of cases of cancer grew by 179.3% for both genders collectively, from 5616 cases in 2001 to 15688 cases in 2018 (Basudan et al., 2023). As digital technology has rapidly advanced and a sizable portion of the

population now has smartphones and other internet-connected devices, the use of technology in cancer patients has significantly shifted (Komariah et al., 2021). Using mobile health (e.g., mHealth) or smartphone health has been reported to be beneficial in the management of cancer therapy, including symptoms and side effects, early diagnosis of cancer, and cancer prevention have all reportedly (Chan et al., 2020). Quality of life (QoL) is a primary indicator of promoting quality of health among cancer patients. QoL includes patients' ability to function physically, mentally, and socially, which is a crucial outcome indicator. Better outcomes and QoL were reported experienced by cancer patients who engaged in appropriate self-care activities and assistance (Zimmermann et al., 2022). Indeed, the ability to cope with cancer is essential for enhancing patients' QoL (Hofman et al., 2021). Cancer patient self-management refers to a person's methods for regulating their disease to maximize well-being or methods they have selected to improve their QoL

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while living with cancer (Howell et al., 2021). Cancer patients must deal with both physical and emotional repercussions as well as therapy side effects (Sauer et al., 2021). Smartphones meet advanced telenursing approaches in terms of clinical evidence and viability (Shahin et al., 2023). For example, mHealth, which has been known as the use of technology such as mobile or other wireless devices in monitoring and delivering healthcare services, has the potential to improve patient engagement, effectiveness, and access to care. It can also describe the application of information and communication technologies to matters of health. Healthcare professionals frequently view these technologies as a key enabling technology to improve care and the experience of care for those living with chronic conditions (i.e., cancer). These technologies have the potential to offer innovative solutions to health issues (Sauer, 2021). Many cancer patients have unmet information needs and lack expertise in health education and self-care during their disease. Patients can receive information and education remotely thanks to mobile devices like smartphones and tablets (Pavic et al., 2020).

The QoL for the elderly includes their ability to perform daily tasks, which reflects their physical, psychological, and social well-being, as well as their satisfaction with their functioning and disease management. There is a link between self-care, QoL, and coping strategies. Coping strategies may be more important for predicting QoL than medical or treatment-related factors (Amirshamsi et al., 2022). Additionally, Stromberg supports encouraging cancer patients to learn self-care to help them develop their sense of self-control and minimize the helplessness that frequently comes with cancer and its treatment (Sivakumar and Susila, 2021). Smartphones offer a variety of methods for delivering educational interventions in addition to voice and text communication, Internet access, a high-quality camera, and a recording device. So, to deliver an eHealth education and training program, the researcher will use a smartphone (Xu et al., 2019). Smartphone-based health interventions for cancer patients are successful in lowering psychological and physiological difficulties (e.g., depression, cancer-related fatigue, distress, nutrition problems, pain) and enhancing health-related QoL. They facilitate symptom monitoring, feedback, and supportive intervention (Fridriksdottir et al., 2018).

According to Azam et al. (2020), 27,885 new cases of cancer were diagnosed in Saudi Arabia in 2020, and the incidence rate is increasing. As cancer is a chronic illness, patients now need to manage their condition at home without regular doctor monitoring, as cancer care has shifted from inpatient to outpatient settings. Despite the growing use of technology and smartphones in healthcare, there is limited information on their effectiveness in improving the QoL for cancer patients in Saudi Arabia. Therefore, this study aimed to evaluate the effectiveness of smartphone-based e-health interventions in enhancing the QoL for cancer

patients in Saudi Arabia. The study had the following specific objectives: a) to assess the efficacy of e-health interventions on the QoL of cancer patients; b) to assess the efficacy of e-health interventions on symptom reduction; c) to design and implement educational and training e-health interventions via smartphones to promote the QoL for cancer patients; d) to compare the knowledge and QoL of cancer patients before and after e-health interventions.

