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## TECHNOLOGY BASED INTERVENTION IN REDUCING FATIGUE IN CHILDREN WITH CANCER

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### Abstract

**Background:** Fatigue is the most common symptom experienced by children with cancer, which can be caused by the disease and side effects of treatment, around 70-80% of child cancer patients undergoing treatment experience fatigue , several studies show that technology-based interventions are effective in reducing fatigue in children with cancer, but research in this area is still limited. **Objective:** This study aims to identify the benefits of Technology Based Intervention in reducing fatigue in children with cancer. **Methodology:** The method used in this research is a systematic review in accordance with PRISMA. The initial step taken is to determine the PICO, then search for and identify research that meets the objectives. The literature search used 7 databases, namely ProQuest, Clinicalkey For Nursing, Pubmed, Science Direct, Scopus, Embase, Sage Journal , articles in English and published from 2013-2023, then a review was carried out to evaluate the quality of the study using the Joanna Briggs Institute (JBI) form **Results:** a total of 8 articles met the inclusion criteria, consisting of 6 with an RCT design, 1 quasi- experimental design and 1 single group design . The results obtained were Technology Based Interventions that were effective in reducing fatigue , namely mobile applications, games, use of telehealth , and use of multimedia. **Conclusion:** Technology Based Intervention can reduce fatigue scores , in its application it can be combined with interventions that are not technology based.

**Keywords:** Children With Cancer, Fatigue, Technology-Based Interventions, Cancer, Health

## INTRODUCTION

The incidence of cancer in children is increasing gradually, throughout the world the number of childhood cancer sufferers ranges from 50 to 200 cases per 1 million population (Li et al., 2023a). In 2020, it is estimated that the number of children and adolescents (aged 0-19 years) diagnosed with cancer worldwide will be almost 280,000 (The International Agency for Research on Cancer, 2022). In the United States in 2023, an estimated 9,910 new cases of cancer will be diagnosed in children from birth to 14 years, and approximately 1,040 children are expected to die from the disease. Although the death rate from cancer in this age group has decreased by 70 percent from 1970 to 2020, cancer is still the main cause of death from the disease in children (National Cancer Institute, 2023). When a child is diagnosed with cancer, his life immediately changes drastically and the lives of his parents also change. Parents bear a huge burden to seek treatment for their child. (Mueller et al., 2022) There are several types of cancer that children suffer from, the most common of which is Acute Lymphoblastic Leukemia, a tumor on the brain and stomach. central nervous system, Neuroblastoma, Non-Hodgkin's Lymphoma, Thyroid Carcinoma (Shin et al., 2019).

Cancer can cause stress and can be life-threatening because the prognosis is unpredictable and combined with painful treatment procedures, children with cancer require long-term treatment, which can last up to 14 days, which causes disruption in development, activities and social interactions. Children can experience various physical disorders such as pain, nausea, vomiting, mucositis and even psychosocial disorders such as anxiety and depression (Kerimoglu Yildiz et al., 2022). Apart from that, the most common

symptom experienced by children with cancer is fatigue. The fatigue experienced can be caused by the disease or the process and side effects of treatment, around 70-80% of child cancer patients undergoing treatment experience fatigue. In the majority of patients Fatigue complaints experienced by children are very severe and can interfere with their daily activities and significantly affect the quality of life of children suffering from cancer (Mahdizadeh et al., 2020).

Chemotherapy is the main treatment for children with cancer and while treatment with chemotherapy combined with medical technology can increase their survival, however, getting cancer is a traumatic event for children. Diagnostic procedures, long hospital stays, various invasive procedures, and side effects from chemotherapy such as nausea, vomiting, pain, fatigue, hair loss can have a negative impact on the physical condition of children with cancer, emotional and psychosocial problems can cause post-traumatic stress disorder. The signs and symptoms experienced do not appear separately, the symptoms experienced can appear simultaneously which adds to suffering so that the child's quality of life decreases (Li et al., 2023)

Conditions caused by anemia, pain and emotions can cause increased fatigue (National Cancer Institute, 2023). Cancer-related-fatigue (CRF) in children with cancer is felt to be very disturbing, worrying and can weaken physical, mental and emotional function which is characterized by decreased physical abilities, feeling very tired and lack of energy (Linder & Hooke, 2019; Tomlinson et al., 2016). CRF has a significant impact on the disease course, treatment, and quality of life of children with cancer (Nunes et al., 2017).



