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A Narrative Review on Multisensory Strategies for Enhancing Well-being of Pediatric Cancer Patients within Therapeutic Environments

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Abstract

Pediatric cancer is a complex and challenging illness that not only affects physical health but also profoundly impacts the psychological and emotional well-being of young patients and their families. This research aims to understand the mental conditions arising from physical illnesses of pediatric cancer patients and address their holistic needs. This narrative literature review examines the potential of a multisensory approach to enhance the well-being of pediatric cancer patients. By synthesizing existing research and evidence, this study explores various sensory elements such as visual, auditory, and tactile stimulation, and their role in improving patient outcomes. Furthermore, the review investigates the effectiveness of multisensory interventions to enhance the quality of living in hospitals, promote mental wellness, and reduce stress among pediatric cancer patients. Ultimately, the findings of this narrative literature review seek to inform healthcare professionals, policymakers, and researchers about the potential benefits of incorporating multisensory therapeutic approaches into pediatric cancer care.

Keywords: Pediatric cancer patient; Therapeutic environment; Multisensory elements; Narrative review.

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1. Introduction

Treatment of cancer has been identified as complex and involves a range of therapies for example surgery, radiation, hormone therapy, chemotherapy, immunotherapy, or some combination of these modalities [1]. Studies show that children diagnosed with cancer go through a lot of physical and emotional pain. Cancer changes the way children live before as they feel isolated, lonely, fatigued, have physical discomfort, and lack of appetite, which leads to anger and fear in many cases [2][3]. Pediatric cancer poses a distinct set of challenges due to the physical, emotional, and psychological toll it takes on both patients and their families. Addressing these challenges requires a holistic and patient-centered approach that includes multi-sensory stimuli. The physical environment within pediatric oncology units often falls short of fostering a healing atmosphere, which may influence the overall well-being and recovery of the affected children [4]. In recent years, there has been growing interest in the use of multisensory strategies within therapeutic environments to enhance the well-being of pediatric cancer patients. Multisensory experience can be applied in the pediatric hospital, including the five primary senses - visual, auditory, tactile, olfactory, and taste. To enable everyone to engage and participate, the design process should aim to create an environment that will support each person in organizing and interpreting sensory information from their surroundings [5]. People who struggle with their sensory processing may find it challenging to carry out daily activities and functional duties [5]. The journey of cancer treatment, marked by invasive procedures, prolonged hospital stays, and uncertainty about the future, can have profound effects on the quality of life of pediatric patients and their families. Recognizing the multidimensional nature of the cancer experience, healthcare providers and researchers have increasingly turned their attention to holistic approaches that address the diverse needs of pediatric cancer patients. People with cancer, in particular, require specifically designed areas since they need to feel safe and comfortable [6]. Additionally, research is assisting us in comprehending how emotions triggered by our senses and perceptions activate our immune system, endocrine system, and brain system [4]. The purpose of this study is to explore the multisensory design strategies for pediatric cancer patients and understand the psychological situation of a pediatric cancer patient. By doing a narrative literature review, the study aims to contribute valuable insights into the multisensory aspects that can impact the psychosocial well-being of young patients. Through a comprehensive review of existing literature, this study seeks to synthesize current knowledge, identify research gaps, and propose evidence-based recommendations for the integration of multisensory approaches into pediatric cancer care. At this stage in the research, the multisensory design strategies will be generally defined as the use of sensors to not only attend to the medical aspects of treatment but also prioritize the comfort, emotional well-being, and overall quality of life of young patients [7].

2. Research Methodology

This study will explore the existing research on the utilization of multi-sensory approaches associated with pediatric cancer healthcare centers for enhancing the well-being of patients. A comprehensive narrative literature review will be conducted to establish a theoretical framework for the study by searching peer-reviewed, English-language articles published between 2000 and 2023 in Google Scholar, Research Gate, PubMed**,** Academia.edu, etc. The keywords and phrases utilized in the search included, but were not limited to “pediatric cancer patient”, “sensory-responsive pediatric cancer healthcare”, "multisensory interventions in healthcare", “therapeutic

environments", "Healing environment", "Visual sense in healthcare" etc. Additionally, manual searches of relevant journals, conference papers, and reference lists of articles will be performed to ensure inclusivity. This will involve an examination of existing research on the mental conditions that are commonly observed in pediatric cancer patients. Then this study will contribute to the understanding of the relationship between mental health conditions and the built environment. Finally, how multisensory interventions contribute to healing environments in pediatric oncology settings. Findings from the included studies will be presented and discussed about their implications for enhancing the well-being of pediatric cancer patients in Bangladesh. This research will highlight commonalities, differences, gaps in the literature, and opportunities for future research and practice.

