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The role of hospital school education in reducing anxiety among hospitalized children

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Purpose: This study aimed to evaluate state and trait anxiety levels in hospitalized children upon admission and discharge from the HS, and to examine whether curriculum-based activities and illness-related factors influence anxiety evolution.

Design: A prospective pretest-posttest design without a control group was conducted in a hospital school setting. Sixty children aged 9 to 14 completed the State-Trait Anxiety Inventory for Children (STAIC) at admission and before discharge. An adapted Likert-based visual scale was used to assess satisfaction with educational activities. Additional variables included type of illness and treatment, length of stay, and previous hospitalizations.

Findings: Children exhibited significantly higher state anxiety compared to trait anxiety upon admission (53rd vs. 31st percentile; $p = 0.001$). Previous hospitalization was a strong predictor of elevated state anxiety ($p = 0.008$). Both trait and state anxiety significantly decreased following hospital school attendance ($p = 0.007$; $p = 0.001$, respectively). A longer hospital school attendance (>6 days) was associated with a greater reduction in trait anxiety ($p = 0.035$). Positive evaluation of educational activities predicted a favorable anxiety evolution (AUC = 0.815; $p = 0.004$).

Value: This study highlights the protective role of hospital school interventions in mitigating anxiety among hospitalized children. Previous admissions emerged as a significant risk factor, while high satisfaction with educational activities correlated with improved emotional outcomes. Visual satisfaction scales may serve as practical tools to identify children at risk of heightened anxiety during hospitalization.

KEYWORDS

hospital school, children's disease, curriculum-based activities, well-being, state and trait anxiety

1 Introduction

When a child is hospitalized, his or her family, social, and school routine is altered and interrupted (Capurso et al., 2021). Hospitalization generates mental health disorders in the child, with anxiety being the most common negative response (Godino-Iáñez et al., 2020). The appearance of anxiety in hospitalized children can be influenced by the individual predisposition expressed in the trait, that may favor the generation of a greater or lesser state of anxiety (Muñoz-Violant et al., 2023). Furthermore, the disease itself and the perception of the hospital as a hostile environment act as stressors that generate anxiety in children. Among

the proposed factors would be those related to their environment and factors specific to the disease process, such as having had readmissions in cases of chronic diseases or the type of disease of the children (Kindervaag et al., 2024). To avoid the interruption of the school routine, Hospital School (HS) has as its main aim to ensure the continuity of education of children admitted to the hospital (Arenas Ponsa et al., 2019; Boff et al., 2021; Lizasoain, 2021). The hospitalization of sick children implies that educational activities and teaching methods should be adapted to the real circumstances of the disease and the necessary medical interventions (García-Parra et al., 2021). However, the interventions performed within the framework of the pedagogy developed at the HS also aim to mitigate the physical and psychoemotional disorders and difficulties they experience during hospitalization (Caggiano et al., 2021; Palma Flores et al., 2022). Regarding anxiety, from an educational point of view, a wide range of activities have been implemented in HS to reduce anxiety levels. Among the proposed practices, play activities, animal companionship, and artistic-expressive activities, such as music or theatrical performances, have been described (Hen, 2023; Ludgério et al., 2023; Maagerø et al., 2023; Padila et al., 2022; Sáez and Chico, 2021; Vollmer and Koppen, 2021; Sextou, 2022). In addition to these activities, specific tasks are carried out in the HS that work on the school curriculum and ensure continuity of learning for the return to their usual environment.

In the present study, we will focus on the educational activities carried out in the HS that are based on the development of the school curriculum. Different authors have suggested that activities developed in the HS can have a positive effect on the emotional state of hospitalized children (Bastidas-Rivera et al., 2023; Gútiérrez Cuevas and Muñoz Garrido, 2021). However, little evidence obtained from empirical studies can be found regarding the impact that these educational interventions may have, not only on the anxiety state associated with the disease and hospitalization, but also on children's coping capacity during adverse situations. Furthermore, the assessment of trait and state anxiety would provide a more comprehensive view of the possible modulation that the activities carried out in HS could have on the children's mental health state (Boff et al., 2021). On the other hand, given that other factors could be involved in the emotional changes of hospitalized children, it would be interesting to evaluate to what extent these factors influence the ability to cope with adversity and the anxiety of these children. This accomplishment would make possible the detection of high-risk situations and the implementation of specific actions (Barnett et al., 2023).

Considering all the above, the purpose of the study is to examine whether curriculum-based activities conducted in the hospital school have a positive effect on the state and trait anxiety levels of hospitalized children. To address this purpose, the following research questions have been posed:

1. What are the baseline levels of state and trait anxiety in hospitalized children upon admission, and to what extent are these levels influenced by illness-related and hospitalization-related variables?
2. How do hospitalized children perceive and evaluate the curriculum-based educational activities provided by the hospital school in terms of satisfaction?
3. What changes in state and trait anxiety are observed in hospitalized children at the time of discharge, following participation in hospital school activities?
4. Do curriculum-based activities implemented in the hospital school contribute to the reduction of anxiety levels in hospitalized children, when controlling for other clinical and contextual variables?

5. Which variables serve as potential predictors of anxiety evolution during hospital school attendance, and how might these inform the early identification of children at risk for adverse emotional outcomes?

2 Methods

This study is included in the research project on Emotions, Anxiety, and Resilience in the Hospital School Classroom developed at the University Hospital Virgen del Rocío of Seville (Spain). Part of the cohort of the present study, who followed similar protocols, has been included in a previous study on resilience and hospital schooling activities (Padillo-Andicoberry et al., 2025).

