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ANXIETY AS A DISTRACTING FACTOR IN CLINICAL SIMULATION: A PRE–POST STUDY IN MEDICAL STUDENTS

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ABSTRACT

Clinical simulation creates a safe space for practicing skills in medical education, but it can also generate strong negative emotions such as anxiety, which can negatively impact learning. Our objective was to determine whether anxiety is a distraction during a high-fidelity clinical simulation. A pre- and post-simulation design was used. A total of 30 eighth-semester medical students participated in an emergency simulation. The State-Trait Anxiety Inventory (STAI) was used to quantify anxiety before and after the simulation. A paired-samples Student's t-test was used to measure anxiety before and after the simulation, along with Cohen's d for effect size and Pearson's correlation ($p < 0.05$). There were no significant differences in anxiety before (23.0 ± 4.24) and after (23.13 ± 4.97) ($t = 0.15$; $p = 0.88$; $d = 0.03$). There was some individual variability, with an increase in negative emotions and a decrease in positive emotions. The change in overall anxiety remained statistically unchanged; however, the simulation revealed some multidimensional aspects of anxiety. Anxiety can persist and either facilitate or hinder learning. There is a clear need to address anxiety in simulation-based education.

KEYWORDS: simulation, anxiety, patient safety, medical education, STAI scale.

INTRODUCTION

Health sciences education has integrated the use of clinical simulation as a means of teaching the skills required for medical practice. It not only protects patient safety but also helps combine theory with real-world practice in a safe, realistic environment (Moslehi et al., 2021; Macnamara et al., 2021). This method aids in the development of the practitioner's clinical competencies, as well as interpersonal and cognitive skills, which include, but are not limited to, decision-making and working under pressure (Ocampo García et al., 2021). That said, students are required to participate in practical simulations and, as a result, often experience strong emotional reactions. This can include anxiety, which is usually the most relevant. Spielberger et al. (2017) and García-Batista et al. (2017) define anxiety as an emotional condition characterized by worry, stress, and physiological arousal. There are two types of anxiety. The first is a state that focuses on the specific aspects of a situation. The other is a trait, which is a more chronic and stable emotional predisposition. This emotional response is quite prevalent in health sciences training due to the ever-increasing demands of academia, clinical responsibility, and the fear of making mistakes (Ahmed et al., 2023). Several studies have shown that students experience increased anxiety during clinical training and in simulated environments. This phenomenon has been shown to have an even greater impact on students with a pre-existing anxiety condition. A large number of students have been reported to experience mild to moderate anxiety during clinical training (Ahmed et al., 2023). Similar studies have shown that students with more severe clinical simulation anxiety have less confidence in their expertise and are more likely to experience performance-related anxiety (Segura Azuara et al., 2020).

Anxiety is a reaction that has been extensively studied in relation to clinical learning and is considered a reaction that can hinder learning and decision-making. In simulation, more intense emotional reactions are associated with a greater mental workload, a loss of emotional control, and/or poorer performance in critical situations such as the sudden death of a simulated patient (Fraser et al., 2021). This suggests that the anxiety experienced by participants is not merely an emotional reaction. Such a response is a cognitive one and modifies the cognitive mechanisms involved in the learning process. Cognitive load theory refers to the degree of mental workload, which is often a critical determinant of tasks and their limitations, and the role of adding mental workload increases the learner's cognitive load. In applications such as surgery and simulation (Dias et al., 2022), studies have shown that when the cognitive load is excessive, mental resources can be depleted to the point where even clinical tasks cannot be performed. In this case, anxiety can function as a cognitive burden. Based on the data above, it can be stated with reasonable certainty that clinical simulation acts as a positive control agent for managing anxiety. Simulation-based training has been found to be an effective method for managing anxiety, building participants' confidence, and improving clinical skills (Yu et al., 2021; Kassabry, 2023). Furthermore, according to the reviewed literature, those who train in augmented reality environments and practice clinical simulation have been found to experience anxiety relief (Pérez de los Cobos Cintas et al., 2025). Each simulation can create different levels of stress for each participating student. Simulations involving instructors in a face-to-face teaching role can increase participants' anxiety levels, while instructors in a supervisory role can create a more relaxed teaching and learning environment (Alhaggas Albaqami & Alharbi, 2025). Factors such as self-efficacy, satisfaction, and the learning environment among health science students have also been significantly related to anxiety (Ahmed et al., 2023; Reed,2022). Anxiety in clinical simulation is multifaceted and varied. While anxiety can enhance learning to some extent, it can also be incredibly counterproductive. Therefore, anxiety in educational settings needs to be well understood, and this can be achieved through pre- and post-tests to measure anxiety levels and determine their relationship to clinical teaching (Reed et al., 2024; Kavakli & Konukbay, 2024).