To avoid these problems, good symptom management is necessary to ensure children continue to carry out activities of daily living and improve their quality of life. The role of nurses in caring for pediatric cancer patients undergoing chemotherapy is symptom management and improving the child's quality of life. Professionals have carried out various interventions such as implementing therapeutic play, which can help children's communication development, help reduce stress in children and provide physical and emotional well-being (Kerimoglu Yildiz et al., 2022). There are several interventions carried out by professionals to help children with cancer, such as the application of complementary therapies, the use of complementary therapies varies based on the social, cultural and economic structure of society (Erdem et al., 2020). However, with the development of computer and multimedia technology, health professionals are starting to choose other alternatives in treating pediatric cancer patients, such as using computer-based applications and mobile devices (Kerimoglu Yildiz et al., 2022).

are several technology-based interventions, namely electronic health applications ( e-health ) and mobile health applications ( m-health ). E-health applications include web-based applications, digital applications, and virtual reality , while m-health applications include mobile and wireless applications such as messaging, mobile applications, wearable technologies , and social media. Technology-based health interventions for children and adolescents have many benefits, namely making it easier to provide information, provide feedback, can be used to carry out assessments, and can facilitate communication between pediatric patients and health workers and can be used to detect health problems in real-time. Technology-based interventions have been effective in improving physical condition and reducing psychological symptoms in children with cancer, and improving parental coping and reducing psychosocial symptoms. Therefore, technology-based interventions can help oncology nurses in providing physical and psychological support to children with cancer (Koyu & Törüner, 2023).

A lot of research has been carried out on technology-based interventions, there

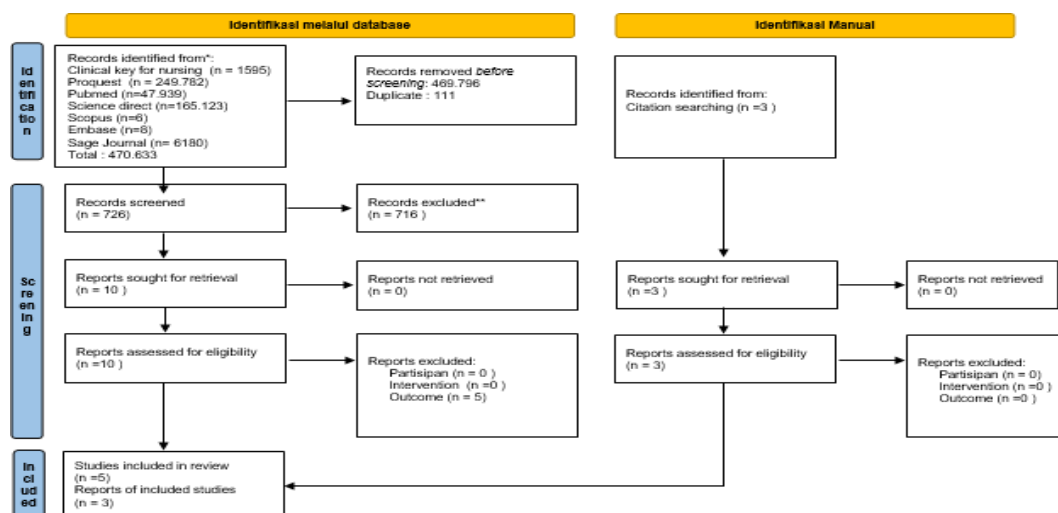


Figure 1. PRISMA Diagram



## RESEARCH METHODS

The author carried out data extraction and processing independently, articles were extracted completely including author, year, country, title, research design, sample, intervention used to reduce fatigue, outcome and results. Data extraction and data processing are attached in Appendix 2.

The author conducted a more in-depth review independently of the articles found to evaluate the methodological quality of the 8 selected articles, by conducting a Critical Appraisal using the Joanna Briggs Institute (JBI) tool. The results are attached in attachment 3.

