

## **Web-Based Interventions in Pediatric Oncology Nursing: A Systematic Review**

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### **Abstract**

**Introduction:** Continuous technological progress and the constantly expanding accessibility of the web have provided new opportunities for the development and implementation of web-based interventions in pediatric oncology nursing.

**Aim:** This study aimed to investigate web-based interventions in pediatric oncology nursing.

**Methods:** This is a systematic review of the literature from 2021 to 2023. Research articles were retrieved from PubMed and Scopus using the PRISMA method. The study includes 15 articles with quantitative, qualitative, or mixed methods studies of children and/or adolescents with cancer and/or their parents/carers and/or health professionals.

**Results:** Results showed that legacy-building interventions, parent education interventions, symptom reporting interventions, counseling interventions, interventions to improve treatment compliance, virtual reality interventions, parent information interventions, and interventions to improve the health-related quality of life of parents of children with cancer, based eHealth and mHealth, showed positive effects on improving the treatment and care of children with cancer. The eHealth literacy and use of technology devices significantly influenced attitudes and confidence in higher quality eHealth and mHealth applications.

**Conclusions:** Web-based interventions in pediatric oncology nursing, based on the available evidence, seem to be useful and acceptable for monitoring complications and may have an important role in relieving and preventing the psychological consequences of children undergoing treatment and improving their quality of life. However, further studies are needed to establish their effectiveness.

**Keywords:** internet-based intervention, oncology nursing, pediatric nursing, cancer, child

## **Introduction**

Every year approximately 429.000 children and adolescents aged 0-19 years are diagnosed with cancer. The 5-year survival is > 80% for 45.000 children with cancer in high-income countries, but is > 30% for 384.000 children in low-middle income countries (Allemani et al., 2018). Children and adolescents with cancer undergoing treatment experience many side effects as a result of the disease and treatment that affect their quality of life (QoL) and their ability to participate in daily activities. They often experience a combination of physical, psychosocial, emotional and spiritual pain. Pediatric palliative care, adapted to their specific needs, is important for reducing pain and improving QoL (Anastasopoulou & Dousis, 2022; Akard et al., 2021a).

The distress experienced by children and adolescents affects not only themselves but also their parents and siblings (Linder & Hooke, 2019). With the diagnosis, the normal life of the family is disrupted and psychosocial consequences occur. To reduce the impact of cancer on children and families, evidence-based interventions are needed (Delemere & Maguire, 2020). Digital health promotion interventions, involving web-based technologies, have been considered effective and important means to improve the health and QoL of patients, as well as healthcare services to reduce health inequalities, due to their wide availability (de Sousa et al., 2022). Web-based interventions for children and young people with physical and psychological problems have been less studied, but are nevertheless very important interventions for access to healthcare and treatment of patients with chronic diseases (Kokcu & Kaya, 2019). A recent study showed that the effectiveness of mobile health (mHealth) interventions in the management of type 2 diabetes mellitus remains unclear (Rovithis et al., 2023). Web-based interventions are digital applications designed to educate patients, support them, and assist in their care and treatment (Khan et al., 2019). Web-based legacy interventions

are applications that aim to create and store digital material by patients to preserve in the family's memory selected moments of their lives, while comforting family members, and thus are beneficial during illness and end-of-life for patients and their families (Delemere & Maguire, 2020). The legacy interventions include among others scrapbooks, songwriting, photographs and video recordings. They have been reported to enhance a sense of dignity, purpose, meaning and will to live, while improving pain and depressive behavior (Akard et al., 2021a).

Technology-based interventions include eHealth and mHealth applications. E-Health applications include web-based digital applications and virtual reality (VR), while mHealth applications include mobile and wireless applications on smartphones, such as messaging and social networks. Technology-based health interventions for children and adolescents offer education, feedback, symptom assessment, better communication between children and health professionals, early diagnosis of health problems, psychosocial support, are easy to use, accessible and affordable. Pediatric oncology nurses can provide physical and psychosocial support to children with cancer and their parents through these interventions (Koyu & Törüner, 2023), while they need to improve their knowledge and skills to use them (Nakas & Kazan, 2020; Arli, Bakan & Yildiz, 2019). This study aimed to investigate web-based interventions in pediatric oncology nursing.