MATERIALS AND METHODS PARTICIPANTS

Thirty eighth-semester medical students were chosen via non-probabilistic convenience sampling according to availability and participation in clinical simulation educational activities. Inclusion criteria included enrollment in the eighth semester and signing of the informed consent document. Failure to complete all evaluation instruments, and/or non-participation in the simulation scenario, also excluded the participants. The participants were exposed to a high-fidelity clinical simulation scenario set in a medical emergency situation in order to generate conditions that reflect real-life emergencies with a requirement of immediate decisions. For this activity, students were provided with information about the evaluation tool to be used and received personalized feedback afterward about their performance and scores.

DESIGN

Observational, cross-sectional and descriptive study with a quantitative approach, pre-post from July 2025 to November 2025 at the Faculty of Medicine of the University of Manizales-Colombia.

PROCEDURE

A total of 30 volunteer medical students took part in the study. First, the students were trained in emergency care practices to normalize their knowledge. Students then performed a high-fidelity clinical simulation designed to imitate a crisis situation. Before beginning the simulation, participants filled in the State Anxiety Inventory (STAI) to assess the emotional response (anxiety) in the pre-simulation situation. The State Anxiety Inventory (STAI) was administered again after the simulation and before analysis, to measure anxiety levels and components of emotional response. All data were processed to identify patterns of anxiety levels before and after the simulation. STROBE guidelines for observational studies were applied to ensure the transparency of the data collection, analysis and interpretation.

DATA COLLECTION TOOL

Anxiety was measured in the present study using the State-Trait Anxiety Inventory (STAI), one of the most widely used and validated anxiety scales for measuring state anxiety, trait anxiety or both separately across settings (Spielberger et al., 2017). This allows for a form of a differential assessment of anxiety, useful in educational and clinical settings, based on the change in experience of an emotion. The STAI scale conceptualizes two dimensions of anxiety state anxiety and trait anxiety. State anxiety (S/A) is a transitory emotional state associated with tension and a heightened perception of activity, while trait anxiety (T/A) is considered an enduring psychological component within an individual that predisposes them to anxiety across multiple environments (Spielberger et al., 2017; García-Batista et al., 2017). This distinction is particularly salient in clinical simulation studies investigating the modified situational actionability of educational intervention. The scale has two subscales of 20 items each (independently covering state and trait anxiety) which were addressed by 40 questions (Spielberger et al., 2017). Its simplicity and short administration time, together with the scoring process being simple have resulted in its use in research and clinical settings, such as among health science students. Stress and anxiety have been assessed in a variety of studies where the STAI scale was utilized in clinical simulation to assess students within structured teaching activities. This tool has been applied in simulation studies examining anxiety prior to and following an educational intervention, demonstrating appropriateness for pre-post designs while effectively capturing the breadth of feelings experienced during simulation (Alhaggas Albaqami & Alharbi, 2025; Reed, 2022). The STAI scale differentiates between state and trait anxiety, so researchers can accurately assess anxiety in study participants. Design for the State-Anxiety Instrument (STAI) for this study is illustrated by Figure 1 and includes two separate groups of 20 items divided into four distinct categories defined using a Likert scale scoring with range from 0 (no anxiety) to 3 (high anxiety)—with subjects answering these item states to measure state anxiety (Spielberger et al., 2017).

