



MSc in Clinical Psychology

Computer-based intervention for preoperative anxiety in children: The role of parental anxiety and child temperament - A Randomized Controlled Pilot Study

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Foreword and acknowledgment

Submitted in partial fulfillment of the requirements of the MSc Clinical Psychology degree, Reykjavik University, this thesis is presented in the style of an article for submission to a peer-reviewed journal. This thesis is based on a culmination of work over three semesters. In the first semester, a literature review was conducted, focusing on the impact of serious health computer games on preoperative anxiety in children, as well as the methods of delivery and psycho-educational interventions. The second semester was dedicated to preparing for data collection, during which the initial draft of the method sections for the thesis was written. In the final semester, data collection commenced, and the resulting data was analyzed, leading to the completion of the result section and final draft of the thesis.

The present thesis represents a pilot study for a larger collaborative project with a team that is currently in the works, in conjunction with at least two other countries. This study was conducted using a methodology similar to that which will be employed in the larger project and will provide valuable insights into areas that require improvement, as well as preliminary results of the usability of the currently designed computer game, Mina and The Land of Dreams (MINA).

I would like to extend my sincere appreciation to my supervisors, Berglind Brynjólfssdóttir and Þórhildur Halldórsdóttir, for their invaluable guidance and support throughout the 18-month period, which deepened my interest and passion for psychology. Furthermore, I would like to thank the MINA team for giving me the opportunity to be part of such a dedicated group of researchers. Finally, I would like to express my sincere appreciation to my family and friends for their unconditional love, encouragement, and counsel.

Abstract

Preoperative anxiety in children can have negative consequences, and technology has been used to address this issue. This study aimed to investigate the effect of a computer game intervention in reducing preoperative anxiety in children and the role of parental anxiety and children's temperament in preoperative anxiety. Thirteen children aged 4-8 years and their parents were recruited from the Akureyri Health Clinic in Iceland. Participants were randomly assigned to either the intervention groups (played a computer game (MINA) and a storybook) or the control group (usual care). The Modified Yale Preoperative Anxiety Scale – short form (mYPAS-SF) was used to measure child preoperative anxiety in the waiting room or during anesthesia induction. The State and Trait Anxiety Inventory (STAI) assessed parental anxiety, and the Children's Behavior Questionnaire (CBQ) evaluated child temperament. No significant differences in child preoperative anxiety were found between the three treatment groups (MINA game, storybook, and usual care) at either timepoint ($p > 0.05$). However, there was a noteworthy trend, as the preoperative anxiety was lower in the MINA game group than in the other groups ($p = .364$). Parental anxiety and child temperament did not significantly predict child preoperative anxiety. These promising findings of this pilot study indicate that MINA may prove to be a valuable tool in reducing preoperative anxiety in children. However, further research is needed to assess its effectiveness in a larger sample.

Keywords: Children's Preoperative Anxiety, Computer-based intervention, Parental Anxiety, Temperament.

Úrdráttur

Kvíði barna fyrir aðgerð getur haft neikvæðar afleiðingar og aukin tæknivæðing hefur ýtt undir þróun inngripa við slíkum kvíða. Þessi rannsókn miðaði að því að kanna áhrif tölvuleikjaíhlutunar á kvíða barna fyrir aðgerð, ásamt hugsanlegum áhrifum kvíða foreldra og skapgerð barna. Þrettán börn á aldrinum 4-8 ára og foreldrar þeirra frá Læknastofum Akureyrar á Íslandi tóku þátt. Þátttakendum var skipt af handahófi í þrjá hópa, íhlutunarhóp (spiluðu tölvuleik (MINA) eða fengu lestur sögubókar) eða viðmiðunarhóp (hefðbundin fræðsla). Kvíði fyrir aðgerð var mældur með The Modified Yale Preoperative Anxiety Scale – stutt form (mYPAS-SF), kvíði foreldra var metinn með State and Trait Anxiety Inventory (STAI) og skapgerðar eiginleikar barna voru metnir með spurningalista um hegðun barna, Children's Behavior Questioner (CBQ). Niðurstöðurnar sýndu ekki marktækan mun á kvíða barna fyrir aðgerð milli meðferðarhópanna þriggja (MINA leikur, sögubók og hefðbundin fræðsla). Niðurstöðurnar benda til athyglisverðrar þróunar þar sem meðaltal kvíðans var lægri hjá þeim börnum sem spiluðu MINA leikinn ($p > 0.05$). Kvíði foreldra og skapgerð barns spáðu ekki marktækt fyrir um kvíða barns fyrir aðgerð. Íhlutun eins og MINA getur reynst dýrmætt tæki og frekari þróun slíkra inngripa er mikilvæg. Því er þörf á framtíðarrannsóknum til þess að meta árangur MINA við að draga úr kvíða fyrir aðgerð hjá börnum í stærra úrtaki.