3. Mental health of pediatric cancer patient

Cancer is a chronic disease and pediatric cancer patients confront a multitude of physical, emotional, and psychological challenges throughout their long-term treatment [8]. Typically, there are four stages of cancer from one to four. Additionally, some tumors have stage zero [7]. Stage zero refers to cancer in situ, which indicates that the cancer is still in its original location. Cancer in this stage is typically curable and can be removed through surgery if it has not spread to nearby tissues [7]. Cancer in stage one is typically curable and can be removed through surgery if it has not spread to neighboring tissues. Cancer in stages two and three has deep roots in the surrounding tissue and may have spread to lymph nodes but not to other body parts. At stage four, other organs or body parts are affected by the cancer [7]. To diagnose childhood cancer, several investigations are needed, for example, Blood Count, Ultra-sonogram, Chest X-ray, CT Scan, MRI, Bone marrow examination, Biopsy, Biochemical Markers such as alpha-feto-protein, LDH, and Cancer Marker [9]. The available treatment options include radiotherapy, chemotherapy, targeted therapy, immunotherapy, hormone therapy, radiofrequency ablation, surgery, and bone marrow transplantation [9]. This treatment often leads to physical and emotional symptoms, including pain, fatigue, insomnia, anxiety, and depression due to complex treatment procedures, unfamiliar hospital environments, and painful practices [10][11]. In this context, pain is defined as an unpleasant emotional and sensory experience linked to tissue injury, either actual or potential due to cancer [12]. Major stress and other pains that come with being sick are caused by poorly designed healthcare facilities, which are usually noisy, break privacy, or interrupt social support [13]. Cancer has a tremendous impact on children's well-being which is divided into three types- physical, emotional, and psychological well-being [14].

Table 01: Impact of cancer on children's well-being

Impact on well-being	Effects of cancer
Physical	Pain (treatment-related or otherwise) & fatigue, loss of appetite, nausea, fever, anemia, hearing problems, infection, etc.
Psychological/ emotional	Fear & insecurity: stress, anxiety, anger, depression, sadness, worry, loss of self-control, etc. Due to confinement, insomnia, feelings of estrangement, and a change in appearance.

A study conducted in Mexico on 37 children aged 8-14 with Leukemia reported that 43.2% of them felt depressed and 10% felt anxious during their treatment [15]. A separate study conducted in South Korea

examined 2,160 children (aged 0–18 years) diagnosed with acute lymphoblastic leukemia (ALL) before and after their diagnosis. The research identified three major psychiatric disorders: depression, anxiety, and stress among the patients. The findings suggest that children with ALL are at an increased risk of developing psychiatric disorders, particularly within the first year after diagnosis [16]. For children who are classified as having average risk, anxiety symptoms tend to decrease after the first month of treatment, while depressive symptoms can persist for at least a year [17]. A separate study undertaken at 31 Children's Oncology Group found that all leukemia patients' worry over the operation peaked one month after their diagnosis and then steadily decreased [18]. These findings show that children with leukemia are more likely than their peers of the same age to experience psychosocial, emotional, and mental issues, and if the condition is not fixed, it may affect the children's quality of life [19] [20]. In addition, children who display depressive symptoms are at a higher risk of developing behavioral and social problems as well as health problems in the body and mind as adults [21].

Major stress and other pains that come with being sick are caused by prolonged hospitalization [16], pain and side effects of treatment [18], loss of normalcy, and poorly designed healthcare facilities, which are usually noisy, break privacy or interrupt social support [13]. Cancer greatly affects children's well-being in physical, emotional, and psychological ways [14]. Early intervention, psychosocial support, and tailored coping strategies are essential to help pediatric cancer patients manage their symptoms and improve their mental and emotional resilience throughout their treatment journey.

Child-centered care and coordinated family-centered care with socioeconomic support are essential components of the treatment. Early in a child's journey, palliative care should be made available to relieve pain and all other forms of suffering, both mental and physical, and to assist families. Children's stress reduction can be greatly helped by play or music therapy that employs distraction strategies.