7.5. Inventario de Ansiedad Estado-Rasgo
(State-Trait Anxiety Inventory, STAI)

1

ANSIEDAD-ESTADO

Instrucciones: A continuación encontrará unas frases que se utilizan corrientemente para describirse uno a sí mismo. Lea cada frase y señale la puntuación de 0 a 3 que indique mejor cómo se *siente usted ahora mismo*, en este momento. No hay respuestas buenas ni malas. No emplee demasiado tiempo en cada frase y conteste señalando la respuesta que mejor describa su situación presente.

1. Me siento calmado	0. Nada 2. Bastante	1. Algo 3. Mucho
2. Me siento seguro	0. Nada 2. Bastante	1. Algo 3. Mucho
3. Estoy tenso	0. Nada 2. Bastante	1. Algo 3. Mucho
4. Estoy contrariado	0. Nada 2. Bastante	1. Algo 3. Mucho

Figure 1. Structure of state anxiety measurement using the abbreviated STAI in clinical simulation scenarios

The STAI scale has general applicability in both educational and clinical research for assessing anxiety. It also measures anxiety in both a situational and dispositional manner, which is appropriate for this type of study. As in this study, the state anxiety scale (STAI) can be used to evaluate the effect of clinical simulations on students' emotional responses (Spielberger et al., 2017; García-Batista et al., 2017).

ETHICAL CONSIDERATIONS

This study was approved by the Bioethics Committee of the University of Manizales (registered under record CBE05_2025, signed on May 12, 2025), in accordance with Resolution 8430 of 1993 and classified as minimal risk. All participants read the information, had the opportunity to clarify any doubts, and signed the informed consent.

STATISTICAL ANALYSIS

IBM SPSS Statistics version 22.0 (Statistical Package for the Social Sciences) (IBM Corp., Armonk, New York, USA) was used to analyze the data. Descriptive statistics were obtained for each variable, and results were expressed in terms of means and standard deviations for quantitative variables. Due to the pre–post nature of the study design, the means of the study variables were evaluated using the Student's t-test for paired samples in order to assess the effect of the clinical simulation on participants' anxiety levels. The effect of clinical simulation on anxiety levels was measured using Cohen's d to determine the magnitude of the differences observed. The Pearson correlation coefficient was used to analyze pre- and post-simulation emotional variables and their positive and negative components, in order to determine the direction and strength of their relationships. A statistical significance level of $p < 0.05$ was established for all tests performed.

RESULTS

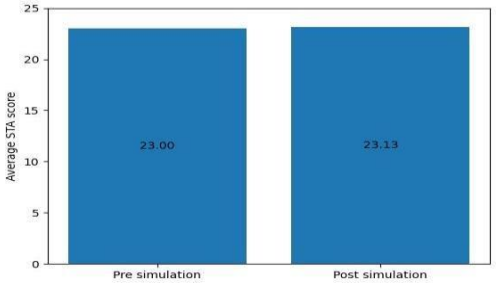

Figure 2. Comparison of mean state anxiety levels before and after the simulation.

Figure 2 shows that the mean state anxiety score before the simulation was 23.0 points (SD= 4.24), and after the simulation it was 23.13 points (SD = 4.97). The paired Student's t-test indicates that the differences were not statistically significant (t = 0.15; p = 0.88). Given that the effect size was small (Cohen's d = 0.03), this suggests that clinical simulation did not have a statistically significant effect on state anxiety levels after the simulation**.**

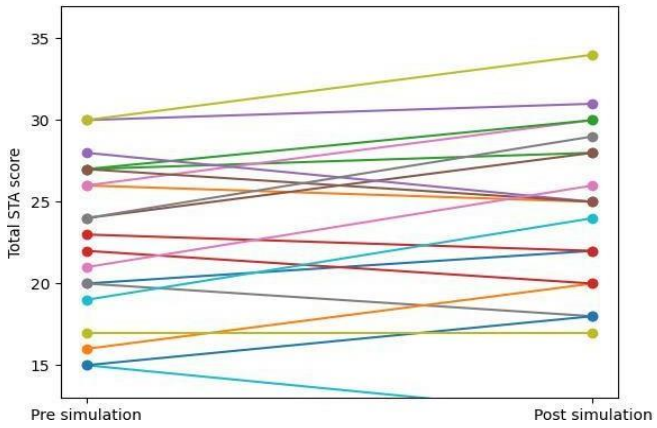

Figure 3. Individual distribution of changes in state anxiety

Figure 3 shows the distribution of individual anxiety scores before and after the simulation. Some individual changes were observed, both decreases and increases, between the pre- and post-measurements. Similarly, some participants showed minimal or no changes.