Lykilorð: Kvíði barna fyrir aðgerðir, Tölvuleikja inngríp, Kvíði foreldra, Skapgerð.

Computer-based intervention for preoperative anxiety in children: The role of parental anxiety and child temperament - A Randomized Controlled Pilot Study

Worldwide, children commonly undergo anesthesia for medical procedures of varying severity. Every year, over five million children undergo surgery in the United States alone (Chow et al., 2016), while in Iceland, approximately 900 operations were performed on children aged 4-8 in 2018 and 2019 (not including private clinics) (Hagdeild Landspítala, personal communication, June 20, 2022). Anxiety is a common issue among children undergoing perioperative procedures, affecting 50-75% of children across different age ranges, from preschoolers to adolescents (Chow et al., 2019; Getahun et al., 2020; Kain, Mayes, O'Connor, et al., 1996). Children's preoperative anxiety (CPA) is characterized by various symptoms, such as tension, uncertainty, irritability, and increased autonomic nervous activity (Getahun et al., 2020). CPA symptoms can manifest as aggression, refusal to cooperate, prolonged anesthesia induction, withdrawal, and regression (Ahmed et al., 2011). Research has shown that CPA mainly occurs on the day of surgery (Capurso & Ragni, 2016; Fronk & Billick, 2020), peaking during anesthesia induction (Getahun et al., 2020; Kain, Mayes, O'Connor, et al., 1996). During the perioperative process, children may be especially vulnerable to experiencing such anxiety due to their inability to control the environment, a limited understanding of the environment, and a high reliance on others (Fronk & Billick, 2020; Getahun et al., 2020; Wright et al., 2007).

Non-pharmacological treatments have gained popularity as an alternative to pharmacological treatments, mainly for encouraging cooperation in children and minimizing pain (Agbayani et al., 2020; Suleiman-Martos et al., 2022). Studies have shown that various multifaceted interventions have effectively improved children's tolerance to psychological stress and facilitated anesthesia induction while reducing complications (Capurso & Ragni, 2016; Jin et al., 2023; Wright et al., 2007; Yip et al., 2011). Complications that may occur

post surgeries include increased pain, delayed recovery, and prolonged hospital stay (Kain, Mayes, O'Connor, et al., 1996). These interventions vary in design and can include education, modeling, therapeutic play, distractive techniques, and social interventions like parental presence (Al-Yateem et al., 2016; Capurso & Ragni, 2016; Kain & Caldwell-Andrews, 2005; Setoodeh et al., 2010; Yip et al., 2011). In addition, coping strategies, such as relaxation and breathing exercises, can help children manage fear and anxiety (Capurso & Ragni, 2016; Wright et al., 2007). Toward this end, it is important to consider the different methods and technologies that can be used in an effective intervention program.

A comprehensive intervention program to reduce CPA should address the entire perioperative process, including content, delivery personnel, and location and timing of administration. Furthermore, several studies have examined different modes of delivery (Chow et al., 2016; Fortier & Kain, 2015; Getahun et al., 2020; Lee et al., 2013). For example, Bellew et al. (2002) found no difference in the reduction of CPA between receiving anesthesia information from an anesthesiologist versus at a preclinical appointment, which requires an additional appointment. However, maintaining this service can be expensive and time-consuming. In general, research suggests that creating an intervention that is user-friendly, readily available, and beneficial for both anxious children and their parents throughout the perioperative process can be a challenging task (Agbayani et al., 2020; Chow et al., 2016).