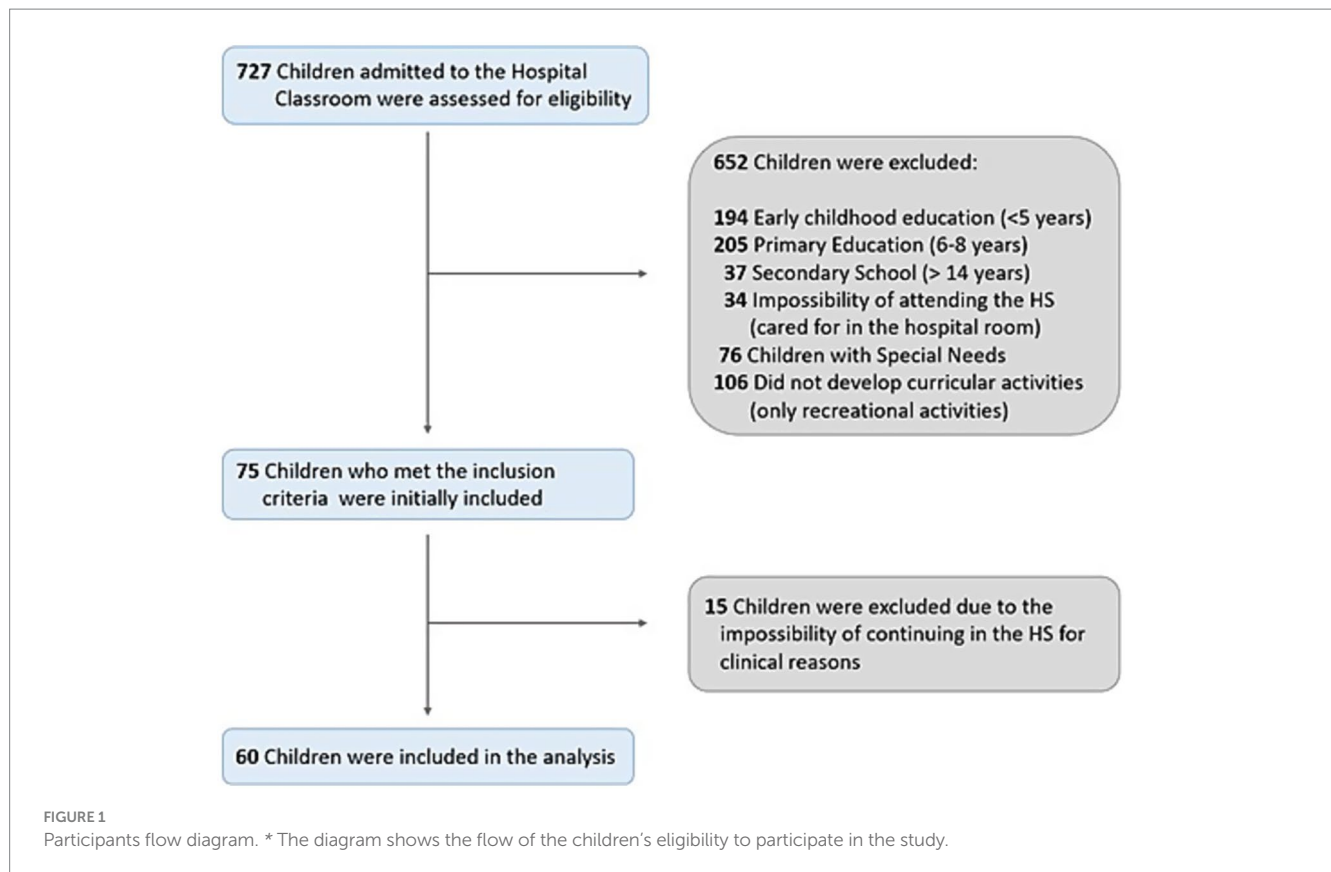
2.1 Participant: demographic description

To achieve the stated questions, a prospective pretest-posttest study in an intervention group (McMillan and Schumacher, 2005) without a control group was carried out in the HS of a University Hospital. To participate in the study, informed consent was requested from the families. Once the child had been properly informed about the procedure in an age-appropriate and comprehensible manner, the informed consent was signed by their parents. The study was approved by the Ethics Committee of the University Hospital on December 2, 2022 (reference code: 2002-N-22). Exclusion criteria included children under 9 years and above 14 years, those with special needs, non-authorization by parents, the patient's unwillingness due to emotional state, and medical reasons that made attendance at the HS impossible.

Sixty children admitted to the hospital who attended the hospital school were included (36 girls and 24 boys). The complete participant flow chart of the study is presented in Figure 1. The sociodemographic characteristics of the participants are presented in Table 1. The age of the children ranged between 9 and 14 years (mean age 11.6 years (SD: 2.6), without significant differences between the girls and boys). For 42 children (68%), it was their first admission, while the remaining 18 (32%) had already had previous hospital experiences with a median of two admissions (IQR 1–3). Forty-five (75%) were considered to have an acute illness, and 15 (25%) were considered to have a chronic disease. Thirty-four children (57%) presented diseases that required medical treatment, and the remaining 26 children (43%) required a surgical approach. The median hospital stay was 9 days (IQR 6–15) without differences between the types of required treatment.

2.2 Hospital school program

Firstly, the hospital teachers offer an educational service to establish a relationship with the child newly admitted to the hospital and the family. In the HS, a systematic approach to curricular-based content is followed, based on the academic planning shared by the students' reference schools after the corresponding coordination process. In the case of students with more extended hospitalizations, instruction is delivered in a structured and coherent manner, aligned with their academic year and educational progression. For students with short- or medium-term hospital stays, the educational intervention relies primarily on information provided by families and the students themselves, complemented by an initial assessment of prior knowledge. Curriculum-based activities developed are focused on the development of competencies in Spanish Language, Mathematics, and Sciences, in accordance with the guidelines established



by the students' home schools. Mathematics instruction emphasizes the development of logical reasoning and problem-solving abilities through algorithmic exercises and real-life application problems. A collaborative learning model is encouraged, wherein younger students solve simpler tasks that generate data required by older peers to complete more advanced problems, thereby fostering inter-age cooperation. Spanish Language sessions are designed to promote reading comprehension, vocabulary expansion, grammatical awareness, and written expression. Students participate in story workshops where they reinterpret traditional tales, integrating visual components and designing language games such as word searches and crosswords. Additional activities include the creation of infographics and syntactic exercises that reinforce text structure and sentence coherence. Science instruction is contextualized through students' lived experiences with illness, which enhances the relevance and applicability of the content. Lessons address the nature and effects of viruses and bacteria on the human body, along with the importance of healthy habits such as proper nutrition and hygiene. Furthermore, students explore the functions of body systems through interactive platforms like *Body Planet*, which promote active engagement and deeper understanding. The families do not attend the HS to foster children's autonomy and to encourage their collaboration with the teachers without interference. The program, which was developed by three teachers and an assistant, also includes projects with institutions outside the hospital.

