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Original Article

# The effects of playing digital games on the pain levels and mobility states of children post-angiography: A randomized controlled trial

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**Abstract**

**Aim:** The aim of this study was to assess the effects of playing digital games on the pain levels and mobility states of children post-angiography.

**Material and Methods:** This randomized controlled trial was carried out at the pediatric cardiology clinic at a tertiary care hospital in eastern Turkey between October 2016 and July 2017. Eighty children (n=40 digital game group, n=40 control group) post-angiography were randomized. Children in the experimental group played digital games. Wong–Baker FACES pain rating scale (WBFS) and in-bed movement form were used.

**Results:** TThe difference between the means pretest WBFS scores of the digital game group and control group children was not significant (t=1.29; p>0.05). The difference between the mean posttest WBFS scores of the digital game group and control group children was statistically significant (t=9.63; p<0.01). The mean number of in-bed movements was 2.45±1.53 in the digital game group and 13.25±18.92 in the control group. The difference between two groups in total mean number of in-bed movements was significant (p<0.01).

**Conclusion:** For children who are post-angiography, playing digital games decreased pain levels and mobility states.

**Keywords:** Postoperative pain; mobility;game; video; distraction methods;congenital heart disease.

## INTRODUCTION

Angiography is a common procedure that is used indetermining the artery anatomy of the heart, monitoring heart defects and treatment of vascular diseases (1). Angiography is a painful method which requires several invasive procedures such as establishing vascular access and catheterization of a large artery or vein. The angiography catheter is generally inserted through a femoral artery or vein, therefore when the child moves their legs after angiography, the risk of hemorrhage increases (1-3). If the child feels pain, it may make the child move their legs and it may negatively affect quality of life as well (4). Relieving the pain and distracting the child in order to keep the leg still may reduce the risk of hemorrhage (5-7).

In order to relieve the pain of the child after angiography, nonpharmacological methods are used as well as pharmacological methods. These are distraction methods such as listening to music, art therapy, therapeutic touch, drawing pictures, reading books and playing games (7-9). A game is the most important occupation of a child where the child participates and enjoys taking a part. A game enables the child to define fears and worries without words and have fun. Therefore, it becomes easy for the child to cope with stressful situations (10,11). In the last century, with technological advances, games took their place on digital screens. Such games are efficient in the development of hand-eye coordination and visual skills of children. It was reported in several studies that digital games reduce stress in any age group (11,12). In literature, there are few studies with small samples on the effects of digital games (12-14). Furthermore, there are no studies which investigated the effects of digital games on the pain and immobilization of children.

The aim of the study was to evaluate whether the effects

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of playing digital games on the pain levels and mobility states of children post-angiography.

## MATERIAL and METHODS

This randomized controlled trial was carried out at the pediatric cardiology clinic at a tertiary care hospital in Turkey between October 2016 and July 2017. The study was carried out with children aged 4–17 years. Children younger than 4 years of age and older than 17 years of age, those who had significant hearing or learning deficits, decline to participate and those who had disabilities in their hands or fingers, were excluded from the study.

The number of participants (80 children) was determined by power analysis based on 0.05 error, 0.95 reliability range, 0.5 effect size and 0.95 representative statistical power of the population.

Angiography is performed once a week in the pediatric cardiology clinic. After angiography, the children who met the research criteria were included in the study (Figure 1). The children were selected by random sampling method. The names of the children who undergoing angiography in that week were written and determined by lot method. The children were suitably assigned to groups one by one, one in the digital game group and the next in the control group. This procedure was continued until there were 40 children in the digital game group and 40 children in the control group. The duration of angiography ranged from 15 to 45 minutes according to the diagnosis for each child and the purpose of the procedure.