3.1 Doctor's recommendation on improving the mental health of pediatric cancer patients

Medical tests and procedures for cancer treatment can cause anxiety for both children and parents, but preparation can help lower this stress. Children need to feel safe for any kind of treatment procedure [7]. Doctors often recommend specific design features and considerations for spaces dedicated to pediatric cancer patients within healthcare facilities. These recommendations aim to create environments that support the unique needs and well-being of young patients undergoing cancer treatment. According to the American Society of Clinical Oncology (ASCO), managing the emotions of pediatric cancer patients is focused on some categories, for example, coping with uncertainty, managing stress, anxiety, depression, guilt, etc.

For managing stress, doctors suggest exercising regularly, spending time outside, socializing with family and friends, getting plenty of sleep, and spending time that is relaxing like gardening, listening to music, etc. Guided imagery, which uses words and sounds to assist calm imagination, peaceful settings, experiences, and feelings, can reduce depression [22], music therapy, etc. Fear of uncertainty, loss of independence, and fear of death often lead cancer patients to anxiety. With the change of regular lifestyle, sleep problems, fatigue, pain, nausea, rash, or other skin conditions, children may feel angry. Doctors recommend that deep breathing, guided imagery, meditation, music therapy, etc. can help to manage stress and anger.

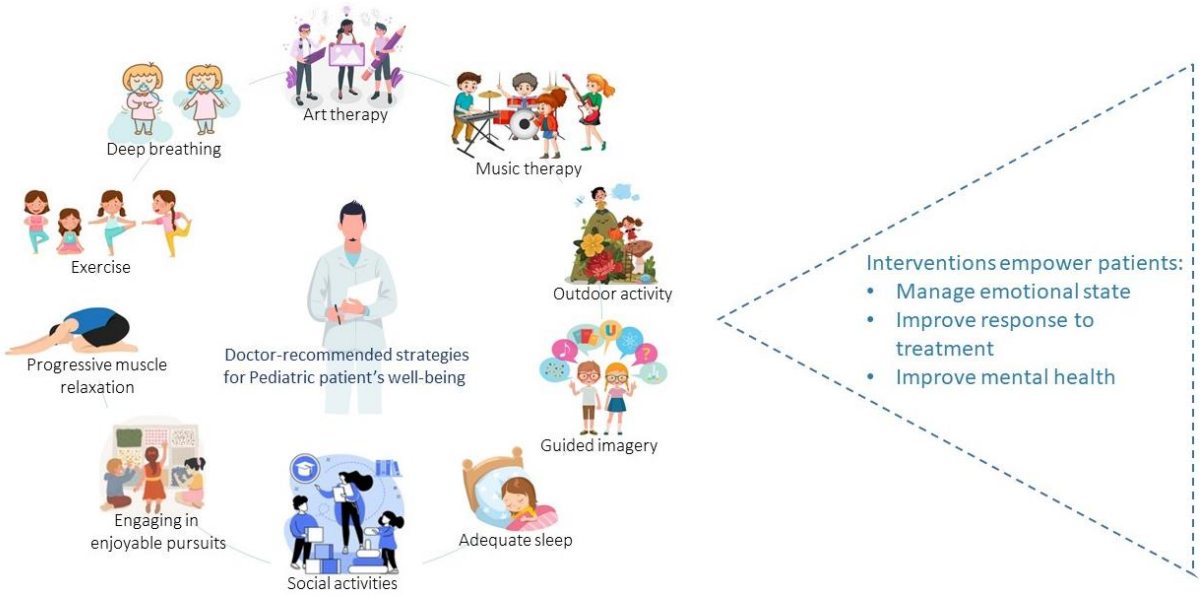

Figure 1: Doctor-recommended strategies for Pediatric patient's well-being

3.2 Impact of built environment on mental health

The physical environment encompasses aspects such as the layout, design, and amenities of healthcare facilities. Comfortable and child-friendly spaces can help reduce stress and anxiety in pediatric cancer patients. A study on designing cancer centers for children gives two guidelines that should be used in cancer centers: i) designing healthcare as if it represents home and ii) considering environmental attributes [6]. Another study suggests that physical activity including exercise is beneficial to the health of pediatric cancer patients [23]. Environmental design should make it easier for people to access or be exposed to social and physical settings that can have a healing or stress-reducing effect [13]. It should include interactive arts, a view of a natural indoor garden and landscape, healing colors, soothing sounds like music, bird songs, and water sounds, sufficient ventilation, low levels of noise, and adequate natural lighting [24]. According to Ulrich, designing a space to provide patients with a sense of control, social support, and positive distractions can help lower stress and promote well-being, and it is called the Supportive design concept [13].