The author independently analyzed the data and found that there were various types of Technology Based Intervention, the duration of the intervention and the primary outcome were different, apart from that, it was found that there were diverse sample groups, namely that there were only children as respondents and some involved their parents, and the

research results were also obtained. some significantly reduce fatigue in children with cancer and some are not significant, therefore the results cannot be analyzed statistically and meta-analysis cannot be carried out, so this review is reported using a systematic methodology.

A total of 8 studies consisting of 6 RCTs, 1 Quasi- experiment and 1 Single group design were included in this research. The study was conducted in several countries, namely: China, Saudi Arabia, Japan, Canada, USA and Indonesia. Publication from 2016 to 2023. The research sample studied consisted of children with cancer and their parents. The research sample studied consisted of 512 children diagnosed with cancer or those who were survivors. Data on author, country, year of publication, research method, sample size, type of intervention in the treatment group and control group, and research results are explained in table 1.

## RESEARCH METHODS

No	Author	Country	Year	Research methods	Sample	Types of Intervention	Research result
1	Masoud, et al.,	Saudi Arabia	2023	Randomized Control Trial	Number of sample: 45 children aged 6–14 years	In group I: 22 children played exergaming for 60 minutes, 2x per week for 3 weeks and in group II: 23 children were given an explanation about physical exercise and asked to do physical exercise 2x a week	Group-I (exergaming group) showed a significant decrease in <i>fatigue</i> compared to group-I, and in group II there was a significant increase in functional capacity/endorurance during the five-week study period. Fatigue and functional capacity/endorurance had large effect sizes ( $\eta^2=0.41$ , $p=.00$ ) and ( $\eta^2=0.27$ , $p=.00$ )
2	Li et al.,	China	2023	Randomized Control Trial	Sample size: 96 children	48 respondents received the Child Life intervention	All respondents participated in the research until



					n aged 8-14 years	which consisted of 3 stages: 1)Developmental The play phase at this stage uses animated audio models to introduce commonly used medical equipment and the side effects of chemotherapy 2) Medical simulation game stage 3) Supportive play Phase 48 children as a control group who received routine care	completion. The intervention group showed a significant reduction in pain, anxiety, fatigue, and sleep disturbances ( $P < 0.001$ ). compared with the control group, but no significant differences were found regarding <i>disorders of excessive somnolence</i> in both groups
3	Hamari et al.,	Japan	2019	Randomized Control Trial	Number of samples: 36 children with cancer, aged 3–16 years	17 children in the intervention group played active video games for 30 minutes every day for 8 weeks and 19 children. The control group received written general instructions regarding physical exercise for 30 minutes per day	The two groups did not show different results for physical exercise ( $p=0.95$ ) and motor performance ( $p=0.77$ ) and for <i>fatigue scores</i> there was also no significant difference in the two groups ( $p=1.00$ ).
4	Cheng & Tan	Canada	2021	An exploratory pilot randomized study	Sample size: 50 children aged 10-18 years	In the intervention group, 25 respondents participated in a symptom management program (home visits, regular home contact/mHealth and routine care. In the control group, 25 respondents received routine care only	Comparison between the 2 groups showed that the intervention group had less fatigue over time ( $P < 0.05$ ). However, no differences were found with respect to nausea and vomiting, pain, mucositis, and anxiety between groups. Children and parents reported positive experiences using the program for symptom management
	Devine et al.,	USA	2020	Randomized controlled trial	Number of samples: 49, aged 13-25 years	In the intervention group 25 the intervention lasted 12 weeks, in the intervention group the first 8 weeks were guided by a	The intervention group showed a high level of satisfaction with the application ( $M = 3.39$ , $SD = 0.97$ ) and the intervention group