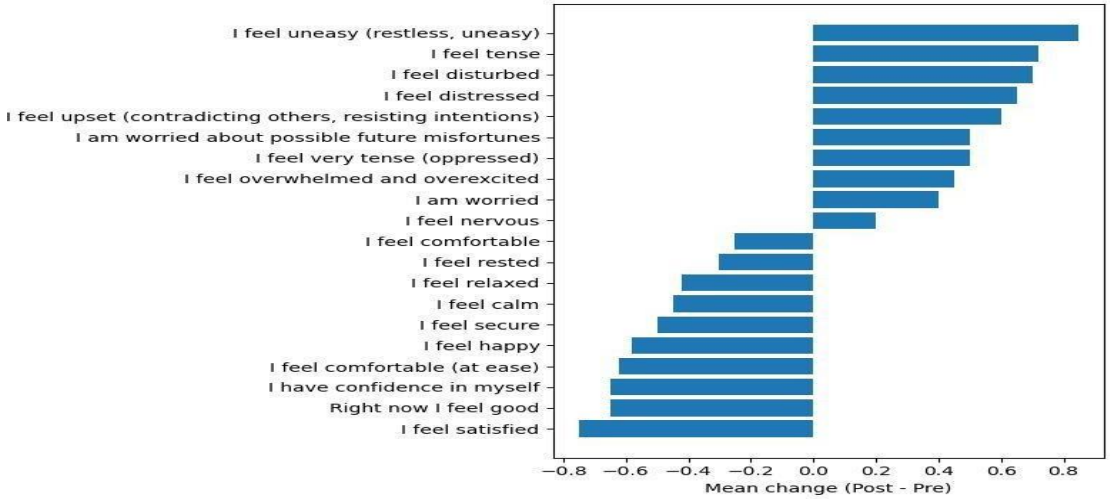

Figure 4. Dominant emotional pattern during the simulation according to the items of the state anxiety scale (STAI)

Figure 4 shows the items of the anxiety scale based on the mean changes calculated from the measurements before and after the simulation. Scores increased more frequently in the items that include the statements: "I feel restless/unsettled," "I feel tense," "I feel upset," "I feel distressed," "I feel troubled," and "I am worried about possible future misfortunes." In contrast, the items "I feel satisfied," "At this moment I feel well," "I feel confident," "I feel comfortable (at ease)," "I feel cheerful," "I feel secure," "I feel calm," and "I feel relaxed" showed decreased scores.

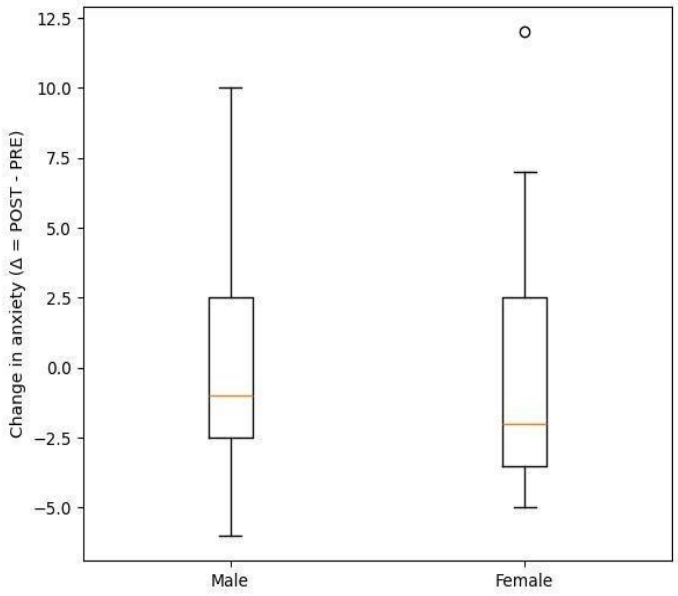

Figure 5. Variation in anxiety according to gender

The analysis of differences in state anxiety levels by gender showed that men had an average increase of 0.73 points (SD = 4.45; n = 11), while women had an average decrease of 0.21 points (SD = 5.08; n = 19). As shown in **Figure 5**, the distribution of the data presented a wide range of variability in both groups, with both positive and negative values, as well as overlapping distributions.