2.3 Study protocol

Firstly, when a child was considered a candidate to be admitted to the hospital, teachers received information about his or her possible

admission. Upon admission to the hospital school, children fill out a form to collect personal data and information about their curriculum level and activities they are doing in regular school. This allowed teachers to prepare educational activities. Afterward, children completed the anxiety assessment scale (STAIC). On the second day, the children were integrated into the hospital school's regular activities. School attendance was three hours daily. During this time, children performed educational activities according to their level and academic year. Finally, an adapted Likert-based visual scale about the developed educational activities was repeatedly applied during the HS attendance, and the average of the obtained values was used for the analyses. In addition, before discharge from the hospital, the STAIC is re-administered to the children. The STAIC assessments were performed on routine days at the HS, independently of the medical procedures.

2.4 Measures

To achieve the set questions, the following instruments were used:

Anxiety evaluation: The State-Trait Anxiety Inventory for Children (STAIC) (Spielberger et al., 1971; Spielberger et al., 2023) was applied for the anxiety assessment. The scale includes two independent scales to measure two types of anxiety: state and trait anxiety. State anxiety is related to transitory anxiety caused by an experience at the moment of the assessment or associated with a specific situation. For state anxiety evaluation, the scale includes 20 items with which the child can express "how he or she feels at a certain moment" with three response options that refer to the intensity of the feeling (1, not at all; 2, somewhat; 3, a lot). On the other hand, trait

TABLE 1 Demographic description of the study cohort.

Variables	Overall	Girls	Boys	Mean/median diff. (95% CI)	<i>p</i> -value
				RR (95% CI)	
Age (years) [mean (SD)]	11.6 (2.6)	12.1 (2.1)	11.0 (1.7)	−1.1 (−2.3–0.2)	0.091
Number of readmissions [median (IQR)]*	2 (1–3)	2 (1–4)	3 (1)*	0 (−2–2)	0.922
Type of admission [<i>n</i> (%)]					
First admission	42 (68.0)	23 (63.9)	19 (79.1)	0.39 (0.13–1.17)	0.103
Readmission	18 (32.0)	13 (36.1)	5 (20.9)		
Length of hospital stay (days) [Median (IQR)]	9 (6–15)	10 (4–16)	9 (6–15)	0 (−4–3)	0.896
Length of HS attendance (days) [Median (IQR)]	6 (2 to 9)	4 (2–10)	6 (2–11)	0 (−2–4)	0.766
Type of disease [<i>n</i> (%)]					
Acute	45 (75.0)	26 (72.2)	19 (79.1)	0.63 (0.19–2.10)	0.494
Chronic	15 (25.0)	10 (27.8)	5 (20.9)		
Type of treatment [<i>n</i> (%)]					
Medical	34 (57.0)	18 (50.0)	16 (66.6)	0.39 (0.16 to 0.98)	0.033
Surgical	26 (43.0)	18 (50.0)	8 (33.4)		

*Among those who had a previous admission.

In bold *p* value < 0.05.

anxiety refers to the child's tendency to experience anxiety consistently, which is also referred to as anxiety rate. The trait anxiety scale also consists of 20 items with which the child can indicate "how he or she feels in general" by choosing one of three response alternatives that are related to the frequency of presentation (1, almost never; 2, sometimes; 3, sometimes slight).

The first validation of this scale in the Spanish language was carried out in children aged 9 to 15 years (Seisdedos, 1990). Later on, another study was carried out on 2,600 children, including both genders aged 8 to 15 years, obtaining a Cronbach's Alpha index of 0.855 for state anxiety and 0.816 for trait anxiety (Cespedes, 2015).

Assessment of perception of the curriculum-based activities developed in the hospital school: An adapted Likert-based visual scale was used for the assessment of educational activities (Salam and Ismail, 2015) with five response options and a score ranging from 1 to 5, where one means completely disagree and five means completely agree. A score higher than 3 points was considered a positive assessment of the activities. Activities in the areas of Spanish Language, Mathematics, and Science were evaluated, analyzing two dimensions: "I enjoyed learning the lesson" and "This lesson has helped me not worry about my stay in the hospital."

2.5 Variables

The main dependent variables analyzed were state and trait anxiety of the hospitalized children who attended the HS. The independent operationally variable was the perception of children's satisfaction with the educational activities developed at the HS and its impact on anxiety. An additional essential independent, non-operational variable that could influence the results at discharge is baseline anxiety state. Complementary variables were age, gender, type of disease, treatment required, whether it was the first admission or readmission, the hospital stay, and the days

of HS attendance. Specific variables related to the clinical evolution of children were not included. Unfortunately, teachers in the HS do not have access to specific details of the children's daily clinical situation (fever, pain, complications, etc.). When doctors or nurses determine that children cannot attend the HS, they inform the teachers. Attendance at the HS itself indicates that the child is in adequate condition and is making positive clinical progress. The only indirect data we were able to collect regarding the progression of the illness were the number of days attended at the HS and the length of the hospital stay.

2.6 Data analysis

Data analysis was performed in the overall sample of 60 children who attended the HS. The normal distribution of the values was obtained. The quantitative variables have been expressed as mean and standard deviation (SD) or as median and interquartile range (IQR) according to the normality of the distribution. The Shapiro-Wilk test was employed to evaluate the normality of quantitative variables.