## **Methods**

**Study Design:** This is a systematic review of the literature from 2021 to 2023.

**Search strategy:** Research articles were retrieved using keywords: web-based intervention, internet-based intervention, pediatric nursing oncology, cancer and children, from PubMed and Scopus. The criteria for inclusion of articles in the study are presented in Table 1. For the study, web-based interventions are defined as digital

applications based on eHealth, mHealth and teleHealth technologies.

**Article selection process:** For the selection of articles the PRISMA methodology was applied which includes identification, screening, eligibility included (Liberati et al., 2009).

**Identification:** The databases retrieved a total of 1762 articles. After the application of the literature search filters and title screening, 466 articles that did not meet the inclusion criteria were rejected (Figure 1). In addition, 549 articles involving duplicate records were rejected.

**Screening:** The title of 747 articles related to web-based interventions in pediatric oncology nursing were evaluated and 662 articles were rejected after abstract evaluation.

**Eligibility:** Using the PICOS approach, the full text of 85 articles was assessed for eligibility. These articles examined web-based interventions in pediatric oncology nursing and patient age. After evaluation, 70 articles were rejected after reading the full text of the articles.

**Included:** After thematic analysis of the full text of the articles, 15 articles were included in the study (Figure 1). The authors assessed the quality of the articles using the PRISMA methodology (Liberati et al., 2009). A "checklist of items to include when reporting systematic reviews" (7 sections, 27 items) was used to assess the quality of the articles (Liberati et al., 2009). The 15 articles included in the study were considered to be of high (or moderate to high) quality and relevant to the aim of this systematic review.

**Data analysis:** The thematic analysis of the studies involved 3 stages: preparation, organization and reporting. In the preparation stage, the full text of the articles was read several times to fully understand their significance and the conclusions drawn. According to the content of each article, the web-based interventions in pediatric oncology nursing were evaluated and relevant information was highlighted for the second stage of data analysis. When organizing the data, the text was organized using codes, creating categories and

grouping the codes into headings. In the final step, the results of web-based interventions in pediatric oncology nursing were reported. For each article, data were extracted from a predefined spreadsheet. Data fields included first author, year of publication, country, purpose, sample, methods, intervention, tools, and results. The results of the studies are summarized in Table 2.

## Results

### Characteristics of studies

The study analyzed quantitative (n = 14) and mixed (n = 1) studies conducted in the USA (n = 9) and from 1 study conducted in China, Peru, Australia, Ireland, Canada and Turkey. The quantitative studies consisted of randomized trials (n = 6) and studies with pre- and post-measurement (n = 5). The articles in this study involve legacy building interventions (n = 3), educational interventions (n = 5), symptom reporting interventions (n = 1), counseling interventions (n = 1), and interventions to improve treatment compliance (n = 1), VR interventions (n = 1), information interventions (n = 1), health-related quality of life (HRQoL) improvement interventions for parents of children with cancer (n = 1), and exploration of mHealth literacy (n = 1).

### Evaluation of quality of studies

The methodological quality of the research design of studies was high. All studies (n = 15) were rated high (or moderate to high) quality. Research questions were clear and data collection methods were appropriate.

### Analysis

The results of the 15 studies examined the implementation of web-based interventions in 614 children, 931 parents and 103 health professionals and were divided into 2 sections:

#### 1. Web-based interventions

Akard et al., 2021a, examined the impact of a web-based legacy building intervention for children with advanced cancer and their parents on parental coping strategies for cancer. The results of the study showed that even it was not statistically significant, the

legacy intervention showed trends toward increased use of primary control coping strategies and disengagement in parents, over time, compared to usual care (Akard et al., 2021a).

Akard et al., 2021b, studied the effect of a web-based memory-making intervention for children with recurrent cancer and their parents on the QoL of children with cancer. The children were asked to answer self-reflective questions and share multimedia content, such as photos, videos, and music. Although there was no statistically significant difference, in the intervention group there were small effects on the child's procedural and perceived anxiety (Akard et al., 2021b).

Linder et al., 2021, evaluated the usability and acceptability of a new game-based mHealth, symptom reporting application for school-aged children with cancer. Children in the intervention group assessed their symptoms by using the web-based Color Me Healthy App (via tablet). Children who used the application most frequently reported the symptoms they experienced and enjoyed the intervention. Parents approved of the interactive nature of the application and the value of the child providing their own report (Linder et al., 2021).