Computer technology is increasingly used to prepare children and parents for preoperative procedures due to the expense and time required for traditional education methods. Game-based video games, online sources, and videotapes have been found to be effective in reducing anxiety and may be relatively cost-effective (Chow et al., 2016; LeRoy et al., 2003; Teruel et al., 2021). Handheld video games and smartphone applications are mostly affordable, feasible, user-friendly, and portable and have been found to reduce CPA during anesthesia induction (Cumino et al., 2017; Matthyssens et al., 2020; Patel et al., 2006;

Suleiman-Martos et al., 2022; Teruel et al., 2021; Yip et al., 2011). Video games can also serve as a distraction and may reduce the need for premedication (Capurso & Ragni, 2016). Active distraction techniques like handheld video games have been found to significantly lower anxiety levels before induction compared to premedication, while passive distraction techniques like watching videos of their choice during induction are also effective in reducing children's anxiety (Manyande et al., 2015; Yip et al., 2011). These findings suggest that distraction techniques can be an effective alternative or supplement to medication in reducing preoperative anxiety. Innovative computer games and applications have emerged as a promising approach for reducing preoperative anxiety, providing effective and affordable alternatives to traditional education methods.

One recent example of an innovative computer game developed for this purpose is the MINA game, created by Ingadottir et al. (2022). Based on cognitive-behavioral principles, the MINA game includes interactive elements such as exposure to medical equipment and coping strategies that aim to reduce anxiety and fear related to perioperative procedures. As an active and passive distraction method, the MINA game can be played at home, making it a consistent approach to perioperative preparation across different healthcare settings. The game's interactive features offer a unique and engaging way to reduce children's preoperative anxiety.

CPA is a complex phenomenon that is influenced by various factors, such as parental anxiety and child's temperament (Caldas et al., 2004; Chow et al., 2019; Kain et al., 2000). Research suggests that parents' anxiety levels, both state and trait anxiety, can intensify their child's preoperative anxiety (Cui et al., 2016; Kim et al., 2019). For example, parents with high levels of trait anxiety (T- anxiety), which is a tendency to experience anxiety in general, may display anxious behaviors and express concerns about their child's surgery, which can in turn increase the child's preoperative anxiety. Similarly, parents with high levels of state

anxiety (S-anxiety), which is anxiety related to a specific situation or event, may also transmit this anxiety to their child due to the stress of their child's upcoming surgery (Kain, Mayes, O'Connor, et al., 1996; Spielberger, 2010). Research in this area is, however, lacking.

Furthermore, a child's temperament can influence how they handle new and unpredictable situations, including anesthesia induction. According to Rothbart's temperament model, negative affect (such as fear, anger, frustration, and sadness) can increase anxiety, while surgency/extraversion (positive emotions and social orientation) can potentially reduce anxiety. Effortful control is crucial for self-regulation and can lead to a potential reduction in anxiety in children with higher levels of effortful control (Rothbart & Posner, 2006). While research on negative affect, surgency and effortful control and CPA is limited, there is good reason to believe they are linked based on their strong association with anxiety in general (Chow et al., 2019).

Screening for children's temperament and parents' anxiety levels can be a crucial step in identifying those at risk of CPA and may inform the choice of appropriate preparation methods in different healthcare settings (Capurso & Ragni, 2016). Identifying patients at risk of anxiety and providing prevention and intervention strategies can help to mitigate their anxiety during the preoperative period. Toward this end, this study utilized a mixed-methods approach, incorporating both questionnaires and observation techniques, which were carried out by the researchers involved in the study. The objective of this pilot study was twofold. First, to evaluate the effectiveness of an educational computer game intervention (MINA game) in reducing preoperative anxiety (CPA), and secondly, to explore the association between parental anxiety and child temperament with CPA during anesthesia induction. To achieve this, we conducted a randomized control trial to compare the effectiveness of the MINA game intervention with a storybook and standard preoperative care (usual care) in reducing CPA in the waiting room prior to surgery and during anesthesia induction.

Additionally, we investigated the intervention's effectiveness and the relationship between parental anxiety and child temperament by testing three hypotheses based on previous literature.

- 1) Children who played the educational computer game (MINA) will have a lower total anxiety score (mYPAS-SF) before anesthesia and during induction of anesthesia compared to children in the webpage storybook and usual care groups.
- 2) Parental anxiety will be associated with higher levels of CPA, regardless of whether the anxiety is related to a specific situation (T-anxiety) or is a general tendency towards anxiety (S-anxiety).
- 3) Children with higher levels of surgency and effortful control will exhibit lower levels of CPA, while higher levels of negative affect will be associated with higher levels of CPA, during anesthesia induction.