We hypothesized that smartphone-based e-health education and training interventions would improve the QoL for cancer patients and have a positive impact. To better understand patient adoption and interest in using smartphone health technology, improve cancer information, QoL, self-care support, and coping with cancer, researchers will present their findings. The major goal of the intervention is to educate patients about self-care and QoL. The study aimed to evaluate the effectiveness of smartphone-based e-health interventions in promoting the QoL for cancer patients in Saudi Arabia.

## 2. Method

We conducted a quasi-experimental cross-sectional study using pre- and post-tests. The study included 106 cancer patients selected through a convenience sampling method. The research took place in two suburban cities in the Riyadh Province, Shaqra and Sajir, which have an average population of about 30,000 people each. Cancer patients from these cities were eligible to participate if they were diagnosed with cancer, had received chemotherapy, radiation, surgery, or a combination of these treatments, were currently undergoing treatment, understood the local language, and were willing to participate in the study. Patients were excluded if they had learning disabilities, were undergoing psychiatric treatment, received other social service interventions, or were unable to perform daily activities.

### 2.1. Socio-demographic and health profile structured sheet

This section included two parts to measure the sociodemographic characteristics and medical history of the patients. Socio-demographic characteristics of the patients include information such as age, sex, residence, marital status, level of education, occupation before retirement, and income. The medical history of the condition includes information such as diagnosis, duration of disease, medication used, side effects of treatment, presence of other medical diseases, and complaints.

### 2.2. Patient's knowledge assessment questionnaire (PKAQ)

We developed this tool based on an extensive review of the literature (Van Driel et al., 2018). It is

designed to assess patients' knowledge about their disease, including the definition of cancer, its causes, the purpose and various methods of chemotherapy administration, the side effects of chemotherapy, and QoL. The Patient Knowledge Assessment Questionnaire (PKAQ) was used, demonstrating strong validity and psychometric reliability with a Cronbach's alpha of 0.87. The scoring system assigned one mark for each correct answer and zero for incorrect answers. The total score was evaluated as follows: less than 60% was considered poor knowledge, and 60% or more was considered good knowledge.

### 2.3. The European Organization for Research and Treatment of Cancer QoL questionnaire (EORTC-QLQ-C30)

This scale was developed by the EORTC Quality of Life Study Group in 1988 (Jassim and AlAnsari, 2020). It includes five functional scales (physical, role, cognitive, emotional, and social), three symptom scales (fatigue, pain, nausea, and vomiting), global health and QoL scales, and six single questions addressing additional symptoms commonly reported by cancer patients (dyspnea, insomnia, appetite loss, constipation, diarrhea, and financial difficulties). The scale has 30 questions. Questions 1 to 28 are coded with the response categories: "Not at all-1," "A little-2," "Quite a bit-3," and "Very much-4." Questions 29 and 30 are coded from "Very poor-1" to "Excellent-7." A high scale score indicates a higher level of response.

### 2.4. Validity and reliability of the tool

The QLQ-C30 is scored according to the recommended EORTC procedures. All raw scores will be converted to lie in a range between 0 and 100. The Arabic version of the European Organization for Research and Treatment of Cancer was used and was shown to have strong psychometric reliability and validity with a Cronbach's alpha range of 0.80–0.84 (Jassim and AlAnsari, 2020). Cancer patients positively promote quality of health life through our eHealth Education and training interventions based on Smartphones.

The researchers translated all questionnaires into Arabic. A panel of professionals from the academic nursing staff at the university (7 professors and assistant professors) to determine the content and face validity. No modifications are required to be made.

### 2.5. Pilot study

The translated questionnaire was piloted on 10% of the study population (ten from both male and female cancer patients) to assess the study instruments' clarity, applicability, and time requirements, as well as investigate their feasibility.

The pilot study results were incorporated into the study results without any changes.