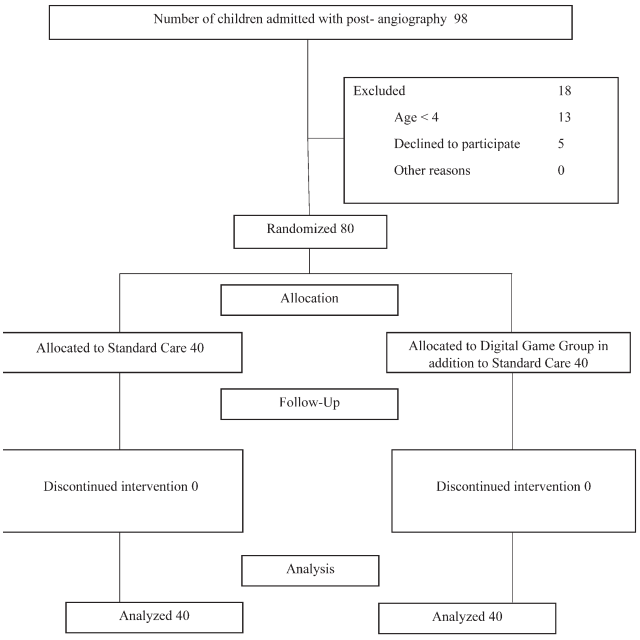


FIG. 1 *Study flow chart*

**Figure 1.** Study flw chart

### Ethics

The parents and their children were informed about the purpose of the study before the operation.Written consent was obtained from parents who wanted to participate in the study, while the children provided verbal assent. The children and their parents in the experimental group were told that the children would play digital games after angiography. The study was approved by the Ethics Committee of Malatya, Turkey (2016/17-6), Clinical Trial Id: /2019/03/024454. The investigation conforms to the principles outlined in the Declaration of Helsinki.

### Measurement Tools

The children's characteristics information form: It includes 4 questions about the age, gender, education level and diagnosis of the children. Vital Findings Evaluation Form: It was developed by the researchers to assess children's post-angiography body temperature, heart and respiratory rate, systolic and diastolic blood pressure and oxygen saturation. In-Bed Movement Form: It was developed by the researchers to record children's post-angiography right-left movement of the legs or flexion and extention movement of the knees. This form included a separate space to record each movement (right-left lateral, flexion-extension). Wong Baker facial pain scale (WBFPS): This scale is widely used for children over the age of 3 and for adults. The faces range from a smiling face to a sad, crying face. A numerical rating is assigned to each face (from 0, “no hurt” to 5, “hurts worst”) of the WBFS . WBFS has a significant ($p<0.05$) responsiveness to pain-increasing (painful procedures) and pain-decreasing (analgesia) events (14).

Standard Care: Vital signs, oxygen saturation and hemorrhage control of children who come to the ward after angiography are monitored regularly. In addition, adequate hydration is provided to all children.

Digital Games Group: In addition to standard care, the children in the trial group played digital games for an hour after the effect of anesthesia decreased and after they had regained consciousness.

### Statistical analysis

The Shapiro–Wilk test was used to determine whether the quantitative data were distributed normally or not. The data of the two groups were compared using the chi-square test and the Student's t-test. Mann–Whitney U test was used to compare the data which were not normally distributed. For all the statistical tests, p value <0.05 was considered significant.

## RESULTS

A total of 98 children were hospitalized for angiography during the period between October 2016 and July 2017. The baseline characteristics of the two groups are described in Table 1. There were no significant differences between the two groups in terms of age, gender, and medical diagnosis.Table 2 shows the means in the comparisons of the WBFS scores and in total mean number of in-bed movements between the two groups of children.The pretest WBFS scores of the digital game group and those of the control group were not significantly different. The WBFS score decreased in the digital game group after one hour of playing digital games. The difference between posttest WBFS score of the digital game group and of the control group was statistically significant ($t=9.63$, $p<0.01$).

**Table 1. Demographic characteristics of the childrens**

| Characteristics | Digital game group (n=40) n(%) | Control group (n=40) n(%) | $X^2$ test p value |
|---|---|---|---|
| **Age Range of Children** | | | |
| **4-8** | 19 (47.5) | 21 (52.5) | 0.06 |
| **9-13** | 18 (45.0) | 10 (25.0) | |
| **14 and more** | 3 (7.5) | 9 (22.5) | |
| | **mean±SD** | **mean±SD** | |
| **Age** | 8.45±3.18 | 9±4.09 | 0.07 |
| | **n(%)** | **n(%)** | |
| **Gender of Children** | | | |
| **Female** | 22 (55.0) | 25 (62.0) | 0.49 |
| **Male** | 18 (45.0) | 15 (38.0) | |
| **Diagnosis of Children** | | | |
| **ASD** | 12 (30.0) | 19 (47.5) | 0 .18 |
| **VSD** | 10 (25.0) | 7 (17.5) | |
| **PDA** | 14 (35.0) | 7 (17.5) | |
| **Fallot Tetratology** | 1 (2.5) | 5 (12.5) | |
| **Other** | 3 (7.5) | 2 (5.0) | |