Method and materials

Participants

The participants comprised 13 children between the ages of 4 to 8 years (mean age 5.1 years old ($SD = 4.75$), 61.5% females) who required surgery and anesthesia due to a medical condition were recruited from the Akureyri Health Clinic between November 2022 and April 2023. The parents' ages ranged from 27 to 43 years ($M = 35.9$, $SD = 4.75$). Participants were recruited from all eligible children undergoing surgery at the Akureyri Health Clinic who met the inclusion criteria. Surgical staff recruited eligible participants and obtained their contact information from the medical journal.

Inclusion criteria were: (1) at least one caregiver must consent to participate with the child, (2) the child must be between the ages of 4 and 8 years, (3) both the child and their parents/guardians must understand Icelandic, (4) the child must be cognitively and physically

able and willing to play computer games, and (5) the child or/and the participating caregiver had access to a smartphones and/or tablet.

Study design

This study employed a randomized controlled trial (RCT) design. All eligible children (N = 28) were initially screened for further criteria, and 13 were randomly assigned to either the intervention group or the control group. An email invitation was sent to parents/caregivers with information regarding the study and a link to a special consent form. Once informed consent was obtained from parents, they were informed of their assigned group. The study was approved by the National Bioethics Committee (Nr. 22-148-V1).

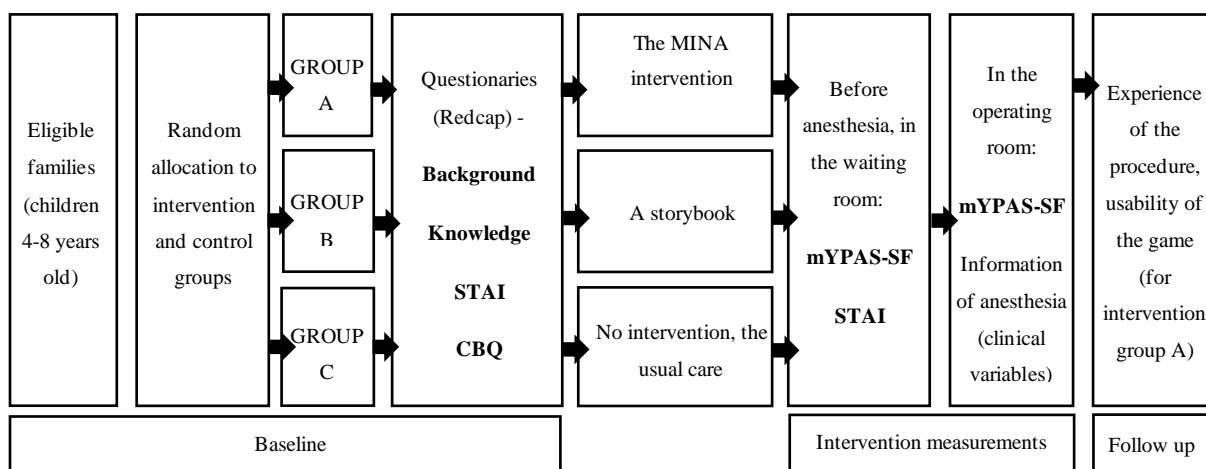
Data collection

Data were collected at four distinct time points: at home 5-7 days before the scheduled operation, in the waiting room, during induction, and postoperatively. All study participants were requested to complete questionnaires at each designated time point.

Participants who did not complete all the questionnaires were excluded from data analyses in this study. A flowchart of the study design is presented in Figure 1 illustrates the study design, including data collection, the various groups involved, and measurement timepoints.

Figure 1.

Flowchart of Study Design, Group Allocations, and the Time Points for Measurements.



Abbreviations: *CBQ*, Children's Behavior Questionnaire; *mYPAS-SF*, Modified Yale Preoperative Anxiety Scale - short form; *STAI*, State-Trait Anxiety Inventory.

During the patient assignment process, the surgeons, anesthesiologists, and parents were blinded to the child's group status. All study procedures, including randomization, screening, obtaining informed consent, data collection, and sending survey reminders, were performed using REDCap (Research Electronic Data Capture) electronic data capture tools hosted at University Hospital, Iceland.

Measures

Demographic characteristics and medical information. Demographic information about the participants was gathered from the medical journal, including age, gender, and any relevant medical history. Further, information about the clinical procedure, such as the type of surgery and any complications, was also collected from the medical journal.