To achieve the first research question, related to determining whether gender, previous admissions, or the type of disease were associated with anxiety upon admission, an unpaired Student's *t*-test was performed for variables with normal distributions among groups. Otherwise, when the requirement of normal distribution was not met, a Mann-Whitney *U*-test was performed. The median difference was calculated according to the Hodges-Lehmann estimator. Cohen's *d* was calculated to determine the effect sizes. Additionally, these tests were also employed to determine possible associations between the same parameters and the values of the Likert-based visual scale that will be included in the second research question. The correlation between continuous variables was calculated using the Pearson correlation coefficient. To analyze the variations in the state and trait anxiety during the hospitalization included in the third research

question, a paired Student's *t*-test was used to compare the values of each dimension at admission and discharge. The mean difference and its 95% confidence interval (CI) were calculated as magnitude measures.

To achieve the fourth research question, first, a comparison between STAIC and Likert-based scales after dichotomization based on the median value was implemented. Then, a mixed ANOVA was performed to assess the association between changes in STAIC scores from admission to discharge and independent variables. To evaluate the variation in STAIC scales from the first assessment at admission in the HS to the end of this attendance, a variable named Δ STAIC was established. The variable Δ STAIC was defined as: Δ STAIC = Discharge STAIC–Admission STAIC. Independent variables included were gender, age, days of HS attendance, and Likert scale scores. These variables were dichotomized at their median values and were included in the model as within and between-subject factors. Finally, to achieve predicting factors for the trait and state anxiety evolution during HS attendance, variables were dichotomized based on the median value. The dichotomized variables were then tested for statistically significant associations using Fisher's exact test. For significant associations, a Receiver Operating Characteristic curve (ROC) analysis was conducted to calculate the Area Under Curve (AUC), and the cut-off value was selected according to the Youden index. Additionally, sensibility and specificity for predicting STAIC evolution after attendance at HS were calculated. Results were considered statistically significant when the *p* (probability) value was <0.05. Statistical analysis was performed using SPSS 26 for Windows (SPSS Inc., Chicago, IL, United States).

To achieve enough sample size, a power analysis was conducted to estimate the change in STAIC percentiles before and after the intervention. Assuming a significance level of $\alpha = 0.05$, a minimum

expected difference of 15 percentiles, a common standard deviation of 30, and a correlation of at least 0.5 between pre- and post-intervention STAIC scores, the resulting statistical power was 88.56%. This value was deemed adequate for the objectives of the study.

3 Results

3.1 Assessment of anxiety at admission to the hospital school

Assessment of trait anxiety: Upon entering the HS, the median trait anxiety raw score and percentile of the children included in the cohort were 30 (26–34) and 30th (IQR: 5–41), with no differences between genders. No differences were observed according to children's type of illness (acute or chronic), nor according to whether they required medical or surgical treatment. However, children with previous admissions presented higher trait anxiety profiles ($p = 0.005$) (Table 2).

Assessment of anxiety state: The studied cohort presented a median raw score and percentile of 32 (IQR: 26–40) and 70th (IQR: 20–90), respectively, for anxiety state. Children with higher trait anxiety entered HS with higher state anxiety ($r = 0.363$; $p = 0.004$). Although the predisposition to anxiety shown in the measurement of trait anxiety was low, the anxiety state upon admission to the HS was significantly elevated in comparison to the trait (percentile 70th vs. 30th; $p = 0.001$). As observed with trait anxiety, there were no differences in state anxiety between the genders according to the type of illness the children had or whether they required medical or surgical treatment. Again, children who had had previous hospital admissions had a significantly higher anxiety state ($p = 0.008$) (Table 2).

TABLE 2 Assessment of state and trait anxiety at admission to the HS by mean of the STAIC scale.

STAIC scale	Assessed variables		Raw scores Median (IQR)	Percentiles Median (IQR)	Median diff. (95% CI)	Cohen's <i>d</i>	<i>p</i> -value
Trait anxiety (percentile)	Gender	Girl	31 (26–37)	30 (5–58)	–4 (–20–15)	0.29	0.441
		Boy	30 (24–32)	30 (4–40)			
	Type of disease	Acute	30 (25–32)	28 (5–40)	–4 (–35–12)		0.570
		Chronic	34 (26–41)	33 (5–78)		0.30	
	Number of admissions	1st admission	28 (25–31)	15 (3–35)	–30 (–45––8)	1.04	0.005
		Readmissions	35 (31–42)	43 (28–85)			
	Type of treatment	Medical	30 (25–34)	30 (5–45)	0 (–10–20)	0.08	0.909
		Surgical	29 (26–34)	25 (10–40)			
State anxiety (percentile)	Gender	Girl	34 (28–41)	80 (50–94)	17 (–5–50)	0.54	0.169
		Boy	26 (25–36)	25 (18–85)			
	Type of disease	Acute	32 (25–40)	68 (21–90)		0.01	0.965
		Chronic	34 (26–40)	75 (15–92)	0 (–24–20)		
	Number of admissions	1st admission	29 (25–37)	50 (15–90)	–31 (–65––4)	1.03	0.008
		Readmissions	39 (34–45)	90 (74–97)			
	Type of treatment	Medical	31 (25–41)	60 (20–90)			0.385
		Surgical	33 (26–40)	75 (20–95)	–5 (–35–7)	0.30	

In bold *p* value < 0.05.

3.2 Process-related findings: assessment of children's satisfaction with curriculum-based activities developed in the HS

The median HS attendance was 6 days (IQR 2–9 days). Most of the children were able to complete the established educational activities. Only in one case was curricular adaptation necessary.

In the evaluation of these activities using the Likert-based visual scale, 82% of the children rated the activities developed at the HS positively, considering that they enjoyed them (median 4.0 out of 5 points; IQR 3.6–4.4). Similarly, 90% of the children perceived that the HS lessons helped them to cope with the hospital experience (median 4.0 out of 5 points; IQR 3.3–4.7). Additionally, the results related to activity satisfaction according to gender, type of disease, number of admissions, and type of treatment required are presented in Table 3. There were no significant differences between the groups compared.

The children who most enjoyed the educational activities perceived that the activities helped them not to worry about their illness and their hospital stay, with a strong correlation ($r = 0.78$; $p < 0.001$). However, no correlations were found between the trait or state anxiety that the children had at admission and satisfaction with the educational activities assessed in the HS.