### 2.6. Procedures

A convenient sampling method was applied to recruit cancer patients from the above-mentioned settings. After obtaining formal authorization, the researchers began gathering data from the patients who satisfied the requirements for inclusion. To get the participants' cooperation and oral consent to be included in the research, the researchers met the participants for one time and engaged in WhatsApp groups. The study was carried out through recruiting and interviewing, implementation and evaluation,

### 2.7. Recruitment and interviewing

Patient recruitment took place from November 2022 to the end of February 2023. The educational program, its goals, the intervention details, and the one-month and three-month requirements were explained to the participants. Each recruited patient was assigned to one of seven groups, with each group consisting of 13 to 17 people on average. The intervention, called "smartphone-based eHealth intervention," utilized a mobile WhatsApp application to create these groups.

To build rapport and establish a relationship with the patients, the researchers set up an online WhatsApp chat group and sent messages to participants twice a day before collecting pre-test data. The purpose of the WhatsApp app was to facilitate patient contact, assess their knowledge and QoL, and promote a better quality of life for cancer patients. Topics covered included the quality of life for cancer patients, the definition of cancer, its causes, the purpose and various methods of chemotherapy administration, and the side effects of chemotherapy. These topics were selected after reviewing the literature, assessing outcomes, and identifying gaps.

### 2.8. Implementation

Participants received an electronic structured questionnaire with instructions on how to complete it via Google Forms. They were sent an email and a WhatsApp message containing a link to the questionnaire. Participants were asked to confirm their agreement to complete the questionnaire by selecting "Yes, I agree to participate" in the online form. The pre-test was done before the online learning sessions, which were conducted using Google Meet and Zoom. The researchers reviewed extensive literature and evidence-based research before developing the sessions. Based on this review, assessment results, and identified gaps, they created interventions to enhance patient knowledge and QoL. The educational program lasted six weeks, totaling 30 hours, with two sessions each week.

To help participants understand the importance of QoL and improve their health, various teaching methods were used, including lectures, group discussions, and scenario-based activities. Participants also received videos, brochures, and posters via smartphone support services. The educational intervention aimed at enhancing patient knowledge and QoL was successfully completed.

### 2.9. Evaluation

The importance of measurement was emphasized. A post-test was completed at the end of the educational intervention to evaluate its effectiveness, track changes in the cancer patients' knowledge and QoL, and promote a better quality of health life for cancer patients.

### 2.10. Statistical analysis

This study assumed that both dimensional and one-dimensional models of the collected data were computerized, reviewed, categorized, tabulated, analyzed, and presented in descriptive and statistical form using the Statistical Package for Social Sciences version 20 (IBM Corp., USA). Qualitative data were expressed as frequency and percentage, while quantitative data were presented as mean (X) and standard deviation (SD). A paired t-test was used to compare two means and examine changes in nursing interns' sustainability attitudes. The significance level was set at p values of  $\leq 0.05$  and highly significant at  $\leq 0.001$ .

## 3. Results

Table 1 shows the socio-demographic characteristics of the cancer patients. It reveals that 38.7% of participants were under 30 years old, with a mean age of  $34.5 \pm 11.7$  years, and 85.8% were female. Almost half of the participants were married (44.3%), and 38.7% were not working. Of the participants, 76.4% had a university education. Most participants (69.8%) had enough family income, 62.3% relied on retirement money, and 54.7% lived with their families. Fig. 1 shows the distribution of cancer types among the patients. Among them, 34% had breast cancer, 15.1% had colon cancer, and 13.2% had prostate cancer. Additionally, 20.8% had other types of cancer. Fig. 2 illustrates the distribution of cancer patients according to their cancer stage. It shows that 41.5% were in the 2nd stage, 33% were in the 1st stage, 20.8% were in the 3rd stage, and only 4.7% were in the 4th stage.