Preoperative anxiety. Preoperative anxiety was evaluated using the Modified Yale Preoperative Anxiety Scale – short form (mYPAS-SF) (Jenkins et al., 2014). The mYPAS-SF is an observational measure that contains 18 items classified into four categories: activity (1-4 points), vocalization (1-6 points), emotional expression (1-4 points), and state of arousal (1-4 points). Total scores range from 23 to 100, with higher scores indicating a higher level of anxiety. A score above 40 is generally considered high anxiety, while a score below 30 is considered low anxiety (Kain et al., 1997; Kain, Mayes, O'Connor, et al., 1996). Therefore, in this study, participants with scores greater than 30 were classified as having high anxiety. The researcher used the mYPAS-SF to evaluate preoperative anxiety in children before surgery, with two measurements taken at different time points: in the waiting room and during anesthesia induction.

The mYPAS-SF has demonstrated strong criterion validity and good to excellent interobserver reliability (Kappa range .73-.91) (Jenkins et al., 2015) and has been utilized extensively across multiple domains such as psychology, surgery, anesthesia, and dentistry.. The mYPAS-SF was translated into Icelandic for the study by the researcher and a translator,

with reviews to ensure accuracy. To facilitate consistent and accurate data collection, researchers received comprehensive training aimed at improving interobserver reliability.

Parental preoperative anxiety. Parental preoperative anxiety was assessed using the Icelandic version of the State and Trait Anxiety Inventory (STAI) (Spielberger, 1970). STAI distinguishes between two types of anxiety: state anxiety and trait anxiety. State anxiety is a transient emotional state in response to a specific event, while trait anxiety reflects a general tendency to experience anxiety and worry regardless of context. Each of the 20 items on the STAI is rated on a 4-point Likert scale, with options ranging from 1 (*Not at all*) to 4 (*A lot*). The total score for each (State and Trait) assessment ranges from 20 to 80, with higher scores indicating a higher level of anxiety. The list was sent out 5 to 7 days before the scheduled operation date. During the surgery, parents/guardians were sent, via email, the second part of the questionnaire (STAI) to complete (refer to Figure 1).

Previous studies have reported good reliability for both foreign and Icelandic translations of the STAI, with high internal consistency ($\alpha = 0.83-0.92$) and test-retest reliability. The trait anxiety (T-anxiety) part of the scale has shown higher coefficients ($r = 0.73-0.86$) than the State (S-anxiety) part ($r = 0.16-0.62$), which may vary due to random events and circumstances (Barnes et al., 2002; Einarsdóttir & Sigurðardóttir, 1991).

Child Temperament. The Children's Behavior Questionnaire - Very Short Form (CBQ-VSF) was used to evaluate child temperament. It comprises 36-items which parents' rate on a 7-point scale (1 = *extremely untrue of my child* to 7 = *extremely true of my child*) how they would expect the child to react in various situations. The measure entails three broad dimensions: surgency/extraversion, effortful control, and negative affectivity. The surgency scale measures outgoing, energetic, and impulsive behavior, the effortful control scales measures behavior and emotional regulation and the negative affectivity is measuring negative emotions like fear, sadness, and anger.

The CBQ-VSF has demonstrated good psychometric properties, including high internal consistency and criterion validity, as well as longitudinal stability and cross-informant agreement comparable to the standard version of the CBQ (M. K. Rothbart et al., 2001). This measure was translated to Icelandic for this study. Two individuals, one a certified translator and the other a healthcare professional, worked separately on the translation. The translators compared the two versions and formed a consensus on the final version.

Intervention

Computerized game intervention. The Mina and the Land of Dreams (MINA) game is an educational computer game that includes synthesized psycho-educational preparation for anesthesia, such as information on the fasting process, coping strategies like breathing and relaxation, insights into the operating room, and exposure to medical equipment. The MINA game also provides positive reinforcement/feedback on a player's courage through "brave points". The child was instructed to play a MINA game one week before the medical procedure. The game is relatively cost-effective and can be played at home, providing a consistent approach to perioperative preparation across healthcare settings.

Storybook. The educational storybook, which was based on the content of the game but lacked the interactive and game elements of MINA, was designed to investigate the superiority of the educational aspects of MINA. Parents were instructed to read the storybook from an illustrated website a week before the medical procedure.

Usual care. In the usual care group, parents and their children received usual care, including information from a doctor, a brief explanation of the planned procedure, and standard instructions on how to prepare the child for the operation. All participants received this usual care, but the children randomized to the MINA game, or the storybook groups also received their respective interventions detailed above.