Patient's sense of control: A sense of control is an important factor in healthcare facilities for patients. The lack of control can increase the stress level of patients. The ability or determination to exert control over one's circumstances and to modify or change their state is referred to as a sense of control [22]. A person's sense of control is seriously compromised by poorly designed facilities that are noisy, difficult to navigate, interrupt privacy, prohibit individual control over the temperature, humidity, and television, force bedridden patients to stare straight at glaring ceiling lights or arrange rooms so that patients cannot see out windows [13,25].

Social support: The provision of psychological support through social interaction to enhance an individual's capacity to manage stress is known as social support [26]. In therapeutic settings, social furniture layouts, entertainment elements, and family and friends all provide social support [25]. Furniture arrangements encourage interaction, provide comfortable distances, and ease eye contact while entertainment features like television and

music allow interactive contact [25]. Outdoor gardens and sitting areas for patients or visitors can increase social interaction [27].

Positive distractions: "A positive distraction is an element that produces positive feelings, effortlessly holding attention and interest and therefore may block or reduce worrisome thoughts" [13]. Positive distraction includes natural elements such as plants, trees, and water. "The most promising interventions for positive distraction are real and artificial nature, music and sound, and audiovisual with light [26]". There is evidence that distraction techniques minimize children's pain, fear [28], and anxiety [29]. Patients and their relatives may find comfort and a sense of a supportive atmosphere by including positive distractions [30]. Child life specialists frequently employ distraction as a behavioral intervention, which involves teaching and helping kids shift their focus from an unpleasant or frightening situation (like an injection) to something more neutral [29]. Patients' psychological and physical well-being have been proven to benefit from positive distractions [31]. Allowing kids to watch cartoons, read a book, play a game, or listen to music during a medical operation are examples of distraction techniques. Different types of arts, games, real and artificial nature in healthcare, auditory pleasing natural sound and soft music, television, Virtual reality, and social interaction are common positive distractions in healthcare settings [32]. Positive distractions in healthcare are categorized into eight themes. The eight themes are found from different sources along the scrutiny, codes, and themes:

i. Art and environmental aesthetics
ii. Visually pleasing Lighting and color
iii. Natural environment-
iv. Auditory pleasing natural sound and Music
v. Play equipment
vi. Electronic media
vii. Reading materials
viii. Socialization

Figure 2: Eight themes of Positive distraction in healthcare from different sources

Art and environmental aesthetics: Children prefer artwork to portray realistic images, cartoon art [33], medical equipment to be hidden, and home-like interior designs [34]. A hospital setting that is vibrant, feels comfortable, and doesn't appear like a hospital can all improve children's hospital experiences. [35].

Visually pleasing Lighting and color: Personalized and cycled lighting in hospital rooms, along with lighting and animation interventions, help reduce patient stress and promote well-being [36]. Circadian rhythms, the body's natural 24-hour cycle are essential for patient recovery, but hospital environments often disrupt them with artificial lighting, noise, and irregular schedules[37]. Daylight therapy through both natural lighting and LED systems that mimic the natural day-night cycle, helps restore these rhythms. Daylight exposure significantly enhanced sleep patterns and well-being in patients [37].

Natural environment: Bringing the outside in can enhance the healing environment in hospitals [38]. Plant screens help balance privacy and views, while interactive garden elements actively engage children, encouraging garden use by children and families [39]. Children find well-designed layouts that include accessible pathways and entertaining attractions (such as play areas, sculptures, and child-scale furniture) more appealing and entertaining which increases physical activity [40]. Furthermore, patients who were randomly placed in rooms with windows overlooking the outside recovered more quickly than those who were placed in rooms with views of brick walls. [31]

Auditory pleasing natural sound and Music: Natural sound, for example, the sound of the waterfall, birds chirping, raindrops, etc., can boost the mood of the patient [41]. Noise in pediatric healthcare environments is associated with increased stress, on the other hand, music positively impacts hospitalized children [39]. There is evidence that music has a favorable impact on patient outcomes, including emotions, tension, anxiety, and pain

[41], and it is regarded as a type of therapy [42].