Table 2 lists the main side effects of cancer treatment experienced by the patients and their family medical history. The main side effects were nausea (42.5%), anorexia (17.9%), hair loss (11.3%), severe pain (9.4%), diarrhea (9.4%), weight loss (4.7%), and high body temperature (4.7%). Regarding family medical history, 20.8% of patients had a family medical history of cancer. Fig. 3 shows

the patients' total knowledge scores before and after the intervention. The level of knowledge significantly improved ( $p < 0.001$ ), with the percentage of good knowledge levels increasing from 24.5% before the intervention to 69.8% after the intervention.

Table 3 compares the mean scores of the Cancer QoL before and after the intervention. There was a significant difference between the QoL domain mean scores before and after the intervention ( $p < 0.001$ ). The five functional scales ranged from  $27.0 \pm 10.2$  to  $59.5 \pm 22.5$  before the intervention and from  $52.9 \pm 13.9$  to  $75.0 \pm 19.7$  after the intervention. The three symptom scales measuring fatigue, pain, nausea, and vomiting ranged from  $28.2 \pm 10.7$  to  $80.6 \pm 30.5$  before the intervention and from  $13.4 \pm 3.5$  to  $41.6 \pm 11.0$  after the intervention. The six single-item measures of dyspnea, insomnia, appetite loss, constipation, diarrhea, and financial functioning ranged from  $25.6 \pm 9.7$  to  $56.0 \pm 21.2$  before the intervention and from  $11.8 \pm 3.1$  to  $38.4 \pm 10.1$  after the intervention.

Table 4 shows the association between the socio-demographic characteristics of the cancer patients and their mean scores of knowledge. The results indicate no significant differences in patients' pre-intervention mean scores based on their socio-demographics. However, all results were significant after the intervention (post-intervention). Male patients, and those who were married, had a university education, were employed, and had sufficient or higher income reported significantly higher mean scores than their counterparts ( $p < 0.05$ ).