Statistical analysis

Data was analyzed using the Statistical Package for the Social Sciences (IBM SPSS statistics 25). Given the small sample size and the explorative nature of this pilot study, no formal power calculation was conducted, and primarily descriptive analyses were performed to test the hypotheses. First, ANOVAs for continuous variables and chi-square tests for categorical variables were conducted at baseline to compare the demographic data and clinical characteristics of the three intervention groups (i.e., MINA game, storybook, usual care). Boxplots were then used to visualize the primary outcomes (mYPAS-SF). Secondly, to determine change in anxiety levels between timepoints, paired sample t-tests were conducted to compare the mean differences in anxiety levels at the two timepoints (in the waiting room and during anesthesia induction) for each of the three groups. Third, to examine differences in outcomes after the intervention, an ANOVA was conducted with the group status (i.e., computer game, storybook and usual care) predicting CPA levels during the administration of anesthesia. Lastly, ANOVAs were also conducted to examine the association of parental anxiety and child temperament with child anxiety levels during anesthesia induction. Due to the small sample size in the study, the analyses on the association between parental anxiety and child temperament with outcomes were conducted for the whole sample, rather than by treatment group. In all analyses, a p-value of alpha 0.05 was considered significant.

Results

Table 1 displays descriptive statistics of the children's and parent's characteristics by treatment group (i.e., MINA game, storybook, and usual care). The children's mean age at surgery was 5.1 years ($SD = 1.12$) and parental mean age was 36.9 years ($SD = 4.75$). The regression analysis found that there was no significant in children's age ($\beta = -.007$, $t = -.022$, $p = .983$) and parental age ($\beta = .408$, $t = 1.484$, $p = .166$) at surgery by treatment group. A chi-square test showed that there was also no significant differences in gender ($\chi^2(df = 2, N =$

13) = 3.282, $p = .194$), previous surgery ($\chi^2(df = 2, N = 13) = 1.130, p = .568$), marital status ($\chi^2(df = 2, N = 13) = 0.692, p = .708$) and highest level of education ($\chi^2(df = 6, N = 13) = 10.111, p = .120$) by treatment group.

Table 1

Descriptive Statistics for Demographic and Clinical Characteristics of Children and Parents, Parental Level of State and Trait Anxiety, and Children’s Temperament by Treatment Group

	Total participants ($n = 13$)	MINA game ($n = 4$)	Storybook ($n = 4$)	Usual care ($n = 5$)
<i>Child characteristic</i>				
Age, mean (SD)	5.1 (1.12)	5.0 (1.41)	5.2 (1.50)	5.0 (0.50)
Sex, girl, n (%)	8 (61.5)	1 (25.0)	3 (75.0)	4 (80.0)
Previous surgery, yes, n (%)	6 (46.2)	1 (25.0)	2 (50.0)	3 (60.0)
Surgency, mean (SD)	4.05 (1.08)	4.8 (1.45)	3.9 (1.09)	3.5 (0.41)
Negative affect, mean (SD)	4.39 (0.70)	3.9 (0.91)	4.5 (0.29)	4.7 (0.67)
Effortful control, mean (SD)	4.40 (0.84)	3.9 (0.61)	4.6 (1.08)	4.6 (0.80)
<i>Parental characteristics</i>				
Age, mean (SD)	35.9 (4.72)	33.0 (5.5)	36.7 (4.27)	37.6 (4.34)
Highest level of education, n (%)				
University degree	9 (69.2)	1 (25.0)	4 (100.0)	4 (80.0)
Other	4 (30.8)	3 (75.0)	0 (0.0)	1 (20.0)
Marital status, n (%)				
Marriage/cohabitation	10 (76.9)	3 (75.0)	3 (75.0)	4 (80.0)
Single/Other	3 (23.1)	1 (25.0)	1 (25.0)	1 (20.0)
State Anxiety (S-Anxiety), mean (SD)	44.0 (2.89)	44.7 (2.75)	43.5 (1.92)	43.8 (3.96)
Trait Anxiety (T-Anxiety), mean (SD)	45.5 (3.02)	46.5 (3.00)	43.0 (2.58)	46.6 (2.61)