3.3 Assessment of anxiety post-hospital school intervention

After HS intervention and before hospital discharge, median trait anxiety was significantly reduced ($p = 0.007$, median difference -6 [95% CI: -13.0 – 0.0]; Cohen's $d = 0.44$) (Figure 2). In contrast to what was observed at baseline assessment, the values of trait anxiety at discharge were similar in children with and without previous admissions (Table 4).

The discharge anxiety state of hospitalized children was also significantly reduced compared to admission ($p = 0.001$, median difference -33 [95% CI: -41.5 – -22.5], Cohen's $d = 1.04$) (Figure 2). In the discharge assessment, the children with the highest anxiety state were still those with previous admissions (30 (18–76) vs. 10 (5–25); $p = 0.037$, Cohen's $d = 0.81$), as observed upon hospital admission (Table 4).

3.4 Factors associated with anxiety evolution during HS attendance

To address the fourth research question, first, a comparison between STAIC and Likert-based visual scales after dichotomization based on the median values (Table 5), and then an ANOVA test was performed.

Regarding trait anxiety, children who enjoyed the activities in the HS more (with higher scores on the Likert-based scale) showed a greater decrease in trait anxiety upon discharge ($p = 0.016$). However, no differences were observed in the children's perception that the activities helped them avoid worry (Table 5). Additionally, the ANOVA test showed that children with previous admissions ($p = 0.008$) and those who were in HS for more than 6 days ($p = 0.035$) had a greater reduction in trait anxiety (Table 6).

In the comparative study conducted between state anxiety at discharge and the assessment of activities performed in the HS, children with higher scores on the Likert-based scale again had lower state anxiety at discharge ($p = 0.015$) (Table 5). Analysis by ANOVA test showed, as in trait anxiety, an association between previous admissions and reduction of anxiety state ($p = 0.002$) (Table 7).

3.5 Factors predicting anxiety evolution during HS attendance

To assess possible predictors of trait anxiety development during HS care, a ROC analysis was conducted. The analysis showed that children who enjoyed HS activities, with Likert-based scale scores equal to or greater than 3.3, were more likely to experience a reduction in trait anxiety, with a sensitivity of 93.9% and a specificity of 55.6% (AUC 0.815; 95% CI: 0.672–0.957; $p = 0.004$) (Figure 3).

Similarly, when conducting the predictive model for state anxiety, the evaluation of the perception of the activities performed in the HS using the Likert-based visual scale obtained significance. The optimal cutoff point on the Likert-based scale was 4.3 points. The sensitivity for predicting the impact on state anxiety at discharge from the responses reflected on the Likert scale was lower than in the trait analysis (55.0%), but the specificity was significantly higher (81.8%). However, the overall model did not reach statistical significance.

TABLE 3 Assessment of curriculum-based activities satisfaction by means of the adapted Likert visual scale.

Variables		Enjoyment* [median (IQR)]	Median diff. (95% CI)	<i>p</i> -value	Usefulness [median (IQR)]	Median diff. (95% CI)	<i>p</i> -value
Gender	Girl	3.9 (3.4–4.3)	0.3 (–0.2–0.7)	0.231	4.0 (3.3–4.8)	0.2 (–0.3–0.7)	0.433
	Boy	4.0 (3.7–4.7)			4.3 (3.5–4.8)		
Type of disease	Acute	4.0 (3.7–4.6)	0.3 (0.0–1.0)	0.146	4.1 (3.4–4.8)	0.2 (–0.5–0.8)	0.440
	Chronic	3.7 (3.3–4.0)			4.0 (3.2–4.6)		
Number of admissions	1st admission	4.0 (3.3–4.7)	0.0 (–0.5–0.4)	0.946	4.3 (3.7–4.8)	0.3 (–0.3–0.8)	0.362
	Readmission	4.0 (3.7–4.4)			4.0 (3.3–4.6)		
Type of Treatment	Medical	4.3 (3.7–4.7)	0.4 (0.0–0.8)	0.073	4.3 (3.3–4.7)	0.1 (–0.3–0.7)	0.658
	Surgical	3.8 (3.3–4.0)			4.0 (3.3–4.8)		

* Enjoyment: "I enjoyed learning the lesson." Usefulness: "This lesson has helped me not worry about my stay in the hospital."