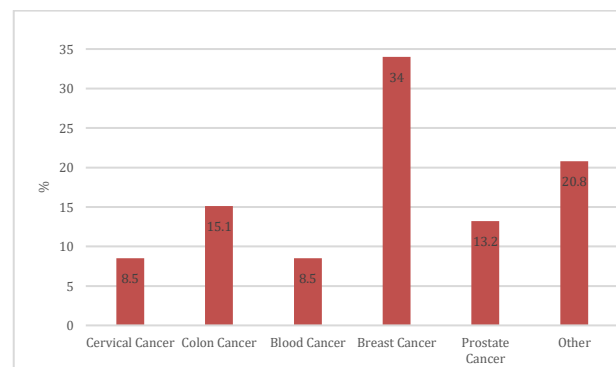


Fig. 1: Distribution of the cancer patients according to type of cancer

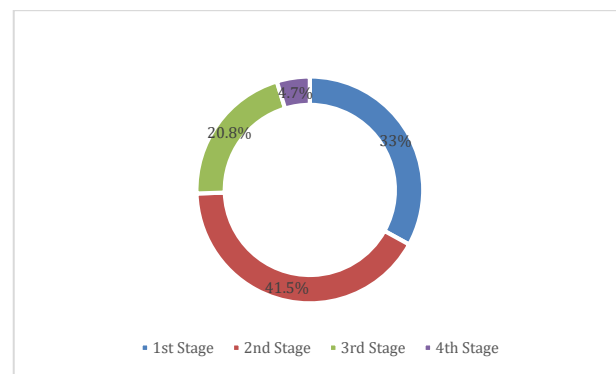


Fig. 2: Distribution of cancer patients according to the stage of cancer

**Table 1:** Distribution of the socio-demographic characteristics of the cancer patients (N=106)

Variable	n	%
<b>Age</b>		
< 30	41	38.7
30 - 40	37	34.9
> 40	28	26.4
Mean ±SD	34.5 ±11.7	
<b>Gender</b>		
Male	15	14.2
Female	91	85.8
<b>Marital status</b>		
Single	44	41.5
Married	47	44.3
Divorced	15	14.2
<b>Education</b>		
Read and write	3	2.8
Secondary education	22	20.8
University education	81	76.4
<b>Occupation</b>		
Not working	41	38.7
Housewife	24	22.6
Merchant	3	2.8
Employee	33	31.1
Worker	5	4.7
<b>Income</b>		
Not enough	22	20.8
Enough	74	69.8
Enough and more	10	9.4
<b>Income source</b>		
Retirement money	66	62.3
Sons' help	4	3.8
Relatives	4	3.8
Social affairs	14	13.2
Outside work	18	17.0
<b>Living status</b>		
Alone	16	15.1
Husband/wife only	14	13.2
All your family	58	54.7
Husband/wife whose children are married	13	12.3
One of the sons/daughters	5	4.7

**Table 2:** Distribution of cancer patients according to the side effects of cancer treatment (N=106)

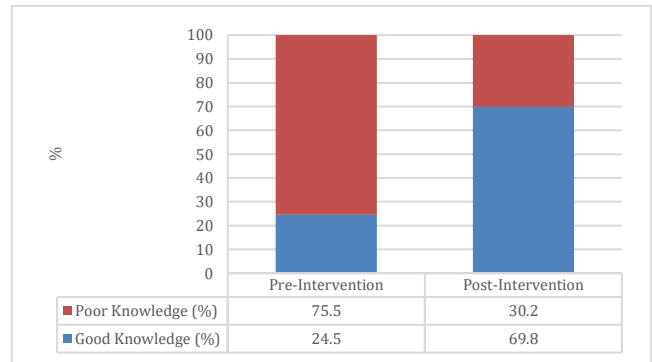
Variable	n	%
<b>Side effects</b>		
Nausea	45	42.5
Weight loss	5	4.7
Anorexia	19	17.9
Hair loss	12	11.3
Severe pain	10	9.4
Diarrhea	10	9.4
High body temperature	5	4.7
<b>Family medical history</b>		
Yes	22	20.8
No	84	79.2

#### 4. Discussion

The study aimed to evaluate the effectiveness of smartphone-based e-health interventions in improving the QoL for cancer patients. The results showed a statistically significant improvement in knowledge and QoL scores after the intervention. This finding supports the study hypothesis.

The results indicated a significant difference in QoL domain scores before and after the intervention, suggesting the program's effectiveness. Similarly, Geng et al. (2021) found that after three months, there was a significant increase (P=.04) in physical activity (PA), which raised the metabolic equivalents (MET). Walking also showed significant improvement (P=.03) after the session. Qualitative findings revealed that breast cancer patients were satisfied with and willing to use the app to manage

PA and other health behaviors. The theory-based mHealth PA intervention has significant potential to increase awareness and engagement in PA among breast cancer patients while supporting behavior modification.



Chi-Square (X<sup>2</sup>): 43.611; p-value<0.001

**Fig. 3:** Distribution of the patient's total knowledge score pre and post-intervention

Regarding the relation between demographic characteristics and knowledge among patients under study, this study revealed that there was a statistically significant relation between the total level of knowledge of patients under study and their educational level and residence. This study might be due to the high level of education in urban areas, which promotes the education of patients to learn more about the disease. This result is supported by Kharyal et al. (2021), who found that the level of education and place of residence had a significant impact on the knowledge of the parents and adolescents. They found that parents and adolescents who had completed secondary school or higher and lived in urban areas had more knowledge than those whose parents had completed middle school and lived in rural areas.

For people with cancer, understanding cancer and cancer literacy are crucial because enough knowledge leads to appropriate activities, whereas a lack of awareness results in improper actions. This study found that there was a statistically significant improvement in the knowledge level of the studied patients following interventions, which demonstrates the beneficial effects of smartphone apps as a means of delivering and disseminating knowledge. Mobile apps have grown in significance in the delivery of instructional content over the past few years. Due to the ubiquitous nature of smartphones, educational interventions can be made available to everyone at any time, with further support always available wherever and whenever it is needed. Thanks to this chance, a wide range of people can now take advantage of straightforward and affordable initiatives. Motivational messages, monitoring tools, and tools for behavior modification can all be sent using mobile devices (Shirzad et al., 2020; Kazemi et al., 2022). These results coincide with the results of a study conducted by Lee et al. (2021), who revealed a significant improvement in the knowledge level of the studied patients following interventions.