Change in CPA between timepoints

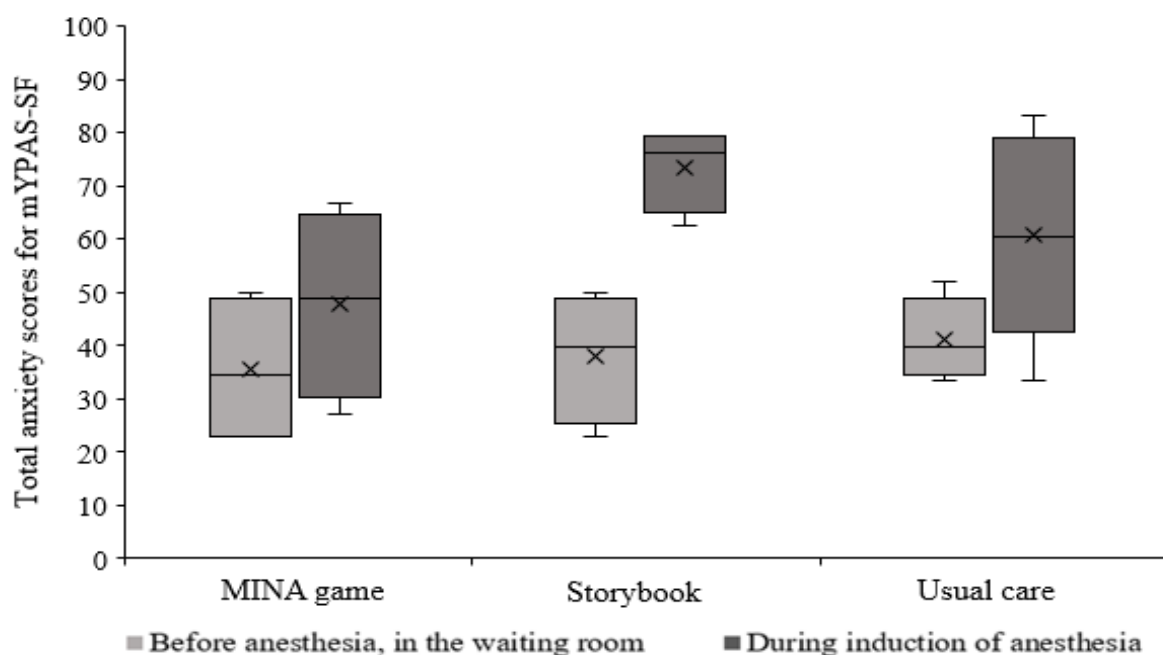
Figure 2 compares the mean anxiety scores of the three groups between the two time points, i.e., in the waiting room and during induction. The results of the regression analyses indicated that there was no significant effect of the different treatment groups on the level of CPA in the waiting room at time point 1 ($\beta = 2.908, p = .445$) or during induction of anesthesia at time point 2 ($\beta = 5.812, p = .364$).

When comparing the two time points for each group, there was a significant increase in CPA during induction compared to the waiting room condition for all the treatment groups, game group ($t(3) = 4.17, p = .025$), storybook group ($t(3) = 3.79, p = .032$), and usual care group ($t(4) = 3.09, p = .037$).

The boxplot displays anxiety score distribution for each group. The median anxiety score is indicated by the horizontal line inside each box. The whiskers extending from the boxes show the range (23 – 100) of anxiety scores within each group. It enables a visual comparison of the mean scores between groups at the two time points.

Figure 2

Boxplot of Total Anxiety Scores (mYPAS-SF) by Groups Between Two Time Points.



Parental Anxiety

Two regression models were conducted to examine the relationship between parental anxiety (measured by S-anxiety and T-anxiety) and children's behavioral distress during the induction of anesthesia (CPA) at time point 2. The results showed that neither S-anxiety ($\beta = -.251, p = .409$) nor T-anxiety ($\beta = -.138, p = .652$) were significant predictors of CPA.

Child Temperament

A one-way ANOVA was performed to determine if surgency, effortful control, and negative affect were significant predictors of total CPA during anesthesia induction. The results showed that the regression model was not significant ($F(3, 9) = 1.223, p = .357$), indicating that surgency, negative affect and effortful control did not significantly predict CPA at induction.