Heneghan et al., 2021, examined the impact of mHealth technology literacy on improving adherence to 6-mercaptopurine (6-MP) medication in children with acute lymphoblastic leukemia. They used the web-based REDCap intervention (via tablet) that assesses technology access, mHealth preferences and records demographic characteristics. Parents were most supportive of the medication list (71%, 35/49), 6-MP information (71%, 35/49), stock-out reminder (71%, 35/49), and 6-MP administration reminder (71%, 35/49). Adolescents and young adults were more supportive of stock depletion reminder (73%, 11/15), 6-MP administration reminder (73%, 11/15) functions (Heneghan et al., 2021).

Delemere & Maguire, 2021, investigated the relationship between technology use, eHealth literacy and attitudes towards

eHealth & mHealth among parents of children with cancer and health professionals. Positive attitudes towards eHealth and mHealth applications and strong eHealth skills were found. However, those who had not used such applications had significantly lower eHealth literacy than those who had used such applications ( $t(74) = 2.08, P = 0.04$ ). In addition, eHealth literacy and device use significantly influenced attitude ( $F(3.75) = 12.01, P < 0.001$ ) and confidence in higher quality eHealth & mHealth applications ( $F(2.58) = 3.87, P = 0.03$ ) (Delemere & Maguire, 2021). Breakey et al., 2022, evaluated the applicability of Teens Taking Charge Cancer, a web-based app for self-care for children with cancer. In the intervention group, 46% participated at least once during the 12 weeks period. The mean completed parent rating was 2.4 out of 12 modules ( $SD = 3.0$ ) and no one completed the program. The 33% of parents in the intervention group logged on to the website at least once and none completed the full program. The current intervention design lacks applicability (Breakey et al., 2022).

Canter et al., 2022, investigated the acceptability, applicability and accessibility of the web-based eSCCI intervention and its impact on psychosocial health. Parents rated eSCCIP as highly acceptable, feasible and accessible. A statistically significant clinical effect was observed for acute distress ( $d = 0.79$ ). Moderate clinical effects were reported for overall symptoms of posttraumatic stress disorder ( $d = 0.37$ ), negative mood/cognitive functioning ( $d = 0.59$ ), and anxiety symptoms ( $d = 0.48$ ) (Canter et al., 2022).

Cho et al., 2023, identified the effects of a web-based legacy building intervention on improving anxiety in children with cancer. The intervention showed small and statistically insignificant effects on coping strategies for direct attempts to influence the stressor or emotional reactions and active attempts to avoid the stressor among children with recurrent or refractory cancer (Cho et al., 2023).

Canter et al., 2023, determined the applicability and acceptability of the web-based eSCCI intervention. 80% of the sample rated the applicability and acceptability of eSCCIP as moderate to high. Enrollment and retention rates were 54% and 70%, respectively. Results showed statistically significant reductions from pre-intervention to post-intervention for general symptoms of post-traumatic stress disorder (PTSD), cluster D symptoms (negative mood and cognition), and anxiety (Canter et al., 2023).

## 2. mHealth interventions

Luo et al., 2021, studied the effectiveness of a mHealth educational program, (included resilience building with pictures or videos, with examples of skills to apply when caring for children with cancer and a structured diary), for reducing depressive symptoms and enhancing both resilience and QoL, in parents of children with cancer. Participants in the intervention group had lower levels of depressive symptoms than those in the control group. QoL scores in the intervention group were higher than those in the control group, but no statistically significant effect of the intervention was identified (Luo et al., 2021).

Vásquez et al., 2021, examined the applicability and utility of the mHealth counselling app ONCOPEDES and its effect on reducing latency to diagnosis (LD) and referral time (RT). In the intervention group, RT was reduced by 66% ( $P = 0.02$ ) with the implementation of ONCOpeds. However, LD was not significantly reduced (Vásquez et al., 2021).

Tennant et al., 2021, examined the applicability, acceptability and effectiveness of mHealth VR intervention in reducing anxiety and preparing children with cancer undergoing computed tomography (CT) and radiotherapy (RT), and their parents. Patients were exposed to VR CT and RT and anxiety measurements were taken before and after. Results showed that high acceptability and satisfaction with the VR intervention were reported by patients, parents and radiotherapists. There were minimal adverse events associated with VR. The VR

intervention improves children's understanding of RT procedures and reduces child and parental anxiety before the procedure. Only one child in the study required general anesthesia (3.33%) (Tennant et al., 2021).