					<p>trainer to carry out exercise for 90 minutes and used the mobile app and FitBit then continued. For 4 weeks respondents only used the FitBit application, assessments were carried out after 2 months, 3, 6 and 9 month.</p> <p>In the control group 24 were only given the FitBit application without any assistance from a trainer</p>	<p>showed significant results in increasing lower extremity muscle strength, compared to the control group. However, it has little effect on quality of life and <i>fatigue</i>. Statistically, the results show that it is not significant (<math>P &gt; 0.05</math>).</p>
Sriasih et al.,	Indonesia	2019	Quasi-experimental	Number of samples: 58 aged 7–18,	<p>The intervention lasted 3 days, 29 respondents in the intervention group received sleep hygiene education, using a booklet with a duration of 30-60 minutes, and the children listened to instrumentals. Music downloaded on YouTube. The control group was given routine care</p>	<p>Respondents in the intervention group had lower fatigue scores, having sleep quality and functional status scores were higher than in the control group (Significant at <math>\alpha &lt; 0.05</math>)</p>
Cheung et al.,	China	2022	Randomized Clinical Trial	The total sample was 161 children aged 9 – 16 years	<p>(81 in the intervention group and 80 in the control group) the intervention group parent and child pairs received a 10 minute educational session given by a trained nurse, then a motivational interviewing (MI) session was given for 10 minutes and parent child pairs were invited to view the site website established by the Center for Health Protection, Department of Health, Hong Kong</p>	<p>The intervention group showed a significant increase in PA compared to the control group. There was a decrease in CRF in the intervention group (<math>\beta = -3.60</math>; 95% CI, <math>-5.97</math> to <math>-1.24</math>; <math>P = .003</math>) Increased grip strength of the left hand (<math>\beta = 1.78</math>; 95% CI, <math>0.05</math>-<math>3.44</math>; <math>P = .04</math>), and right (<math>\beta = 2.11</math>; 95% CI, <math>0.40</math>-<math>3.82</math>; <math>P = .02</math>) Improved Quality of life (<math>\beta = 4.00</math>; 95% CI, <math>0.25</math>-<math>7.74</math>; <math>P = .04</math>)</p>



				Special Administrative Region. Brief MIs were individually sent to each parent via a mobile instant messaging application by the nurse. The control group was given routine care and received a 10 minute educational session and was asked to open the website as well but was not given a brief MI.	However, there was no significant increase in Peak expiratory flow rate ( $\beta = 6.48$ ; 95% CI, $-5.49$ to $18.45$ ; $P = .29$ ).	
Hooke et al., 2016	USA	2016	Single group design	The total sample was 17 respondents, children aged 6-15 years	Participants taking part in the study are receiving cycles chemotherapy and get the full dose of corticosteroid medication (dexamethasone or prednisone) and their parents were taught in depth how to upload the FitBit program to their home computer, how and when to use it FitBit, and how to access FitBit. monitored for 2 weeks	There was a trend towards increasing number of steps per day from weeks 1–2 ( $P = 0.079$ ); For fatigue scores, the results were low and did not increase during corticosteroid administration, and there is a relationship between the amounts steps per day for 2 weeks with <i>fatigue scores</i> after steroid administration, the results of the study found that a greater number of steps resulted in a lower fatigue score, a significant correlation ( $r = -0.66$ , $P = 0.005$ )

Table 1. Summary of Screening Results Articles

Data obtained from the results of a systematic review of 8 articles showed that *technology based intervention* can help nurses in providing intervention to children with cancer who experience *fatigue*, various types of technology that can be used, some using the simplest technology up to sophisticated technology.

The types of technology used and their effectiveness are described in table 1.

Technology, some of the telehealth that have been applied include: is the use of cell phones for consultations and to monitor the home-based multimodal symptom-management program, the use of telehealth to carry out the home-based symptom-management program, proven



effective in reducing fatigue scores (Cheng & Tan, 2021) Apart from that, telehealth is also carried out using mobile instant messaging applications such as WhatsApp and WeChat ) and combined with using websites as educational media, in this study the combination of these two technologies was proven to be able to increase physical activity and reduce fatigue scores from fatigue scores T0: 28.78 (8.79) down to 19.49 (5.65) at T4, ( $P < .001$ ). The measuring tool used is Cancer-related fatigue , measured with the Chinese version of the Fatigue Scale (scale from 13 – 65). The higher the score, the higher the level of fatigue. (Cheung et al., 2022).

Another use of technology that can reduce fatigue scores in both children with cancer who are receiving treatment and those who have completed the treatment program is the use of multimedia technology, including MP3 players and earphones for listening to music. Listening to music combined with sleep hygiene education can reduce fatigue scores in children with cancer. Before the intervention the average fatigue score was 18.62 and after the intervention the average fatigue score was 13.3. The measuring tool used was the Allen-Child Oncology Fatigue Scale (FOA). -A) (Sriasih et al., 2019). Apart from that, there is the use of multimedia in the form of animated audio video in the form of an intervention called Child Life , which is an intervention program that combines technology based intervention (audio, animated video) and intervention that is not technology based (picture games, dolls, providing verbal comfort by providing encouragement. , agreeing on gifts, relaxation exercises, playing role plays and so on) can reduce fatigue scores , anxiety pain and sleep disorders in pediatric cancer patients (Li et al., 2023).