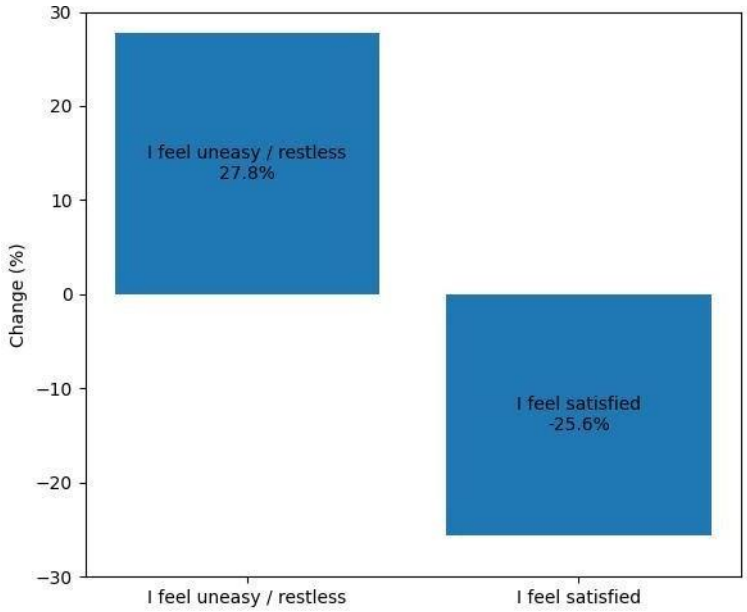

Figure 6. Questions with the greatest positive and negative variation

Regarding the individual analysis of the items in the STAI scale, the greatest increase was observed in the item "I feel restless/unsettled," with an increase of 27.8% compared to the previous measurement, while the greatest decrease was observed in the item "I feel satisfied," which showed a reduction of 25.6%, as shown in **Figure 6.**

DISCUSSION

The current research showed that while individual variations exist, there were no significant changes in state anxiety levels among participants after a high-fidelity clinical simulation. This study aligns with current literature supporting the notion that state anxiety in clinical simulations is unique, complex, and multifactorial, and does not tend to decrease after a single clinical intervention. State anxiety during simulations is reported to be impacted and influenced by the interactive combination of the educational and psychosocial climate, facilitative self-efficacy, and the learner's individual psychosocial constructs (Ahmed et al., 2023; Reed, 2022). Various studies have demonstrated that anxiety is a common response in health science students during clinical and simulated settings, with anxiety levels typically reported as mild to moderate. This is often attributed to the educational and psychosocial climate, fear of making mistakes, uncertainty, and the complexity of the clinical environment (Segura Azuara et al., 2020; Ahmed et al., 2023). Therefore, the anxiety levels that remain unchanged in this study are already clear and frequently anticipated, especially within a simulated training environment. Simulation does not reduce or prevent anxiety as such, but rather sustains and manages the emotion within its effective balance to facilitate learning (Reed et al., 2024). The reported results reflected a strong individual variation in anxiety, with some participants reporting decreased levels of anxiety and some experiencing increased levels of the same. Well known is that anxiety either promotes or obstructs a student learning, depending on their levels of emotional regulation (Ignacio et al., 2016; Reed et al., 2024). This works to bring levels of anxiety to an optimal low (or even moderate), which can provide clarity and help better achieve goals in daily life. On the other hand, higher levels of anxiety can cause breakdowns in a clinician's decision-making or increased cognitive overload (Dias et al., 2022; Fraser et al., 2021). Another significant finding is that while overall anxiety levels stayed the same, there were changes in some individual emotions. These included higher levels of anxiety, tension, restlessness and worry; lower levels of positive feelings like confidence, well-being and relaxation. Results confirmed that anxiety in the context of simulation is a multidimensional construct and different emotional components can vary independently from each other (Fraser et al., 2021). Likewise, they point out that clinical simulations involving critical incidents elicit more than one emotion and these emotions may affect cognitive and emotional tasks (Fraser et al., 2021). This decreasing trend was not acknowledged:D: 5 The gender roar-e concluded

that sex-specific differences in anxiety increased in men and decreased in women but the heterogenicity between studies, as well as overlapping data (eg between female groups), allowed for no robust findings because of gender.