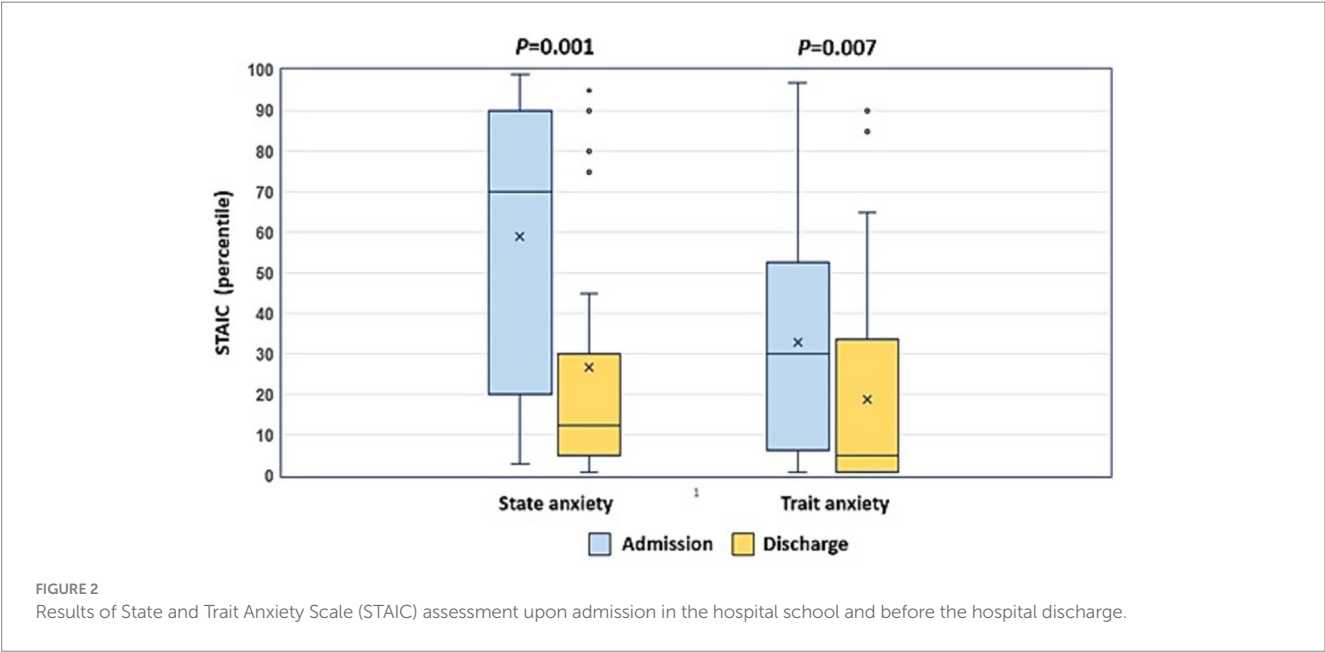


TABLE 4 Assessment of state and trait anxiety at discharge by mean of the STAIC scale.

STAIC scale	Assessed variables		Raw scores Median (IQR)	Percentiles Median (IQR)	Median diff. (95% CI)	Cohen's <i>d</i>	<i>p</i> -value
Trait anxiety (percentile)	Gender	Girl	27 (24–34)	10 (3–40)	1 (–7–10)	0.23	0.561
		Boy	27 (22–32)	10 (1–33)			
	Type of disease	Acute	27 (22–32)	8 (1–39)	–1 (–20–9)	0.13	0.551
		Chronic	27 (25–35)	10 (3–41)			
	Number of admissions	1st admission	26 (22–32)	5 (1–35)	–4 (–29–2)	0.52	0.167
		Readmissions	29 (24–39)	18 (3–66)			
	Type of treatment	Medical	27 (22–33)	10 (1–35)		0.22	0.899
		Surgical	27 (24–32)	10 (3–40)	0 (–9–9)		
State anxiety (percentile)	Gender	Girl	25 (23–31)	20 (5–60)	5 (–4–21)	0.60	0.440
		Boy	22 (20–27)	10 (4–30)			
	Type of disease	Acute	24 (21–28)	10 (5–29)		0.42	0.192
		Chronic	27 (22–31)	30 (15–52)	–15 (–26–3)		
	Number of admissions	1st admission	23 (21–26)	10 (5–25)	–20 (–40–0)	0.81	0.037
		Readmission	28 (22–34)	30 (18–76)			
	Type of treatment	Medical	24 (20–29)	15 (5–30)		0.19	0.534
		Surgical	25 (22–29)	24 (5–30)	–3 (–17–6)		

In bold *p* value < 0.05.

4 Discussion

This study aimed to assess the state and trait anxiety upon admission and discharge from the HS, as well as to analyze whether the educational activities developed, and other parameters related to the disease and hospitalization could play a role in the evolution of anxiety in children.

Regarding to the first research question related to the anxiety assessment at admission in the HS, hospitalized children presented a state of anxiety with a percentile of 70th. This percentile, does not necessarily

indicate a clinical problem, but it does suggest that the children may be experiencing higher than expected levels of anxiety, interpreting this data as an average level within the range without clinical significance. By describing the cohort of children in our study upon arrival at the HS, we could define them as a group of children who, although they had an acceptable coping capacity in adverse situations in the assessment of trait anxiety, presented a higher state of anxiety that could be attributable to their illness, as previously described. Children with more accentuated trait anxiety react with greater stress to the experiences they must face on a daily basis. Therefore, when high trait anxiety is detected, it should

TABLE 5 Comparison between STAIC and Likert-based scales after dichotomization based on the median value.

Variables		Enjoyment ≥4	p-value	Usefulness* ≥4	p-value
Trait anxiety					
At admission	<30	8 (33.3)	0.480	10 (41.7)	0.281
	≥30	7 (38.9)		10 (55.6)	
At discharge	<10	11 (44.0)	0.207	12 (48.0)	1.000
	≥10	4 (23.5)		8 (47.1)	
Trait ΔSTAIC	<0	15 (45.5)	0.016	17 (51.5)	0.460
	≥0	0 (0.0)		3 (33.3)	
State anxiety					
At admission	<70	10 (43.5)	0.337	11 (47.8)	0.610
	≥70	5 (26.3)		9 (47.4)	
At discharge	<15	11 (55.0)	0.015	12 (60.0)	0.216
	≥15	4 (18.2)		8 (36.4)	
State ΔSTAIC	<−30	5 (23.8)	0.197	9 (42.9)	0.758
	≥−30	10 (47.6)		11 (52.4)	

*Enjoyment: "I enjoyed learning the lesson." Usefulness: "This lesson has helped me not worry about my stay in the hospital." Δ STAIC = variation of STAIC scale from admission to discharge. Values are represented as mean (SD). In bold *p* value < 0.05.

TABLE 6 ANOVA test to evaluate factors associated with trait anxiety evolution after HS attendance.

Variable	<i>p</i> -value	
	Within-subjects	Between-subjects
Gender	0.763	0.385
Age ≥ 11 years	0.798	0.796
Readmission	0.060	0.008
Length of HS attendance ≥ 6 days	0.546	0.035
Likert—enjoyment ≥ 4	0.281	0.620
Likert—usefulness ≥ 4	0.350	0.993