Technology based intervention is also used to increase Physical Activity (PA) because increasing PA is closely related to reducing fatigue scores , doing PA is one of the recommendations in fatigue management (Patel et al., 2023). in a study conducted by (Oberoi et al., 2018)) concluded that PA was effective in reducing fatigue . One technology-based intervention that can increase PA and at the same time reduce fatigue scores is exergaming . The exergaming protocol allows children to choose 23 types of Wii games . Playing exergaming with intensity for 60 minutes twice a week for three weeks can significantly reduce fatigue in children suffering from acute lymphoblastic leukemia. (Masoud, Shaheen, et al., 2023) However, in the research conducted by (Hamari, Järvelä, Lähteenmäki, Arola, Axelin, Vahlberg, et al., 2019) providing intervention in the form of active video games in the treatment group and providing written advice to do PA 30 minutes/day in the control group, the results were lower in both groups. The results of the pre-test and post-test did not show significant results and there were no significant difference in reducing fatigue scores between the two groups. The limitations in this research are explained as a result of the rapid speed of technological development but the relatively slow implementation of research.

A technology-based intervention that is also used to increase physical activity and reduce fatigue scores is the use of Fitness Tracker technology called The FitBit ® . Using FitBit ® in children with Acute Lymphoblastic Leukemia resulted in a trend of increasing physical activity in the form of an increase in the number of steps per day from the first week to the second week, a low fatigue score that did not increase during administration of corticosteroid medication, a relationship





between the number of steps per day for two weeks and Fatigue scores after administering corticosteroid drugs showed that increasing the number of steps had an impact on reducing fatigue scores (Hooke et al., 2016), while research on FitSurvivor technology which aims to determine the feasibility and influence of FitSurvivor technology on PA, muscle strength, fitness, quality of life, and fatigue obtained results namely a high level of satisfaction with the FitSurvivor application in the intervention group, and an increase in lower extremity muscle strength in The intervention group showed significant results compared to the control group, but did not show significant results on fitness, quality of life, and fatigue (Devine et al., 2020).

Studies on the use of technology-based interventions for fatigue show that there are various types of technology that can be used to reduce fatigue scores and that technology-based interventions in their application can be combined with interventions that are not technology-based (Li et al., 2023). Technology-based interventions can be in the form of telehealth, use of multimedia, games, and mobile applications. Not all uses of technology-based interventions have a direct impact on reducing fatigue, but there are several technologies that are used as tools to support other programs such as programs to increase physical activity, where the program These have the aim of reducing fatigue as well, for example the FitBit® application, and mobile instant messaging applications.

**This systematic review has several limitations, including limiting articles that use English, limiting the year of publication to 10 years, not all of the 8 articles found were RCTs and not all of the 8 articles showed significant results in reducing fatigue. In this study, the**

**number of studies was limited, the sample in this study was small, and heterogeneity was high.**

## CONCLUSION

This systematic review identified eight studies on technology-based interventions to reduce fatigue scores in children with cancer. There were several types of technology used in this study, namely telehealth, use of multimedia, games, and mobile applications, although there were two types of technology (active video games and FitSurvivor application) which shows insignificant results in reducing fatigue, but there are still many technology-based intervention options that can be used to reduce fatigue scores and have been proven to have significant results in reducing fatigue scores. Technology based interventions are flexible in their use and can be combined with non-technology based interventions so that we can provide more complete interventions for children with cancer who experience fatigue.

The rapid development of technology in the health sector needs to be balanced with the implementation of research regarding the feasibility and benefits of this health technology, so that we can provide higher quality nursing services based on evidence-based practice. **This research can be used as a reference for selecting and using technology based intervention in treating pediatric cancer patients who experience fatigue. The results of this study also need to be examined carefully due to the limited nature of the study, small sample size and high heterogeneity.**



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