Semerici, Kostak & Taskin, 2022, evaluated the implementation of an mHealth training application, 5inD, and investigated its impact on the management of chemotherapy-induced nausea and vomiting (CINV). Mean scores for children and parents in the intervention groups were lower than those in the control group ( $P < 0.05$ ). There was a statistically significant difference between parents' and children's CINV scores between groups in terms of group interaction, time, and group time. Although a statistically significant difference was found between the mean scores of the intervention and control groups in terms of group, time, and group time for acute CINV ( $P < 0.05$ ), there was no statistically significant difference for delayed CINV between the groups' scores in terms of time and group time interaction ( $P > 0.05$ ) (Semerci, Kostak & Taskin, 2022).

Landier et al., 2023, developed, tested the improvement and evaluated a mHealth application (COG KidsCare) to support the information needs of parents of children with cancer. The mean ( $\pm$  SD) for application quality, usability, and acceptability were: Mobile Application Rating Scale (MARS):  $4.5 \pm 0.7$  on a 5-point scale, System Usability Scale (SUS):  $86.7 \pm 23.8$  on a 100-point scale and System Acceptability Scale (SAS): superior (61%), similar (28%), inferior (11%) to written materials. The qualitative findings largely confirmed the quantitative data. The COG KidsCare app is of high quality and received high usability and acceptability ratings (Landier et al., 2023).

Koblick et al., 2023, evaluated the applicability and acceptability of the Roadmap mHealth app (ONC Roadmap) in parents of children with cancer and explored self-reported HRQoL & accessibility outcomes of the application. The study was feasible and acceptable as the majority (>50%) reported "Agree or Strongly Agree"



in each of the domains. Improvements were observed in the majority of HRQoL cognitive domains across all groups. Although it was insufficient, there were significant improvements in the specific

HRQoL domains of anxiety, depression and fatigue for children and a trend towards improvement in depression for children and fatigue for adult patients (Koblick et al., 2023).

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**Table 1:** PICOS and criteria for including articles in the study

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**PICOS Question:** What are web-based interventions in pediatric oncology nursing?

**Population (P):** children and/or adolescents with cancer, and/or parents, and/or carers, and/or health professionals

**Intervention (I):** Web-based interventions (mHealth or/and eHealth or/and teleHealth), mHealth literacy

**Comparator (C):** With or without comparison

**Outcomes (O):** Qualitative, quantitative, or mixed data on the web-based interventions in pediatric oncology nursing, effect of intervention on QoL of children with cancer, evaluation of intervention implementation, testing of interventions.