**Table 2. Comparison of wong baker facial pain scale and number of in-bed movements in the two group**

| WBFPS SCALE | Digital Game Group (n=40) Mean (SD) | Control Group (n=40) Mean (SD) | *t value | p value |
|---|---|---|---|---|
| **Pre Test** | 3.37 (0.83) | 3.12 (0.88) | 1.29 | 0.19 |
| **Post Test** | 1.27 (0.90) | 3.42 (1.08) | 9.63 | 0.000 |
| **p value** | 0.000 | 0.07 | | |
| ****t value** | 16.39 | 1.07 | | |
| *****Number of in-bed movements** | 2.45 (1.53) | 13.25 (18.92) | U test=57.50 | 0.000 |

* Independent t test, **Paired t test, ***Mann Whitney U test

**Table 3. Comparison of vital signs and saturation value of groups before and after the procedure**

| | Pre Test | | | | Post Test | | | |
|---|---|---|---|---|---|---|---|---|
| **Vıtal Signs and Saturatıon** | **Digital Game Group (n=40)** | **Control Group (n=40)** | **t value** | **P Value** | **Digital Game Group (N=40)** | **Control Group (N=40)** | **t value** | **P Value** |
| | **Mean(SD)** | **Mean(SD)** | | | **Mean(SD)** | **Mean(SD)** | | |
| **Body Temperature (°C)** | 36.42 (0.27) | 36.29 (0.24) | 2.19 | 0.31 | 36.41 (0.36) | 36.41(0.25) | 0.36 | 0.97 |
| **Heart Rate (/min)** | 103.0 (20.36) | 96.27 (24.3) | 1.34 | 0.18 | 97.25 (16.79) | 95.1 (23.77) | 0.46 | 0.97 |
| **Respiratory Rate (/min)** | 25.05 (2.61) | 24.85 (5.22) | 0.21 | 0.82 | 23.22 (2.17) | 24.55 (4.67) | 1.62 | 0.10 |
| **Systolic Pressure (/mmHg)** | 111.2 (13.84) | 102.57 (9.89) | 3.20 | 0.02 | 107.8 (13.19) | 102.45 (10.22) | 2.02 | 0.46 |
| **Diastolic Pressure (/mmHg)** | 66.25 (8.71) | 66.47 (6.76) | 0.12 | 0.89 | 67.12 (10.28) | 67.2 (8.22) | 0.36 | 0.97 |
| **Oxygen Saturation (%)** | 94.05 (3.92) | 94.22 (4.49) | 0.18 | 0.85 | 97.27 (3.47) | 94.7 (4.46) | 2.17 | 0.05 |

Values in mean (SD)

**Table 4. Comparison of vital signs and saturation value within group before and after the procedure**

| Signs and Saturation | Pre Test | Post Test | t value | p value |
|---|---|---|---|---|
| | Mean(SD) | Mean(SD) | | |
| **Digital Game Group (n=40)** | | | | |
| **Body Temperature ( C )** | 36.42 (0.27) | 36.41 (0.36) | 0.13 | 0.89 |
| **Heart Rate (/min)** | 103.0 (20.36) | 97.25 (16.79) | 3.35 | 0.002 |
| **Respiratory Rate (/min)** | 25.05 (2.61) | 23.22 (2.17) | 4.17 | 0.000 |
| **Systolic Pressure (/mmHg)** | 111.2 (13.84) | 107.8 (13.19) | 2.06 | 0.046 |
| **Diastolic Pressure (/mmHg)** | 66.25 (8.71) | 67.12 (10.28) | 0.80 | 0.42 |
| **Oxygen Saturation (%)** | 94.05 (3.92) | 97.27 (3.47) | 8.68 | 0.000 |
| **Control Group (n=40)** | | | | |
| **Body Temperature ( C )** | 36.29 (0.24) | 36.41 (0.25) | 2.99 | 0.005 |
| **Heart Rate (/min)** | 96.27 (24.3) | 95.1 (23.77) | 0.37 | 0.71 |
| **Respiratory Rate (/min)** | 24.85 (5.22) | 24.55 (4.67) | 0.60 | 0.55 |
| **Systolic Pressure (/mmHg)** | 102.57 (9.89) | 102.45 (10.22) | 0.06 | 0.95 |
| **Diastolic Pressure (/mmHg)** | 66.47 (6.76) | 67.2 (8.22) | 0.54 | 0.59 |
| **Oxygen Saturation (%)** | 94.22 (4.49) | 94.7 (4.46) | 1.07 | 0.29 |

Values in mean (SD)

Intragroup pretest and posttest WBFS scores were compared. The difference in pretest and posttest WBFS scores in the digital game group was significant (t=16.39, p<0.01).

Analysis of Mann-Whitney U test revealed that there was a significant difference between the two groups in total mean number of in-bed movements (U=57.50, p<0.01). The mean number of in-bed movements was lower in the digital game group than in the control group (Table 2).