Discussion

Preoperative anxiety is a common issue among children that can have unfavorable consequences. However, recent interventions have made significant progress in addressing this concern, with technology playing a prominent role. For example, handheld games have shown positive results in reducing CPA (Cumino et al., 2017; Matthyssens et al., 2020; Patel et al., 2006; Suleiman-Martos et al., 2022; Teruel et al., 2021; Yip et al., 2011), leading to the development of the MINA game, an educational computer game designed to help children in preparing for the perioperative period (Ingadottir et al., 2022). This study aimed to examine the effectiveness of the MINA game, a tablet-based game called Mina and The Land of Dreams, and a storybook intervention in reducing children's anxiety before surgery compared to usual care. Additionally, it aimed to explore the association between parental anxiety and child temperament with CPA during anesthesia induction.

Although we hypothesized that children who played the educational computer game MINA would experience lower levels of anxiety before and during induction of anesthesia

compared to children in the webpage storybook and usual care groups, we found no significant differences in CPA between the three treatment groups at either timepoint. Instead, the study found a significant increase in CPA during induction for all treatment groups, which aligns with prior research highlighting the stressful nature of anesthesia induction for pediatric patients (Getahun et al., 2020; Kain, Mayes, O'Connor, et al., 1996). Nevertheless, the study results indicate a noteworthy trend, as the average CPA score was lower in the MINA game group for both measurement points, albeit the difference was not significant. The small sample sizes for each group may have affected the results. These findings are promising, and further studies are needed in larger samples to see whether MINA outperforms the others treatment options.

Further research is needed to determine the effectiveness of the MINA game in reducing preoperative anxiety in children. However, it is crucial to emphasize that a comprehensive approach is necessary to consider all contributing factors, including the screening and assessment of preoperative anxiety and parental anxiety levels. Although non-pharmacological interventions such as the MINA game may prove valuable, creating a computer game can be a costly procedure. Nevertheless, it is considered cost-effective in the long run due to the valuable preparation it provides for healthcare professionals, making it a feasible and efficient option for reducing preoperative anxiety in children. Future research should also include treatment satisfaction questionnaires to gain insights into how well the interventions are being received by participants and their views on the game. This information can be used to optimize outcomes and improve future interventions by providing valuable insights into the acceptability and practicality of non-pharmacological interventions.

Although prior studies have suggested that parental anxiety can increase a child's preoperative anxiety (Kain, Mayes, Caramico, et al., 1996; Spielberger et al., 1995), our

regression models did not support this finding for either S-anxiety or T-anxiety as predictors of CPA. However, interestingly, parents in the Storybook groups had comparatively lower average anxiety levels, even though the differences were not statistically significant. One explanation for this observation could be, while children played the game independently, it is conceivable that their parents were more involved in providing them with storybook interventions, leading to a positive impact on their preparation for their child's surgery.

In addition to exploring the relationship between parental anxiety and CPA, the present study also aimed to investigate the potential link between temperament traits and CPA levels during anesthesia induction. Previous research had shown a possible correlation between different temperament traits (surgency, negative affect, effortful control) and general anxiety (M. Rothbart & Posner, 2006). However, our results did not support the hypothesis that certain temperament traits predict lower or higher CPA during anesthesia induction. We did not find any significant association between temperament traits and CPA. It is important to note that preoperative anxiety levels could be influenced by other factors, such as previous surgery, gender, and age. Therefore, further research is necessary to fully understand the complex interplay between temperament and CPA during anesthesia induction.

Although the study is informative, it is crucial to note the limitations of this study, namely the small sample size, which increases the likelihood of obtaining chance results and limits the generalizability of the findings. As such, the current results should be considered preliminary and not conclusive, but instead, serve as a foundation for further research with a larger and more diverse sample. It is important to acknowledge that additional data are necessary to make valid inferences and draw meaningful conclusions. Despite conducting regression analysis, it should be noted that there may exist a reverse causality where the anxiety of the child could affect the anxiety levels of the parents, further complicating the

interpretation of the relationships. Moreover, a lack of pre-existing anxiety measures for the participants before the intervention presents a challenge in assessing the impact of the intervention on anxiety levels.

In conclusion, the present study highlights the significance of non-pharmacological interventions and screening procedures in mitigating preoperative anxiety among pediatric patients. By focusing on these aspects, researchers can make meaningful contributions to the development of effective interventions that can significantly improve the healthcare experience for children and their families. Although the results did not demonstrate a significant decrease in preoperative anxiety with the use of the MINA intervention compared to storybook or usual care, and parental anxiety and child temperament did not show significant association with CPA, the study provides encouraging directions for future research with larger samples. It is crucial to acknowledge the limitations of the present study and continue to advance the development of interventions that can effectively address preoperative anxiety in pediatric patients.

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