**Table 3:** Comparisons between mean scores of the cancer QoL before and after intervention among the studied patients (N=106)

Variable	Pre-intervention		Post-intervention		Paired t-test	
	Mean ±SD		Mean ±SD		t	p
<b>Functional scales</b>						
Physical functioning	36.5 ±13.8		61.5 ±16.2		12.094	<0.001
Role functioning	27.0 ±10.2		58.7 ±15.5		17.589	<0.001
Emotional functioning	46.0 ±17.4		67.6 ±17.8		8.934	<0.001
Cognitive functioning	59.5 ±22.5		75.0 ±19.7		5.336	<0.001
Social functioning	40.9 ±15.5		52.9 ±13.9		5.972	<0.001
Global health status/QoL	25.8 ±9.8		75.7 ±19.9		23.160	<0.001
<b>Symptom scales/items</b>						
Fatigue	78.3 ±29.6		41.6 ±11.0		11.965	<0.001
Nausea and vomiting	28.2 ±10.7		13.4 ±3.5		13.535	<0.001
Pain	80.6 ±30.5		35.8 ±9.4		14.452	<0.001
Dyspnea	36.0 ±13.6		17.9 ±4.7		12.950	<0.001
Insomnia	56.0 ±21.2		18.9 ±5.0		17.536	<0.001
Appetite loss	52.4 ±19.8		27.1 ±7.1		12.383	<0.001
Constipation	47.3 ±17.9		26.8 ±7.1		10.960	<0.001
Diarrhea	25.6 ±9.7		11.8 ±3.1		13.952	<0.001
Financial difficulties	48.8 ±18.5		38.4 ±10.1		5.080	<0.001

**Table 4:** Association between sociodemographic characteristics of the cancer patients and their mean scores of knowledge (N=106)

Variable	Pre-intervention		Post-intervention	
	Mean±SD		Mean±SD	
<b>Gender</b>				
Male	32.5±5.1		41.0±8.1	
Female	31.9±7.9		36.1±7.4	
T-test [T, P]	T=0.299, P=0.766		T=2.381, P=0.019*	
<b>Marital status</b>				
Single	31.4±9.0		35.7±9.4	
Married	31.6±6.1		38.9±6.4	
Divorced	35.0±6.6		33.3±2.4	
One-way ANOVA [F, P]	F=1.403, P=0.250		F=3.922, P=0.023*	
<b>Education</b>				
Read and write	31.7±4.0		31.0 ±1.7	
Secondary education	30.8±8.7		35.8 ±5.4	
University education	32.3±7.4		39.6±8.3	
One-way ANOVA [F, P]	F=0.340, P=0.712		F=3.584, P=0.031*	
<b>Occupation</b>				
Not working	32.0±8.3		34.1±8.5	
Housewife	32.1±6.3		35.8±3.8	
Merchant	36.7±8.3		36.0±0.1	
Employee	31.6±7.8		39.9±7.5	
Worker	30.6±5.7		44.0±8.2	
One-way ANOVA [F, P]	F=0.340, P=0.850		F=4.314, P=0.003*	
<b>Income</b>				
Not enough	33.8±8.5		32.7±8.5	
Enough	31.9±7.3		38.0±7.4	
Enough and more	28.8±7.0		36.9±5.0	
One-way ANOVA [F, P]	F=1.523, P=0.223		F=4.190, P=0.018*	