**Setting (S):** Hospital, community

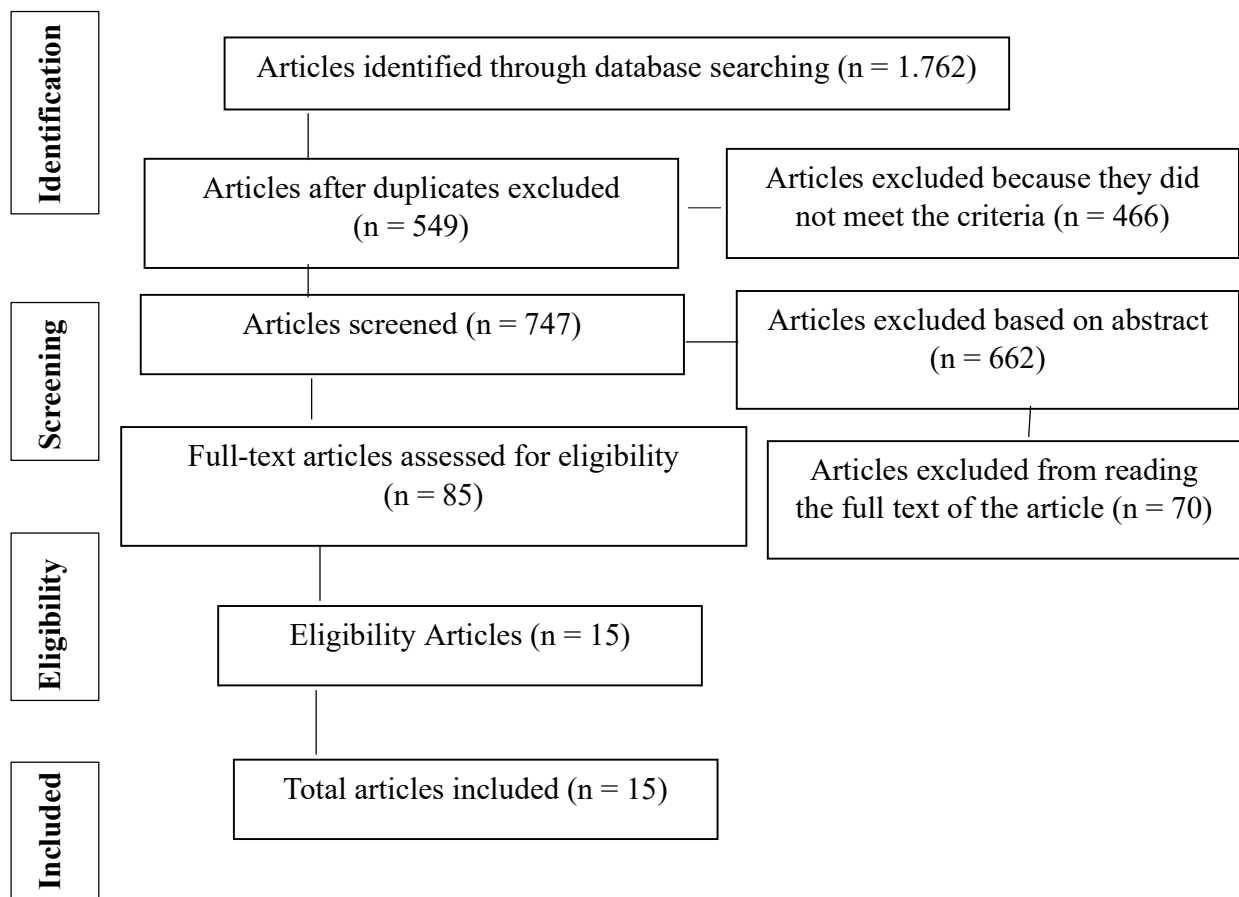
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**Inclusion criteria**

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- Qualitative, quantitative or mixed nursing studies.
  - Published after 2021.
  - Exploring web-based interventions in pediatric oncology nursing
  - Published in English language.
  - Published in peer reviewed journals.
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**Figure 1: Selection of articles**



**Table 2: Characteristics of the studies**

Author, Year, Country, Purpose	Sample	Methods	Intervention	Tools	Results
<b>1. Web-based interventions</b>					
Akard et al., 2021a, USA, Investigation of the impact of a web-based legacy intervention for children with advanced cancer & their parents on parental coping strategies.	150 children & parents (dyads).	Randomized clinical study with intervention & control group & pre-post measurements.	Web-based storytelling for legacy creation.	Responses to Stress Questionnaire.	Although it was not statistically significant, the legacy intervention showed trends toward increased use of primary control coping & disengagement strategies in parents over time compared to usual care.
Akard et. al, 2021b, USA, Investigation of the impact of a web-based intervention on the quality of life (QoL) of children with cancer.	97 children & their parents (dyads).	Randomized double-blind clinical study with intervention & control group & pre-post measurements.	Web-based legacy creation application via facebook (they answered questions about themselves & uploaded photos, videos & music).	PedsQL 3.0 Cancer Module (Child Self-Report versions & Parent Proxy-Report), Stress Questionnaire.	Although & there was no statistically significant difference in the intervention group there were small effects on child anxiety.
Linder et. al.,2021, USA, Evaluation of the applicability & acceptability of a novel game-based, symptom reporting application for school-aged children with cancer.	19 children & parents (dyads).	Cross-sectional study.	Symptom reporting intervention [web-based Color Me Healthy App (via tablet)].	Semi-structured interviews with parents & children.	Children who used the application reported symptoms more often & enjoyed aspects of the application. Parents endorsed the interactive nature of the application & the value of the children providing their own report.
Heneghan et al., 2021, USA, Investigation of the impact of mHealth literacy on improving adherence to 6-mercaptopurine (6-MP) medication in children with acute lymphoblastic leukemia.	49 parents & 15 children, teenagers & young adults	Cross-sectional study	Web-based intervention to assess literacy in mHealth technology (REDCap).	Patient record. Assessment of compliance with treatment.	Parents were most supportive of the functions of medication list (71%, 35/49), information about 6-MP (71%, 35/49), stock depletion reminder (71%, 35/49) & 6-MP administration reminder (71%, 35/49). Adolescents & young adults were more supportive of the functions of stock depletion reminder (73%, 11/15), 6-MP