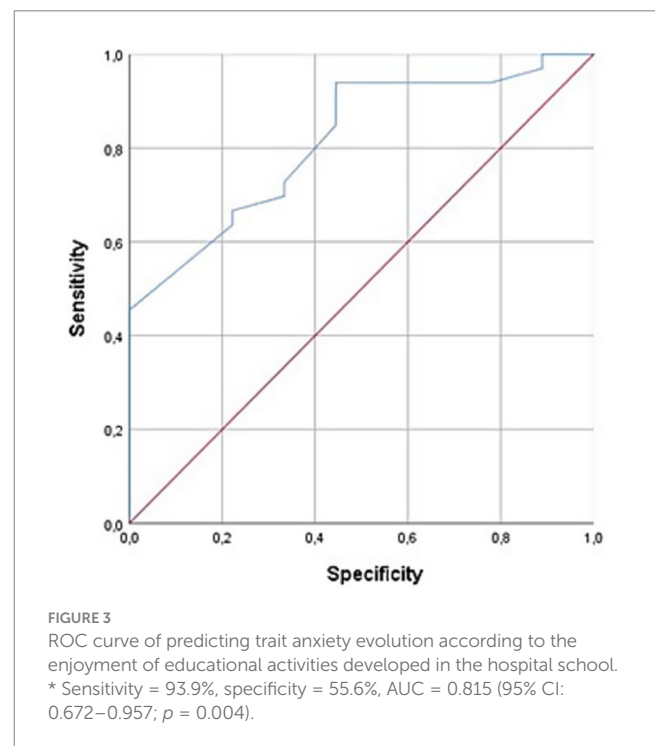
In bold *p* value < 0.05.

TABLE 7 ANOVA test to evaluate factors associated with state anxiety evolution after HS attendance.

Variable	<i>p</i> -value	
	Within-subjects	Between-subjects
Gender (girl)	0.757	0.050
Age ≥ 11 years	0.508	0.785
Readmission	0.410	0.002
Length of HS attendance ≥ 6 days	0.168	0.463
Likert—enjoyment ≥ 4	0.390	0.238
Likert—usefulness ≥ 4	0.406	0.242

In bold *p* value < 0.05.

be recognized as a vulnerability in children (Al-Yateem and Rossiter, 2017). This vulnerability can be exacerbated in more complex and exceptional situations, such as hospitalization. Hence, trait anxiety may play an important role in the child's response to hospitalization. This has been observed in the present study, in which children who presented a



more marked trait anxiety upon admission to the hospital faced the experience of hospitalization with a significantly higher state of anxiety. Regarding potential factors that could modulate anxiety under the frame of hospitalization, it has been classically considered that surgical interventions may entail a greater stress load and therefore anxiety (Celik and Sahiner, 2024; López-García et al., 2021). However, no studies have been found that explicitly compare both therapeutic options. In our study, children who attended HS with conditions requiring surgical intervention presented similar levels of anxiety to those who required medical treatment. On the other hand, it could also be interesting to evaluate whether children with acute illnesses present differences in their coping

or state of anxiety compared to those suffering from chronic processes. Whereas in some studies mild or severe chronic disease is associated with emotional changes (Daughtrey et al., 2024), other authors, as observed in our study, did not find differences (Meentken et al., 2021) considering that chronic diseases have probably had an adaptation that makes them face crisis episodes in a similar way to those in whom the perception of disease is new. Finally, other potential factors that might influence emotional status include the socioeconomic environment, family support, and cultural context in children. In this sense, Ahmadipour et al. (2022) considered that the most severe anxiety observed at admission in girls could be related to family support, cultural, and socioeconomic factors. In the present study, these socioeconomic, cultural, and family factors were not evaluated.

According to our second research question, we assessed the degree of satisfaction among children with the curriculum-based activities performed in the HS. Children enjoyed the activities carried out in the HS and perceived that the educational activities helped them cope with their illness and hospital stay. This can be justified based on the Normalization Principle (Benigno and Fante, 2020), which considers that the HS provides hospitalized children with a structure of continuity in relation to the usual work environment of regular school and their daily routine. In addition to the positive effect of the environment, various authors suggest that Hospital Pedagogy (Violant-Holz et al., 2022) can be a valuable resource for promoting the child's psychoeducational well-being. Certainly, educational activities can be considered a strategy to influence coping skills. In fact, well-planned and developed activities have been proposed in this context to strengthen the coping skills of hospitalized children (García-Parra et al., 2021). These educational activities can be based, among others, on distraction (Lawrence and Lazer, 2024; Naina and Pooja, 2023), modeling techniques (Van Dijk, 2017), information reception (Nicholas and Chahauver, 2017), the specific development of cognitive skills (de Jong et al., 2020), or in strategies for illness acceptance (Barash et al., 2023).

The third research question of the study was to analyze the evolution of the children's state and trait anxiety after the HS intervention. According to what was observed, the anxiety state of the children included in the study decreased significantly, with a 30% reduction. This result has also been observed by other authors, who associate the improvement of the anxiety state in this context with the fact that it is a transitory event linked to a specific negative experience (Saviola et al., 2020). Regarding the assessment of trait anxiety, our study also found significant improvement in children's emotional management with values around the 10th percentile upon discharge from the hospital. However, other studies, such as that of Delvecchio et al. (2019), differ from ours, and the trait is considered a structural component of anxiety. Nevertheless, our findings are aligned with the randomized study by Zamani et al. (2022), who observed that after an intervention in the school through digital media, not only the state but also the trait decreased. This evolution is very important because, according to De Mula-Fuentes et al. (2018), the trait would constitute a predisposition of the individual to perceive environmental circumstances as threatening. Hence, a decrease in the levels of trait anxiety could reduce the predisposition to negative reactions and facilitate the reincorporation of children into their usual educational context.

In order to achieve the fourth research question, actions carried out in the HS aim to ensure educational continuity for children and, at the same time, attempt to emotionally strengthen children who

need it to cope with the fear and anxiety caused by illness and hospitalization (Dinç et al., 2023). However, there are few quantitative studies evaluating the potential role of educational activities carried out in HS in improving children's anxiety. Recently, Ciucci et al. (2024) published an experimental study assessing lessons taught in HS and as a tool for improving the emotions, distress, and pain of hospitalized children, observing very positive results. However, this study does not focus on the specific context of anxiety, which, as previously mentioned, is the most common adverse reaction. The potential impact of activities developed in the HS on anxiety could be explained by the fact that most of the educational activities carried out in hospital teaching units are familiar to hospitalized children and young people, as they are a common practice in schools (voáin, 2021). Along this strategy, Owens et al. (2012) observed that performing memory exercises positively modulated trait anxiety and academic performance in a small sample of 31 children aged 12 to 13. This preliminary work was expanded in a subsequent study conducted by Sarah et al. (2021) in a larger group of 174 children. According to these authors, our study's findings are relevant because the curriculum-based activities carried out in the HS have not only reduced anxiety but also modulated children's predisposition to negatively manage emotions that may have arisen during their hospital stay. As previously mentioned, this finding is important because it would reduce the risk of adverse reactions and contribute to children's better adaptation upon returning to their usual educational environment (De Mula-Fuentes et al., 2018).