Table 3 shows the means in the pretest and posttest comparisons of the vital signs and saturation rates between the two groups of children. There was a significant difference between the systolic blood pressure meansin the pretest. The differences in the other parameters were not significant.In the posttest comparisons of the two groups, the difference between the means of the vital signs and oxygen saturation rates was not significant. Intragroup pretest and posttest vital signs and saturation rates were compared. The difference between the pretest and posttest heart and respiratory rate, systolic blood pressure, and oxygen saturation were significant in the digital game group (p<0.05). No significant difference was found in the control group (Table 4).

## DISCUSSION

This randomized controlled study proves that decreases occurred in the pain levels and in-bed movement numbers of children who played digital games after angiography. Posttest WBSF scores of digital game group children were found to be lower than those of the control group. When the mean pain levels of the digital game and control group children were compared, it was found that the differences in both the intragroup and intergroup mean pain levels were statistically significant (Table 2). Digital playing focused onthe child's attention on the game, and the child had a good time. Our findings are consistent with previous studies on distraction techniques (15-17).

In their randomized controlled trial, Kaheni et al. found that children 3–6 years of age who played video games during venipuncture had less pain compared to the standard care group (18). In their study on the effectiveness of soap bubbles in distracting children between 3–6 years of age who were undergoing blood sampling, Caprilli et al. found that pain and stress decreased in the soap bubble group when compared with the standard care group and that the difference between the two groups was significant (19).

In this study, the numbers of in-bed movements between pretest and posttest were counted and recorded. As a result, it was determined that the mean number of in-bed movements of the digital game group children was 2.45, while it was 13.25 in the control group (Table 2). According to the statistical analysis, the difference was significant. It is thought that the games played by the digital game group children distracted them from focusing on their bodies and made them relax. Therefore, their in-bed movements decreased. No other studies that investigated the effects of video games on immobilization of children who underwent angiography could be found. It is thought that this situation may be due to the fact that the subject is quite specific.

In this study was found comparisons of the digital game group and control group children who underwent angiography that the difference between the means of heart rates, body temperature, respiration rates, diastolic pressure and oxygen saturation rates was not significant in the pretest (Table 3). However, it was found that average of systolic blood pressure of pretest in digital game group was higher than control group and It is unknown why differences. Digital game group children can be more

stressful at the beginning.

It was found in this research that in the post-test comparison of the vital signs and oxygen saturation of the digital game group and control group children was not significant (Table 3). Different results were found in the literature. Miller et al. found out in their study which investigated the effect of virtual games on the vital signs and oxygen saturation of the children who had burn injuries while medical dressing that there was no difference of vital signs and oxygen saturations between groups (10). In a similar study, it was detected that there was difference between oxygen saturations but no difference between vital signs (11). Differences in research findings can be explained by medical diagnosis, procedure, anxiety and age of children. Further research results are needed.

When the intragroup means of digital game group childrenbetween pretest and posttestwere compared, it was found that the differences between heart rates ($p<0.01$), respiration rates ($p<0.01$), systolic blood pressures ($p>0.05$) and oxygen saturation rates ($p<0.01$) were significant.When the intragroup means of the control group children were compared, the difference between body temperatures was significant ($p<0.01$), while the differences between other vital signs and oxygen saturation levels were not significant ($p>0.05$, Table 4).In this study, the digital game group relaxed and this is why the vital signs of the digital game group children stabilized in comparison to the control group children.In a study Gershon et al. assessed heart rate, pain and anxiety of children with cancer who were between 7 and 19 years of age by making them watch virtual reality videos, they found that children's pain and anxiety levels, heart rates and stress behaviors decreased (12). In a similar study, Mott et al. found that determined that there was a difference between respiratory and pulse ratesbut no difference between oxygen saturations (11). Researches shows that computer games are effective in stabilizing the children's vital signs during or after the medical procedure.

## CONCLUSION

The results of this study revealed that, for children who underwent angiography, playing digital games is effective on decreasing pain and providing immobilization and vital signs stabilized.Therefore, digital games may be played without any adverse effects as a safe and enjoyable method after angiography (when the child regains consciousness).Pediatric nurses can use digital game widely in the post-operative period.

*Competing interests: The authors declare that they have no competing interest.*

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Ethical approval: *The study was approved by the Ethics Committee of Malatya, Turkey (2016/17-6), Clinical Trial Id: /2019/03/024454. The investigation conforms to the principles outlined in the Declaration of Helsinki.*

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