					administration reminder (73%, 11/15).
Delemere & Maguire, 2021, Ireland,  Exploration of the relationship between technology use, eHealth literacy & attitudes towards eHealth & mHealth, among parents of children with cancer & health professionals.	85 parents & health professionals.	Cross-sectional study.	Web-based online intervention	Health Information National Trends Survey (HINTS), eHealth literacy eScale, Attitudes Toward Computer/Internet Questionnaire (ATC/IQ).	Positive attitudes towards eHealth & mHealth applications & strong eHealth skills were found, however, those who had not used such applications had significantly lower eHealth literacy than those who had ( $t(74) = 2.08, P = 0.04$ ). eHealth literacy & device use significantly influenced attitude ( $F(3.75) = 12.01, P < 0.001$ ) & confidence in higher quality eHealth & mHealth applications ( $F(2.58) = 3.87, P = 0.03$ ).
Breakey et al, 2022, Canada,  Investigation of the applicability of Teens Taking Charge Cancer, a web-based self-care application for children with cancer.	81 adolescents & their parents (dyads).	Pilot randomized blinded clinical study with pre & post measurements.	Web-based intervention Teens Taking Charge of Cancer, which includes education for cancer, self-care, skills & social support strategies.	Telephone interviews. Adolescent Cancer Knowledge Questionnaire, Investigator modified Generalized Self-Efficacy-Sherer Scale, Morisky Green Levine Medication Assessment Questionnaire, Brief Pain Inventory-short form, PedsQL Multidimensional Fatigue Module, Hospital Anxiety & Depression Scale, Perceived Social Support from Friends Scale, Cancer Transition Scales, PedsQL Cancer Module.	The mean of completed parent evaluations was 2.4 /12 sections (SD = 3.0) & no one completed the program. The 33% of parents in the intervention group logged on to the website at least once & none completed the full program. Current intervention design lacks applicability.

<p>Canter et al., 2022, USA,</p> <p>Investigation of the acceptability, applicability &amp; accessibility of the eSCCI intervention &amp; its impact on psychosocial health.</p>	<p>19 parents</p>	<p>Cross-sectional clinical study.</p>	<p>Web-based implementation of the Electronic Surviving Cancer Competently Intervention Program (eSCCI), including education, practice groups, telehealth visits.</p>	<p>Psychosocial Assessment Tool (PAT). eSCCIP Evaluation Questionnaire. National Comprehensive Cancer Network Distress Thermometer &amp; Problem List (NCCN DT). PTSD Checklist for DSM-5 (PCL-5). Generalized Anxiety Disorder scale (GAD-7). SCORE-15.</p>	<p>Parents rated eSCCIP as highly acceptable, applicable &amp; accessible. A large clinical effect was detected for acute distress (d = 0.79). Moderate clinical effects were reported for overall post-traumatic stress disorder (PTSD) symptoms (d = 0.37), negative mood/cognitive functioning (d = 0.59) &amp; anxiety symptoms (d = 0.48).</p>
<p>Cho et al., 2023, USA,</p> <p>Determination of the impact of a web-based legacy building intervention on improving anxiety in children with cancer.</p>	<p>92 child/carer-parent dyads.</p>	<p>Randomized clinical study with intervention &amp; control groups.</p>	<p>Facebook intervention &amp; website to develop web-based stories related to hobbies, relationships with loved ones &amp; personal messages they would like to share (they could upload photos, videos &amp; music).</p>	<p>Response to Stress Questionnaire (RSQ).</p>	<p>The intervention showed small &amp; statistically insignificant effects on coping strategies for direct attempts to influence the stressor or emotional reactions &amp; active attempts to avoid the stressor, among children with recurrent or resistant cancer.</p>
<p>Canter et al., 2023, USA,</p> <p>Determination of the applicability &amp; acceptability of the eSCCI intervention.</p>	<p>44 caregivers/parents.</p>	<p>Non-randomized pilot clinical study with pre &amp; post measurements.</p>	<p>Implementation of the Electronic Surviving Cancer Competently Intervention Program (eSCCI), including: training, practice groups, telehealth visits, program evaluation.</p>	<p>eSCCIP Evaluation Questionnaire &amp; IIAQ. Psychosocial Assessment Tool. SCORE-15. National Comprehensive Cancer Network DT &amp; Problem List. PTSD Checklist for DSM-5.</p>	<p>The 80% of the sample rated the applicability &amp; acceptability of eSCCIP as moderate to high. Registration &amp; retention rates were 54% &amp; 70%, respectively. Statistically significant reductions from pre-intervention to post-intervention for general symptoms of PTSD &amp; anxiety.</p>

