

The Impact of an Interactive Computer Game on the Quality of Life of Children Undergoing Chemotherapy

Abstract

Background: Quality of life (QOL) of children with cancer reduces right from the diagnosis of disease and the start of treatment. Computer games in medicine are utilized to interact with patients and to improve their health-related behaviors. This study aimed to investigate the effect of an interactive computer game on the QOL of children undergoing chemotherapy. **Materials and Methods:** In this clinical trial, 64 children with cancer aged between 8 and 12 years were selected through convenience sampling and randomly assigned to experimental or control group. The experimental group played a computer game for 3 hours a week for 4 consecutive weeks and the control group only received routine care. The data collection tool was the Pediatric Quality of Life Inventory (PedsQL) 3.0 Cancer Module Child self-report designed for children aged between 8 to 12 years. Data were analyzed using descriptive and inferential statistics in SPSS software. **Results:** Before intervention, there was no significant difference between the two groups in terms of mean total QOL score ($p = 0.87$). However, immediately after the intervention ($p = 0.02$) and 1 month after the intervention ($p < 0.001$), the overall mean QOL score was significantly higher in the intervention group than the control group. **Conclusions:** Based on the findings, computer games seem to be effective as a tool in influencing health-related behavior and improving the QOL of children undergoing chemotherapy. Therefore, according to the findings of this study, computer games can be used to improve the QOL of children undergoing chemotherapy.

Keywords: Chemotherapy, children, computer games, life quality

Introduction

One of the most important non-communicable diseases and a major cause of death in the world is cancer.^[1] According to the World Health Organization (WHO), of every 1 million children, 100 of them have cancer.^[2] This disease is the cause of about 4% of deaths in children under 5 years of age and 13% of children of 5 to 15 years of age in the Iranian population.^[3] Children with cancer are not only at risk for adverse events resulting from medical procedures, but their mental and social health may also be severely affected as a result of the disease and its treatment.^[4] Studies have shown that the quality of life (QOL) of children with cancer reduced with the diagnosis of the disease and the start of treatment compared to their peers.^[5-7]

Despite medical advances and the development of cancer treatments that are increasingly effective on the survival of these patients, patients feel helpless and afraid during the disease process.^[8] All these

moods and feelings, including physical and mental fatigue after chemotherapy, can greatly affect the QOL of these patients.^[9] The physical and psychological effects of chemotherapy in patients result in fear from chemotherapy and even resistance or rejection of the anti-cancer treatment programs.^[10] In addition, it is also damaging for patients and the healthcare network, such as prolonged hospitalization, increased costs of nurses and doctors, and reduced QOL and performance of patients, which are more important in children due to the involvement of their families, and thus, are vital to control.^[11] Education about treatment, side effects, and self-care behaviors can reduce the side effects of chemotherapy, reduce the symptoms, and improve QOL. Although the importance of education for these patients is well known, several factors limit the ability of nurses to teach patients. Chemotherapy protocol that is increasingly performed on an outpatient basis and education about

Zahra Fazelnia¹,
Mostafa Najafi²,
Alireza Moafi³,
Sedigheh Talakoub⁴

¹Student Research Center, School of Nursing & Midwifery, Isfahan University of Medical Sciences, Departments of ²Psychiatric, ³Pediatric Oncology and ⁴Pediatric and Neonatal Nursing, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran

Address for correspondence:
Ms. Sedigheh Talakoub,
Department of Pediatric and Neonatal Nursing, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran.
E-mail: talakoub@nm.mui.ac.ir

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treatment, side effects, and self-care behaviors should be conducted in a specific and limited period. However, due to nausea and fatigue, patients cannot focus or pay attention. Thus, researchers are trying to find ways to educate patients undergoing chemotherapy.^[12] Based on the above-mentioned points, it can be concluded that it is necessary for the treatment team to assess and improve the physical, emotional, and social aspects of QOL of patients. The role of nurses is emphasized in this regard, because nurses play an important role in the care of cancer patients and have a suitable status for educating the patients and their families and providing spiritual support.^[13] During recent decades, computer games have become one of the main leisure activities for children and adolescents, and children aged 6 to 12 years are intrigued by computer games.^[14] Moreover, these children spend an hour or more of their time playing computer games.^[15] Thus, computer games may have various advantages over other means of education as a tool to influence health-related behavior.^[16] In medicine, these games are used as a means to interact with patients and to improve their health-related behaviors. In addition, they can activate the focus, courage, and motivation of the patients, as well as increase awareness of the disease and how they can take care of themselves.^[17] Therefore, this study aimed to determine the effect of computer games on the QOL of children undergoing chemotherapy.