Finally, according to the fifth research question, we first evaluated the potential factors that could play a role in the evolution of state and trait anxiety during hospitalization. Only previous admissions had any influence on this evolution. Thus, the children who had had previous experiences in the hospital were those who registered a greater decrease in both state and trait anxiety. As previously mentioned, these were the children who were more anxious on admission and possibly those who could have benefited most from the curriculum-based activities developed in the HS, as will be discussed later. Once children are admitted to the hospital, the course of their illness itself should be a key factor in improving anxiety. As commented in the Methods section, the teachers of the HS do not have access to specific data on clinical progress. Authorization by doctors and nurses for children to attend the HS in itself implies favorable outcomes. The only indirect data available to assess the children's progress were the number of days they attended the HS and the length of their hospital stay. Based on the above premises, theoretically, attendance at the HS could be interpreted as an indirect sign of good progress on each day, and the length of stay in the hospital could potentially be a negative indicator. Furthermore, a very important factor to consider, which can negatively affect children's anxiety, is the length of hospital stay (Daughtrey et al., 2024). However, in our study, the days of hospital stay were not associated with worsening anxiety in the children. This can be explained by Van Dijk (2017) postulation, which expresses that the negative impact of longer hospital stays can be mitigated by maintaining during hospitalization actions that could generate positive stimuli in children to improve emotional well-being, despite maintaining the circumstances that can destabilize them. This was found in our study, in which we observed that children with a stay in the HS of more than 6 days presented a greater decrease in trait anxiety. The best scenario for hospitalized children is that they recover as soon as possible and can be discharged from the hospital with the shortest possible stay. However, for those who require more days of hospitalization, we again highlight the association between the number

of days of attendance at the HS and this modulation of trait anxiety. This makes us emphasize the importance of promoting and facilitating that, during hospitalization, children attend the HS continuously, as long as their process allows it. In addition, the Likert-based scale measuring enjoyment of HS activities proved to be a valuable predictor of reductions in trait anxiety, yielding an area under the curve (AUC) greater than 0.8. The cut-off score identified (3.3) demonstrated high sensitivity—exceeding 90%—which is particularly useful for teachers to identify children who are less likely to experience improvements in trait anxiety, as it minimizes the probability of false negatives. Thus, would allow the teachers to identify children at greater risk of emotional fragility when facing discharge from the hospital. Once again, the multidisciplinary work of all participants involved in the children's care would be essential for children to leave the hospital in the best physical and emotional condition.

Implications: if the results shown in the present study are confirmed in larger sample size studies, a multidisciplinary strategy could be proposed that would include a systematic assessment of state and trait anxiety upon arrival at HS to identify those children at greater risk. Afterward, the strategy would also include indirect monitoring of their emotional state during their days at the HS by assessing their perceptions of the activities carried out there. The creation of programs aimed at monitoring children's assessments of educational activities carried out in the HS can guide teachers and professionals in identifying children with greater psychoeducational needs and those who require special intervention to strengthen their emotional state. This would bring the hospital teacher in line with contemporary pedagogical thinking, which proposes that all children be cared for holistically.

Limitations: To achieve the most scientific evidence, it would be worth considering whether it would be feasible to have a control group through a quasi-experimental or randomized study. Although these types of studies have been conducted with recreational and educational activities such as games, artistic activities, or activities with animals, in the case of the current study, activities that develop the curriculum should not be eliminated from the work carried out in the control group, since access to education is a right of all children. Regulations prevent a group of students from being deprived of classes that would allow them to maintain their educational development. Therefore, children were compared with themselves in a before-and-after study. On the other hand, this study did not include aspects such as family support or cultural and socioeconomic environment, that could be considered another limitation. Due to the fact that these factors could influence not only the baseline anxiety status but also the response to the intervention at HS, these factors should be addressed in future research to complement the analysis conducted. Finally, the limited sample size could also be considered a limitation. However, the inclusion of children in HS studies is more complex than in other educational settings. The physical health state of children and the psychological state of both the children and their parents, family, and caregivers often make it difficult to include these children in experimental studies. For future studies, to increase the number of children, a multicenter trial could be necessary.

5 Conclusion

The present study aimed to answer the research question of whether educational activities conducted in the HS could influence

the state and trait anxiety of hospitalized children. Firstly, we observed that sick children admitted to the HS presented a medium level of state anxiety and low trait anxiety. Children with higher trait anxiety developed more pronounced state anxiety upon admission to the HS. Moreover, when factors related to the disease were analyzed, only prior hospitalizations were associated with greater anxiety among children upon arrival at the hospital. When analyzing the children's experience, the curriculum-based activities carried out based on the HS were perceived positively by the children, both in terms of enjoyment and the perception that they had helped them not worry about illness and hospitalization. When the factors associated with this improvement were evaluated, none related to the illness itself were associated with the positive changes observed in state and trait anxiety. On the contrary, the positive perception of the educational activities carried out in the HS was associated with an improvement in state and, above all, in trait anxiety. Finally, from a practical perspective, the assessment by HS teachers of children's perceptions of the curriculum-based activities they made can provide information for identifying children at greater risk of not improving their coping skills in the face of adversity and, therefore, at greater risk of maintaining their anxiety.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by Ethics Committee of the University Hospital Virgen del Rocío, Seville, Spain. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

AP-A: Formal analysis, Investigation, Writing – review & editing, Methodology, Conceptualization, Writing – original draft. FD-B: Project administration, Writing – original draft, Conceptualization, Investigation. ES-L: Supervision, Writing – review & editing, Validation. CR-P: Validation, Supervision, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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