				Generalized Anxiety Disorder Scale (GAD-7). OVID-19 Exposure & Family Impact Survey.	
<b>2. mHealth interventions</b>					
Luo et. al, 2021, China,  To evaluate the effectiveness of an mHealth educational program in reducing depressive symptoms and enhancing resilience and QoL, in parents of children with cancer.	103 parents.	Randomized clinical study with intervention & control group.	Training program (on WeChat) that included methods to develop parenting resilience with pictures or videos, with examples of skills application when caring for children with cancer.	Connor–Davidson Resilience Scale, Self-Rating Depression Scale, Short Form of the 6-Dimension Health Survey, Diary.	The intervention group had lower levels of depressive symptoms than the control group. The QoL score in the intervention group was higher than that of the control group, but no statistically significant effect of the intervention was found.
Vásquez et. al, 2021, Peru,  Evaluation of the applicability & utility of ONCOPEDS application & its impact on reducing latency to diagnosis (LD) & referral time (RT).	23 children & adolescents.	Prospective multicenter pilot study with intervention & control group.	Counselling intervention (mHealth) ONCOPEDS	Consultation by telephone, email.	RT was reduced by 66% (P = 0.02) with the application of ONCOPEds. However, LD was not significantly reduced.
Tennant et al., 2021, Australia,  To investigate the applicability, acceptability & effectiveness of a virtual reality (VR) simulation intervention in reducing anxiety & preparing pediatric patients undergoing computed tomography (CT) & radiotherapy (RT) & their parents.	30 children & their parents.	Cross-sectional cohort study.	mHealth VR intervention.	Abbreviated Acceptability Rating Profile (AARP). Child Simulator Sickness Questionnaire (CSSQ). Child Anxiety (VAS), Parent Anxiety (VAS) & parent-proxy reports of child anxiety.	High acceptance & satisfaction of the VR intervention was reported by patients, parents & radiotherapists. There were minimal adverse effects associated with VR. VR intervention was found to improve children's understanding of RT procedures & reduce child & parental anxiety prior to the procedure. Only one child in the study required general anesthesia (3.33%).

<p>Semerci, Kostak, &amp; Taskin, 2022, Turkey,</p> <p>Evaluation of mHealth training application, 5inD &amp; investigation of its impact on the management of chemotherapy-induced nausea &amp; vomiting (CINV).</p>	<p>57 children &amp; their mothers.</p>	<p>Prospective randomized (1:1) study with intervention &amp; control groups.</p>	<p>mHealth training intervention (5inD).</p>	<p>Adapted Rhodes Index of Nausea &amp; Vomiting for Pediatrics by Child (ARINVc) &amp; by Parent (ARINVp). Patient diary.</p>	<p>The mean scores for children &amp; parents in the intervention groups were lower than those of the control group (<math>P &lt; 0.05</math>). There was statistically significant difference between CINV scores of parents &amp; children between groups in terms of group interaction, time &amp; group time. While a statistically significant difference was found between the mean scores of intervention group &amp; control group in terms of group, time &amp; group time for acute CINV (<math>P &lt; 0.05</math>). There was no statistically significant difference for delayed CINV between the scores of groups in terms of time &amp; group time interaction (<math>P &gt; 0.05</math>).</p>
<p>Landier et al., 2023, USA,</p> <p>To develop, test the improvement and evaluate an mHealth application to support the information needs of parents of children with cancer.</p>	<p>32 parents &amp; 17 physicians.</p>	<p>Mixed study.</p>	<p>Parental information intervention (COG KidsCare).</p>	<p>Mobile Application Rating Scale (MARS), System Usability Scale (SUS), System Acceptability Scale (SAS).</p>	<p>The COG KidsCare app is of high quality &amp; has received high usability &amp; acceptance ratings. The qualitative findings largely confirmed the quantitative data.</p>
<p>Koblick et al., 2023, USA,</p> <p>Evaluation of the applicability &amp; acceptability of the Roadmap mHealth (ONC Roadmap) application to parents of children with cancer. Exploration of self-reported health related quality of life (HRQoL) outcomes &amp; accessibility to the application.</p>	<p>100 participants (50 caregivers-children dyads).</p>	<p>Pilot cross-sectional study with pre &amp; post measurements.</p>	<p>mHealth application to improve HRQoL of parents of children with cancer (ONC Roadmap).</p>	<p>HRQoL PROMIS scale.</p>	<p>The study was feasible &amp; acceptable. Improvements were observed in the majority of HRQoL cognitive domains in all groups. Although they were inadequate, there were significant improvements in specific aspects of HRQoL, anxiety, depression &amp; fatigue for children &amp; a trend towards improvement in depression for children &amp; fatigue for adult patients.</p>