Materials and Methods

This research was a clinical trial (Irct20161024144333n60) with two groups (experimental and control) and a two-step test plan of before and after the training period. The subjects were selected from among all children with cancer who referred to Imam Reza Hospital, Isfahan, Iran, from May 2015 to October 2015 through convenience sampling. The inclusion criteria were age range of 8 to 12 years, suffering from one type of cancer, undergoing at least 4 months of chemotherapy, being treated during the study, the ability to play computer games, reading and understanding the dialect of Farsi, and lack of major physical or mental problems before cancer. After explaining the purpose of the study to the participants and obtaining informed consents from them, they were randomly (by lottery) assigned to either of the two groups. With a 95% confidence interval and 84% statistical power, the number of participants for each group was calculated to be 32. The researcher started the intervention after gaining permission from the children and their parents and explaining the purpose and method of the study to them. The participants could withdraw from the study in case of unwillingness to participate in the study at any stage. Patients were excluded from the study if they experienced stressful events, such as parental divorce, and death of a parent, brother, or sister, that affected their QOL and self-esteem, and created stress during the study.

The tool used in this study was the Pediatric Quality of Life Inventory (PedsQL) 3.0 Cancer Module child self-report, which was designed specifically for children of 8–12 years of age with cancer. The reliability of the PedsQL was reported at 0.98 in most studies.^[7,18,19] This questionnaire contains 8 subscales (pain and discomfort, nausea, anxiety due to the interventions, anxiety due to the treatment, anxiety, cognitive problems, perceived physical appearance, and communication). The PedsQL is scored based on a 5-point Likert scale (4 = always, 3 = often, 2 = sometimes, 1 = rarely, and 0 = never). The scores of the questionnaire were reversed and converted to 0–100. Then, the percentage of the scores obtained and the mean of the percentages were calculated in each dimension; the higher the score, the more favorable the QOL.^[7] Before the intervention, the questionnaires were completed through interviews. The intervention program included an educational-entertainment computer game named “The City of Dreams”. This game was developed by the authors of the study and designed by computer engineers, and then, used in the experimental group. The City of Dreams consists of 4 parts; house, hospital, theme park, and building. The house software consists of 5 categories; hero and difficult struggle, championship is not related to hair (in the case of hair loss the children could choose among wig, scarf, or hat), everything is calm (the children had the chance to choose among medication use, or distraction by listening to music or the sound of the Quran for pain relief), tales of lethargy and fatigue, tales of nausea and loss of appetite. By clicking on the first story, and after completion of the poem and dressing up, by clicking on the door, the child entered the hospital. After returning from the hospital, the rest of the game is activated.

The theme park included 2-player games, puzzles, and Ray Mission games (the inside of the body which contained healthy and unhealthy cells were shown and at this stage the child was guided by a robot to destroy the unhealthy cells). In the building, questions about the side effects of chemotherapy were included.

First, a training session was held for the children and parents of the experimental group regarding the content of the computer game, how to load it, and the entire process of installing and using the software. Then, to ensure that the children and parents had learned the mentioned steps, they were asked to perform the steps for the researcher. Immediately after the child had played the game, the questionnaire was given to them.

They were asked to play the game for at least 3 hours a week for 4 consecutive weeks with focus and precision. After 4 weeks of follow-up of the experimental group for the game, the questionnaire was given to the subjects and the results were compared in three stages among the experimental and control groups. Data analysis was performed using descriptive statistics (frequency tables, distribution, mean, and standard

deviation) and inferential statistics (independent *t*-test, Chi-square test, repeated measures ANOVA, Mann–Whitney test, and *post hoc* LSD) in SPSS software (version 16, SPSS Inc., Chicago, IL, USA).

Ethical considerations

The ethical aspects of the study were investigated and confirmed by Isfahan University of Medical Sciences, Isfahan, Iran, and an informed written consent was obtained from each participant or their parents (in under-aged individuals). Moreover, in terms of no adverse psychological impact on children (such as aggression, feelings of hopelessness, increased fear and anxiety, negative effects of dialogs and or story, color combinations) and scientific content, the game was confirmed by psychiatrist and specialists of oncologist in the Imam Reza Hospital, Isfahan, Iran.

Results

Based on the results of the statistical analysis, no significant difference was observed between the two groups in terms of variables of gender (mean: 46.9 girls and 56.2 boys), age (mean: 9.9 in the experimental group and 10.2 in the control group), education level (fathers' education: $p = 0.170$; mothers' education: $p = 0.400$), type of disease ($p = 0.240$), and duration of the illness ($p = 0.880$).

Independent *t*-test results showed that, before the intervention, the mean QOL scores did not differ significantly between the two groups ($p = 0.870$). However, immediately after the intervention ($p = 0.020$) and 1 month after the intervention ($p < 0.001$), the mean total QOL score was significantly greater in the intervention group than the control group.

Repeated measures ANOVA showed that in the control group, the mean QOL score was not significantly different between the three time points ($p = 0.370$). Nevertheless, in the intervention group, the overall mean QOL score was significantly different between the three time points ($p < 0.001$). The *post hoc* LSD showed that overall mean QOL score in the intervention group significantly increased immediately after the intervention compared to before the intervention ($p = 0.030$) and 1 month after the intervention compared to immediately after the intervention and before the intervention ($p < 0.001$) [Table 1].