Play equipment: During various phases of inpatient treatment, the kids' own selections of toys and cartoons worked well as constructive diversion [43]. The screenplay offers a pleasant, captivating experience without the usage of contact surfaces, which prevents the spread of infection [44]. Different types of games, interactive projection games, Xbox, and puzzle tables, inspire controlled physical activity that is beneficial for patients in healthcare.

Electronic media: Patients benefit from television while undergoing therapy, but excessive television viewing, especially when children are young, is linked to detrimental impacts on sleep, focus, and relationships[45]. A virtual reality technology proved to be a useful and captivating diversion for children throughout the intrusive medical treatment. [46]. Interactive projections on walls and floors use creative technology to facilitate play as a healing mechanism, designed in collaboration with doctors and health experts to promote positive well-being.

Reading materials: Reading materials such as books, magazines, newspapers, and posters play a crucial role as positive distractions in healthcare settings. Reading materials, posters, and magazines about health-related issues can serve as an educational tool for health-related topics [47].

Socialization: Children desire social connection while staying in the hospital for a long time for treatment. Children's social connectivity can be expanded in hospitals with the use of technology [38]. Hospital settings must be created with children's rights to dignity, privacy, family support, and self-control in mind, in addition to being kid-friendly [38]. Negative emotions can be reduced by socialization and exchanging feelings with other adults [48].

Incorporating these themes into healthcare environments can enhance patient experiences, give a sense of control, promote faster recovery, and improve overall hospital design by fostering engagement and relaxation. Individual control over the temperature, humidity, and television, gives bedridden patients a sense of control [25, 30].

4. The concept of the therapeutic environment in healthcare

The concept of a therapeutic environment in healthcare emphasizes creating spaces that promote well-being, comfort, and healing for patients. In the context of pediatric cancer patients, such environments play a crucial role in enhancing their overall experience and aiding in their recovery process. There has been discussion since Florence Nightingale in the 19th century on the significance of the physical environment for patient health and well-being as well as the delivery and support of healthcare [49]. Therapeutic environments are viewed as "smart investments" since they lower costs, boost employee productivity, and shorten hospital stays for patients by reducing stress [13]. Therapeutic environments have a physical, social, and psychological impact on patients, which speeds up their healing process by removing them from their indoor isolation and distracting their focus from their health issues [25].

According to a researcher, the therapeutic environment includes eight basic components, they are, thermal comfort, air quality, noise control, privacy, views of nature, light, visual serenity for those who are very ill, and

Visual stimulation for those who are recuperating [50]. Other factors that are included in this list are nature access, positive diversion, social support, options and choice (control), and removing environmental stressors like glare, noise, poor air quality, etc [50].

The framework of the therapeutic environment is further described as a triangular relationship among building systems, (materials, space plan, interior, services, site, skin, structure) performance (user outcome includes- no errors, safety & security, control, privacy, comfort, family support, organization and functionality, technical support. Building system outcomes include: safety and security, production support, compliance with laws, energy and sustainability, adaptability, initial and operational costs, and the user (patients, family, staff) [51,52]. Each element affects the other two in this framework. To ensure that patients experience the best care possible in a comfortable and welcoming environment, oncology centers need to adhere to four primary design principles– natural lighting, establishing a connection, designing it like home, and environmental attributes [6].

However, another researcher prioritizes "therapeutic architecture" as recreating the practical elements of "therapeutic landscapes" over the symbolic and social components [53]. It is challenging to model the social components of a therapeutic environment in healthcare since mental facilities and individual patients differ greatly in the way that personnel interact. Instead, healing is a provisional and continuing outcome of a relational process in which social interaction and lived experience patterns interact with physical aspects of the built environment.

4.1. Multi-sensory in the healthcare environment

In healthcare, a multisensory approach might be used to create a more comforting and less distressing environment for patients. For example, in a pediatric cancer ward, multisensory strategies could include visually appealing and calming wall colors, soothing background music (auditory), and soft bedding and clothing materials (tactile) to enhance the well-being of child patients undergoing treatment [54]. Incorporating multisensory elements into the environment can engage patients' senses and provide distractions from pain and discomfort [54].