## Discussion

Study have suggested that eHealth literacy and device access play a crucial role in facilitating web-based interventions use for stakeholders in paediatric oncology (Delemere & Maguire, 2021). The use of smartphone applications increases patients' and families' access to reliable and appropriate education and information about the disease (Mehdizadeh et al., 2019). TeleHealth applications show great potential as a new way for clinicians to reach patients remotely, often in the comfort of their homes (Wang et al., 2020). Despite the limitless possibilities offered by new technologies, studies exploring eHealth in home-based pediatric palliative care are rare. Children with cancer and their families appear to have positive attitudes towards eHealth applications (Holmen, Riiser & Winger, 2020). Systematic review support the value of digital health interventions as an acceptable and convenient approach to providing care for pediatric cancer survivors (Cheng, 2020a).

Providing tele-oncology services to children with cancer can improve the accuracy of diagnosis and reduce costs and mortality. Also, care management, education, satisfaction and workload can be improved by using digital health interventions (Kermani, Orooji & Sheikhtaheri, 2020). Based on the available evidence, mHealth applications are likely to be useful and acceptable for monitoring complications and may help in the self-management of treatment-related complications (Magalhães et al., 2021).

Other studies suggest that due to growing evidence of effectiveness, combined with increasing access to digital technologies, eHealth and mHealth interventions can have an important role in alleviating or preventing the psychological consequences for young people undergoing cancer treatment and for children, adolescents and young adult survivors of childhood cancer and their parents (Ramsey et al., 2019; McGar, Kindler & Marsac, 2019).

Meta-analysis has shown that technology-based psychosocial interventions are effective, as they appear to have an impact on reducing anger, anxiety and depression in pediatric oncology (Ozturk & Toruner, 2022). These interventions

help children and adolescents with cancer to learn about themselves and cancer, connect with others in a reliable and safe way, and become empowered (Cheng et al., 2020b). Results from other studies suggest that new technologies have the potential to offer an innovative way to address pain, anxiety and depression, which are major symptoms of childhood cancer (Lopez-Rodriguez et al., 2020). Findings from a recent study show that pain monitoring applications can be widely used by patients and parents, while supporting healthcare professionals in ensuring continuity of care (Tiozzo et al., 2021). Existing digital tools for pain in children with cancer are mainly applications for monitoring pain severity and their effectiveness is still unknown (Simon et al., 2023).

Study concludes that families and patients need to become familiar with the use of the applications in order to be willing to use these applications (Dasat & Anggraini, 2023). High-quality research evidence is needed to fully evaluate the impact of these applications on improving outcomes in paediatric oncology nursing (Osborn et al., 2019; Koyu & Törüner, 2023; Lau et al., 2020; Viola, Panigrahi & Devine, 2020).

The present review has some limitations. The number of included studies is relatively small. The included studies were published in the English language only. Some studies have small numbers of participants. Some studies have been conducted in a single hospital or in a single city. Most participants had to speak English to take part in the study. The participation of most participants in the studies was voluntary.

**Conclusions:** Web-based interventions in pediatric oncology nursing are essential to improve the QoL of children with cancer and their families. They provide direct access to educational materials, treatment and symptom information, and facilitate communication between health professionals. However, more studies are needed to confirm their effectiveness.

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