Discussion

This study aimed to evaluate the effect of an interactive computer game on the QOL of children undergoing chemotherapy. The experimental and control groups were similar in terms of demographic characteristics (age, gender, duration of treatment, and type of disease). The results of the intervention at the end of the fourth week showed significant differences in QOL scores between the two groups. The QOL score in the intervention group had increased compared to the control group. In this regard, Kauhanen *et al.* showed that in subjects in the intervention group compared to the control group, physical activity ($p < 0.050$) and fatigue ($p < 0.050$) had improved and QOL ($p < 0.050$) had increased at the end of the intervention.^[20] The findings of Bartholomew *et al.* showed that at the end of the intervention, in the experimental group compared to the control group, the illness symptoms decreased, and the level of knowledge on and self-management of asthma ($p = 0.010$) as well as QOL had increased ($p = 0.050$).^[21] The study by Landier and Tse also revealed that computer games, as a cognitive behavioral intervention, can reduce fear and stress due to vessel blood sampling and embedded venous port in children and adolescents with cancer.^[22] In the past, many computer or video games were used more as a distraction method and not necessarily for a specific purpose.^[23]

The results of the present study illustrated the positive role of computer games during the intervention and 4 weeks after the intervention. Therefore, it is necessary to use this efficient strategy for teaching self-care behaviors and to interact with patients to improve their health-related behaviors. Notable features of the structure and content of this interactive computer game (The City of Dreams) included the reasons for anxiety and concern about the side effects of chemotherapy, use of cognitive and behavioral theories of game design, use of fun games and music along with role-playing, and use of professional engineers and graphic artists in the programming. All the above features of this game contributed to the successful results.

Other researchers have also noted the positive role of computer games in education of self-care and health-related behaviors. The study by Beale *et al.* showed that computer games play a positive role in health care and other health-related results.^[24] They also found that, in

Table 1: Average overall quality of life score in the experimental and control groups at different times

Time	Experimental group	Control group	<i>t</i> -test	
	Mean (SD)	Mean (SD)	<i>t</i>	<i>p</i>
Before the intervention	42.7 (19.30)	43.40 (15.30)	0.16	0.870
Immediately after the intervention	51.10 (18.80)	43.10 (14.70)	2.37	0.020
4 weeks after the intervention	64.70 (13.90)	45.20 (13.80)	5.59	<0.001
Repeated measures ANOVA				
<i>F</i>	127.84	1.69		
<i>p</i>	<0.001	0.370		

general, the level of self-care in the intervention group had significantly increased compared to the control group ($p < 0.010$).^[24] Vasterling *et al.* observed a significant reduction in heart rate, anxiety, and nausea following chemotherapy among patients in whom distraction or relaxation was achieved through computer games compared with the control group ($p < 0.001$).^[25] Moreover, the results of the study by Ebrahimpour *et al.* showed that stress levels caused by insulin injection were significantly lower in diabetic children who used computer games than the control group ($p = 0.001$).^[23]

Factors that greatly affect the QOL of children with cancer are the physical and psychological effects of chemotherapy, which cause fear of starting chemotherapy, and even resistance to or rejection of an anti-cancer treatment program.^[26] Therefore, it is important to enroll patients in self-care, and increase their level of knowledge and function regarding current treatment regimens, such as chemotherapy, to promote their QOL.

Using *The City of Dreams* computer game, the researchers could provide information and education for children undergoing chemotherapy in a cheerful and attractive simulated environment. It reduced their fear and anxiety regarding the side effects of chemotherapy, and increased their knowledge in this field and their QOL.

Kato *et al.* showed that computer games had no effect on stress management ($p = 0.931$) and QOL ($p = 0.112$) of the experimental group compared to the control group, although they had more information about cancer and knowledge about their own role in disease management ($p = 0.030$).^[16] This was not in agreement with the findings of the current study. The researcher believed the difference in the findings of this study and that of Kato *et al.* may be due to their differences in sample size, type and content of the computer games used, and the age-related, cultural, and social differences of the two research communities.

The limitation of this study was the use of other means of education during the study. Therefore, it is suggested that in future researches, in addition to minimizing the foregoing limitation, the shortcomings of this study be resolved by using more subjects and a longer follow-up.

Conclusion

Based on the findings, computer games were effective as a tool in influencing health-related behavior and improving the QOL of children undergoing chemotherapy. Considering computer games' effectiveness and ease of use, nurses, as key members of the healthcare team, can use the study findings to improve the QOL of children undergoing chemotherapy. Nurses play an important role in the care of patients with cancer under treatment and have a suitable status for educating the patients and their families and providing emotional support.

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Conflicts of interest

There are no conflicts of interest.

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