According to the results of the current study, breast cancer is the most common type of cancer among the study's participants. This result is consistent with the findings of Siegel et al. (2022), who noted the most common cancer diagnosed in men and women in 2024 was breast cancer, with breast cancer alone accounting for 32% of cases. Also, this is in agreement with El-Melook et al. (2015), who stated that among cancer patients, breast cancer is the most common form. Additionally, this supports a study conducted in Palestine by Thweib (2011), which found that lung cancer, colorectal cancer, and breast cancer account for the majority of cancer cases. Additionally, the most frequent side effect of treatment was nausea, which was followed by anorexia and hair loss. In the current study, diarrhea, mouth ulcers, anorexia, and vomiting were the most frequent adverse effects of chemotherapy. This outcome is in line with what Kirkham et al. (2018) found when assessing the nutritional health of Egyptian patients undergoing chemotherapy. The top three side effects recorded

were anorexia, nausea, and vomiting (Koom et al., 2012). This finding is supported by Skolin et al. (2001), who observed that after implementing new mealtime routines during chemotherapy, the number of meals and energy consumption increased by 12%. They also noted that chemotherapy side effects can significantly impact a cancer patient's ability to eat. The most common issues are dizziness and nausea, along with anorexia caused by chemotherapy's damage to the gastrointestinal mucosal cells. Educating patients on managing these side effects can help them consume more fluids orally. However, this study did not consider whether patients received antiemetic therapy, and current antiemetics are not completely effective in preventing drug-induced vomiting (Beauchemin et al., 2020). Regarding the distribution of cancer patients by stage, the present study shows that most patients were in the 2<sup>nd</sup> stage. This result differs from Ellison and Saint-Jacques (2023), who found that most cancer patients were in the 1<sup>st</sup> stage and emphasized that the stage at diagnosis significantly

affects survival, reflecting how far the disease has spread at detection. Similarly, [Cardoso et al. \(2022\)](#) reported that about half of the cancers were diagnosed at advanced stages III or IV. Cancer is a major public health and economic concern, and its burden is predicted to increase ([Alam et al., 2020](#)). Their QoL is one of the most worrisome health concerns for oncology patients. Along with eliminating the tumor cells, treatment for many cancer patients aims to enhance their QoL. While QOL varies greatly depending on the kind of cancer, a sizable number of all patients suffer from side effects from the disease and its therapies, which lower QOL ([Mohammed et al., 2018](#)). To guarantee QoL, evidence-based treatment, a more individualized patient approach, cutting-edge management techniques, and adequate patient education are used. The widespread usage of mHealth apps nowadays can significantly contribute to patient education, disease self-management, and remote patient monitoring, improving their QoL ([Giannoula et al., 2020](#)). It concluded that mHealth and eHealth tools are efficient in enhancing provider expertise, self-assurance, and behaviors related to cancer screening, treatment, and survivorship care. With more than 2 million new cases in 2020, breast cancer (BC) will be the most frequently diagnosed malignancy in women worldwide. Due to changes in risk factor profiles, improved cancer registration, and cancer detection during the past three decades, its incidence and death rates have increased ([Łukasiewicz, et al., 2021](#)).

## 5. Conclusion

The number of smartphone users is rising globally. Mass media could play a vital role in providing the public with information about risk factors and early detection of cancer. Implementing eHealth interventions Based on Smartphones improves the patients' knowledge of cancer and positively affects their QoL. Health-care professionals also need specific knowledge about problems and restrictions in daily living and QoL of patients newly diagnosed with cancer to meet their specific needs and to provide support. Further studies should be undertaken on different modalities of telehealth and their appropriate and effective use in interventions to improve the QOL of cancer patients undergoing treatment.

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## Compliance with ethical standards

### Ethical consideration

Ethical clearance was obtained from Shaqra University's standing committee of research ethics (ERC\_SU\_20230011). The researcher informed the eligible participants about the nature of the study procedure, and informed oral consent was obtained. In addition, consent was obtained by asking patients under study to confirm that they agreed to complete the questionnaire by marking a "Yes, I agree to participate." The researcher assured the privacy of the data collected. Participation in the study was voluntary.

### Conflict of interest

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