This is in line with Reed (2022), who reported inconsistency in the way gender differences in anxiety are reported during clinical simulations. Conversely, women can experience more anxiety in clinical simulations [2], and thus we have shown through research that gender categories are contextual and driven by curricula. On the other hand, low variability in anxiety could be due to features of the design of our simulation. It was shown that the fidelity level, instructional supervision type or feedback level involved affects the participants emotional engagement (Moslehi et al., 2021; Macnamara et al., 2021). Specifically, anxiety caused by the observer effect is exacerbated by direct teacher supervision, while the absence of supervision tends to create a more relaxed environment and increase participant confidence (Alhaggas Albaqami & Alharbi, 2025).

Yu et al. (2021) and Kassabry (2023) state that clinical simulation allows for the structuring of repeated practice and facilitates the consolidation of clinical skills, reducing anxiety and improving confidence. With this in mind, the fact that the small changes detected in this study may stem from a lack of exposure to simulation reinforces the need for further longitudinal studies. It is well established that the use of technology decreases anxiety, even in immersive and virtual environments (Pérez de los Cobos Cintas et al., 2025). Similarly, clinical simulation has recently been reported to support and improve the clinical reasoning and decision-making skills of health science students, as well as decrease anxiety. (Hu et al., 2021). Recent studies have reported that immersive technology, and especially virtual reality technology, can support the gradual development of students' learning capacity and emotional regulation in the context of complex clinical experiences (Einloft et al., 2024). Regarding cognitive load theory, the results of this study could be considered somewhat positive, as anxiety is theorized to be an extrinsic load that diverts mental attention from the task and negatively impacts performance (Dias et al., 2022). Under optimal conditions, the total load, including task load and extrinsic load, would be moderate. When this occurs, the extrinsic load is beneficial for mindset and is therefore expected to aid learning. This lends weight to the idea that we need to manage anxiety, rather than eradicate it entirely, to achieve the desired outcomes in an educational setting (Ignacio et al., 2016).

EDUCATIONAL IMPLICATIONS

The results of this study indicate that anxiety generated during clinical simulations must be viewed as a component of the learning process and not as something that should be eliminated. For this reason, the teaching techniques for emotional regulation of anxiety must be part of this learning program, as students manifest important variations in their responses to simulated situations. Also key in this regard are the conditions for anxiety and their purposeful construction within pedagogical simulation settings. The emotional condition of the learner, for instance, could be largely determined by the realism of the simulation, the style of supervision, and the type of feedback provided. Longitudinal simulation studies, for this reason, may be successful in achieving gradual improvements in anxiety control and emotional regulation. The research indicates the need for a total assessment of anxiety and for different factors to be considered in examining various elements of anxiety, not only to determine the extent of anxiety experienced by an individual.

LIMITATIONS

This study was cross-sectional, which restricted the student sample to a single institution and used a simulation laboratory. Although the simulation lab has realistic situational use, it may not ensure that new behaviours are used in a real clinical setting. However, despite this limitation the new study should proved as starting point for future works, which should involve a longitudinal design with multiple institutions.

CONCLUSION

High-fidelity clinical simulation revealed high individual variability and showed changes in emotional components, where anxiety is understood as a complex and multidimensional phenomenon. While this does not translate into statistically significant changes in overall anxiety, it is observed within a multifactorial context where anxiety is not necessarily understood as a negative phenomenon, but rather as a mechanism that is part of the learning process. Its intensity, control, and/or regulation can have significant effects, both positive and negative, on other processes. In this sense, anxiety may be an element that should be omitted from curriculum design, along with other teaching methodologies and coping techniques, allowing for its management and the transfer of anxiety towards the development of the clinical skills that are being targeted.

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