Visual: The visual sensory system refers to the part of the nervous system responsible for processing visual information. It is primarily enabled by the eyes, which capture light and convert it into electrochemical signals that can be interpreted by the brain. The visual system allows us to perceive our environment in terms of light, color, shape, motion, and depth [55]. In a hospital setting, from a patient's perspective, visual sensory elements can include the aesthetics and navigability of the environment, such as lighting, color schemes, signage, and the cleanliness and tidiness of space. These visual aspects can influence the patient's comfort, well-being, and perception of care quality [55]. The effects of daylight, brightness, and luminance intensity on individuals are all included in the concept of visual comfort. Patients in healthcare settings appear to benefit greatly from having access to daylight [56]. Compared to rooms with poor lighting, patients who stayed in sunny rooms spent less time in the hospital [57]. According to a study specific kinds of "psychologically appropriate" art can help people feel less stressed and achieve better results, like pain relief [58]. These kinds of art include figurative works that depict emotionally positive gestures and facial expressions, as well as representational images with themes

relating to waterscapes, natural landscapes, flowers, and gardens [13]. However, patients may react negatively or with hate to abstract or ambiguous visuals or emotionally charged content [13]. Those with views of nature experienced shorter recovery times after surgery, used fewer painkillers, and received better feedback from nurses, in contrast, to patients with brick walls, [13, 59]. ‘‘Color can repair and heal the body when the frequency of the color aligns with the emotion needed to activate the micro particulars so healing can take place [60].” The color blue stimulates calmness, quiet, peaceful, safe, and well-ordered. Green is the color of balance and harmony that is healthy, calming, upbeat, and relaxing. It helps to heal, relieve tension and stress. ‘Those who have a green work environment experience fewer stomach aches. Tension increases in the yellow room, and babies cry more in the yellow room. On the other hand, red stimulates the physical and adrenaline and it raises blood pressure, heart rate, and respiration [60].

Auditory: The auditory environment within healthcare settings significantly impacts patients' experiences and emotional states. Designing therapeutic environments that minimize intrusive noises and incorporate soothing sounds, such as nature sounds or gentle music, can create a more calming and healing atmosphere [61]. The hospital's noise levels mostly impacted the comfort and healing of its patients. [62]. Studies have shown that after the first dose of chemotherapy medications, a significant rate of sensorineural hearing loss has been noticed[63]. Various auditory treatments might assist clinical practices to lower the degree of discomfort and anxiety [12]. Music therapy can enhance individuals' sensory and body awareness [64]. Applying selected audio interventions can effectively decrease the severity of the discomfort of pediatric cancer patients [12]. Music therapy has proven to be a significant intervention in childhood cancer care, reducing mood disturbances and improving pain perception in patients undergoing high-dose chemotherapy. Children undergoing cancer treatment require interventions that address emotional needs [61]. Music therapy is an effective intervention, allowing meaningful bodily function and activity participation, essential for maintaining holistic well-being [61].

Tactile: The tactile sensory, also known as the sense of touch, is a complex system that allows individuals to perceive pressure, temperature, texture, pain, and other physical sensations. It is a critical component in healthcare service because it plays a significant role in patient care and comfort. Tactile stimulation involves touching the body and is frequently used to improve mood or lower stress levels in individuals. Examples include using simple touch to soothe someone, massage methods, physiotherapy, whole-body vibration training, and basic touch. Other examples include acupressure, Reiki, and vibro-acoustic therapy [65]. Incorporating tactile elements into therapeutic environments, such as soft furnishings, textured surfaces, or tactile play areas, can create a sensory-rich and comforting atmosphere for pediatric cancer patients. These elements contribute to the overall multisensory experience, promoting relaxation, distraction, and emotional well-being [26]. Engaging the sense of touch through tactile objects or textures can serve as a distraction from medical procedures and treatment-related stressors. Providing soft blankets, stuffed animals, or sensory toys allows patients to focus on comforting sensations, promoting relaxation and emotional regulation [26]. The quality of linens, the firmness of a mattress, and the fit and texture of patient gowns can affect patient comfort.

Understanding the interconnectedness of these senses and their impact on perception, cognition, and emotional experience, healthcare providers have explored innovative approaches to leverage multisensory interventions in pediatric care settings. For example, combined stimulation of touch and hearing is called vibro-acoustics [65][66].

Here, one or two tactile actuators produce a tactile (vibration) effect that is directly inspired by the lower frequencies of the music and this combination might be effective for relaxation or falling asleep according to experimental findings [65][67].

By integrating multisensory elements into healthcare environments, providers can create holistic, patient-centered spaces that promote comfort, reduce stress, and enhance overall well-being for pediatric cancer patients.

5. Discussion

This study has explored the complex psychological challenges faced by pediatric cancer patients, including stress, anxiety, depression, insomnia, pain, fatigue, and anger. The findings highlight the significant role of both healthcare-recommended coping strategies and targeted environmental modifications in alleviating these challenges. Healthcare professionals emphasize the importance of managing emotional distress through interventions such as guided imagery, music therapy, social support, and positive distraction. While these strategies provide emotional relief, their effectiveness varies depending on factors such as the child's personality, age, and severity of illness.

The built environment of healthcare facilities plays a vital role in the emotional well-being of pediatric cancer patients. Existing literature supports the notion that child-friendly healthcare spaces can reduce anxiety and stress. This study categorizes eight themes of positive distractions, underscoring the significance of interactive art, calming sounds, and play areas in pediatric cancer wards. While these elements contribute to an improved patient experience, their effectiveness remains subjective. For example, natural scenery and interactive elements may be beneficial for some patients, whereas others may require more personalized interventions, such as virtual reality experiences. The impact of these strategies depends on various factors, including the patient's age, cancer stage, treatment type, mental state, and socio-cultural background.

A multisensory approach incorporating visual, auditory, and tactile elements—such as calming color schemes, soft textures, and soothing sounds—fosters an overall sense of comfort. These strategies should be adaptable, allowing pediatric patients and their caregivers to modify their surroundings based on individual preferences and needs. The concept of multisensory therapeutic design presents a promising avenue for enhancing patient well-being; however, further research is required to ensure its effective implementation. Additionally, socio-cultural and economic contexts must be considered when integrating these strategies into healthcare settings. Emerging healthcare technologies with demonstrated benefits in patient outcomes should also be explored as potential tools for enhancing pediatric care environments.

The integration of sensory stimulation into clinical practice offers significant potential for promoting relaxation, reducing stress, alleviating pain, and enhancing emotional resilience in pediatric patients. However, the successful implementation of multisensory interventions requires careful consideration of individual differences, logistical challenges, ethical concerns, and the need for further empirical validation. Future studies should address these factors to refine and optimize multisensory interventions, ensuring their effectiveness and accessibility in

pediatric oncology care.

6. Conclusion

While the role of the therapeutic environment is proven to be helpful in patient outcomes, it is still in an exploratory phase. The evidence from studies is clear that integrating visual, auditory, and tactile elements that are tailored to the preferences and comforts of young patients can contribute significantly to reducing the emotional burdens of hospitalization and medical treatments. To create a therapeutic environment factors like a supportive physical environment, multisensory stimulation, and therapeutic environments can significantly impact the experiences and outcomes of young patients undergoing cancer treatment. Key elements such as natural light, soothing colors, access to nature, calming auditory inputs, art, and aesthetically pleasing surroundings contribute to creating a healing environment. Additionally, positive distractions, including play equipment, electronic media, reading materials, and opportunities for socialization, help shift children's focus from clinical procedures to a more comforting and engaging atmosphere. Given these findings, future healthcare design and treatment protocols for pediatric patients should prioritize multisensory therapeutic strategies. Healthcare professionals, policymakers, and researchers must focus on interventions that address not only the immediate sensory and emotional needs of young patients but also enhance their overall clinical outcomes. By fostering an environment conducive to recovery and well-being, healthcare settings can better support pediatric patients in their healing journey.

7. Limitations of the study

This study primarily relied on qualitative data, which, although rich in insights, may introduce subjective biases. The absence of extensive quantitative measures, such as physiological indicators of stress and anxiety, limits the ability to provide an objective assessment of intervention effectiveness. Future research incorporating both qualitative and quantitative methodologies would enhance the robustness of findings. Additionally, cultural differences in healthcare experiences were not comprehensively examined. Since environmental and psychological support preferences may vary across cultural contexts, cross-cultural studies are necessary to explore these variations and ensure broader applicability of the findings.

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