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DERLEME | REVIEW

Psychiatric Monitoring in Children Undergoing Hematopoietic Stem Cell Transplantation: A Current Approach from Child Psychiatry and Hematology-Oncology Perspectives

Hematopoietik Kök Hücre Nakli Geçiren Çocuklarda Psikiyatrik İzleme: Çocuk Psikiyatrisi ve Hematoloji-Onkoloji Perspektiflerinden Güncel Bir Yaklaşım

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Abstract

Hematopoietic stem cell transplantation (HSCT) is a life saving intervention for pediatric malignancies and several non-malignant hematological or genetic disorders. However, this intensive treatment process may lead to long-term psychiatric and neurocognitive complications beyond its physical impact. Emerging evidence suggests that children undergoing HSCT are at risk for anxiety, depression, attentional problems, and executive function deficits, often persisting years after treatment. This review explores the psychiatric and neurocognitive outcomes following HSCT in childhood and examines early intervention approaches to mitigate these effects. It also discusses the psychological burden on parents and caregivers, emphasizing the need for routine psychosocial screening and integrated mental health care in survivorship protocols. A multidisciplinary approach, incorporating child psychiatry, is essential for optimal long-term outcomes. Furthermore, identifying reliable biomarkers and neurodevelopmental risk factors early in the transplantation trajectory may enable more personalized and timely psychiatric interventions. Ultimately, embedding mental health support as a core component of HSCT care pathways rather than an ancillary service represents a critical step toward improving the holistic well-being and quality of life of pediatric survivors.

Keywords: Childhood, hematopoietic stem cell transplantation, neurocognitive effects, early intervention

Öz

Hematopoietik kök hücre transplantasyonu (HKHT), pediatrik malignitelerin ve çeşitli malign olmayan hematolojik veya genetik bozuklukların tedavisinde hayat kurtarıcı bir müdahaledir. Ancak bu yoğun tedavi süreci, fiziksel etkilerinin ötesinde uzun vadeli psikiyatrik ve nörokognitif komplikasyonlara yol açabilmektedir. Giderek artan kanıtlar, HKHT uygulanan çocukların anksiyete, depresyon, dikkat sorunları ve yürütücü işlev bozuklukları açısından risk altında olduğunu ve bu sorunların tedaviden yıllar sonra dahi sürebildiğini göstermektedir. Bu derleme, çocukluk çağında HKHT sonrası ortaya çıkan psikiyatrik ve nörokognitif sonuçları ele almakta ve bu etkileri azaltmaya yönelik erken müdahale yaklaşımlarını incelemektedir. Aynı zamanda ebeveynler ve bakım verenler üzerindeki psikolojik yükü de tartışarak, sağkalım protokollerinde rutin psikososyal tarama ve entegre ruh sağlığı bakımının gerekliliğini vurgulamaktadır. Uzun vadeli sonuçların iyileştirilmesi için çocuk psikiyatrisini de kapsayan multidisipliner bir yaklaşım büyük önem taşımaktadır. Bunun yanı sıra, transplantasyon sürecinin erken döneminde güvenilir biyobelirteçlerin ve nörogelişimsel risk faktörlerinin belirlenmesi, daha kişiselleştirilmiş ve zamanında psikiyatrik müdahalelerin uygulanmasını mümkün kılabilir. Son olarak, ruh sağlığı desteğinin yardımcı bir hizmet olarak değil, HKHT bakım süreçlerinin temel bir bileşeni olarak konumlandırılması; pediatrik sağkalımcıların bütüncül iyilik hali ve yaşam kalitesinin artırılması yolunda kritik bir adımı temsil etmektedir.

Anahtar kelimeler: Çocukluk dönemi, hematopoietik kök hücre nakli, nörobilişsel etkiler, erken müdahale

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Introduction

Hematopoietic stem cell transplantation (HSCT) is widely utilized in the treatment of various childhood diseases, encompassing hematological disorders such as acute lymphoblastic leukemia (ALL), acute myeloid leukemia (AML), and aplastic anemia, as well as several metabolic and genetic disorders (Wiener et al., 2023). In particular, the recovery process required for the immune system to become effective following bone marrow suppression after allogeneic transplantation presents both physical and psychological challenges (Evans et al., 2021). The developing brain during childhood is particularly vulnerable to factors such as environmental and physical stress. Highly stressful medical treatments, such as HSCT, have the potential to exert lasting effects on cognitive and psychological well-being (Savani & Tichelli, 2021). Studies have demonstrated that children undergoing HSCT are at a higher risk of experiencing difficulties such as emotional distress, attention deficits, social withdrawal, decline in academic performance, and adjustment problems (Di Giuseppe et al., 2020; Maleki et al., 2024). In light of current evidence, this review aims to critically examine the psychiatric and neurocognitive issues emerging after pediatric HSCT, as well as the psychological burden experienced by caregivers, the intervention methods employed, and the significance of early assessment and a multidisciplinary approach.

This article was prepared as a narrative review focusing on psychiatric and neurocognitive outcomes in children undergoing hematopoietic stem cell transplantation (HSCT). Relevant studies published between January 2000 and April 2026 were identified through searches conducted in PubMed, Scopus, and Web of Science databases. During the search process, keywords such as “pediatric hematopoietic stem cell transplantation,” “HSCT,” “child psychiatry,” “neurocognitive outcomes,” “psychological effects,” “caregiver burden,” “anxiety,” “depression,” and “psychosocial interventions,” as well as combinations of these terms, were used. Studies examining pediatric HSCT populations and evaluating psychiatric or neurocognitive outcomes were included in the review. Case reports, conference abstracts, studies conducted exclusively with adult samples, and publications not directly related to psychiatric or neurocognitive outcomes were excluded. Initially, titles and abstracts were screened, followed by full-text evaluation of the relevant articles. During the preparation of the review, particular attention was given to recent and clinically significant studies in child and adolescent psychiatry.

Psychiatric Disorders after HSCT

While HSCT provides a life-saving treatment option, it also brings with it numerous psychiatric burdens and morbidities during and after the treatment process. Prolonged hospital stays, social isolation, uncertainties regarding the treatment process, painful medical procedures, and the fear of relapse can all impose psychological burdens on both children and caregivers. At the same time, being away from school life, daily routines, and peer relationships increases ruminative thoughts. It can particularly increase psychological vulnerability during developmentally sensitive periods.

Current literature indicates that various psychiatric difficulties, such as anxiety symptoms, depressive symptoms, post-traumatic stress symptoms, and adjustment problems, may be more frequently observed in children undergoing pediatric HSCT (Di Giuseppe et al., 2020). To understand the causes of these difficulties, it is necessary to examine both the HSCT process and individual development and family dynamics in detail. In particular, anxiety symptoms and anxiety disorders are among the most frequently reported psychiatric problems following pediatric HSCT. It is thought that prolonged hospital stays, intensive medical procedures, the risk of complications, and uncertainties regarding the transplant process may increase anxiety levels in children (Döring et al., 2023; Y. M. Wang et al., 2024).

In addition, depressive symptoms and emotional difficulties are also among the significant psychiatric problems reported following pediatric HSCT. The long-term treatment process, physical limitations, social isolation, being away from school life, and disruption of daily routines can have negative effects on children's mood (Di Giuseppe et al., 2020; Maleki et al., 2024). Additionally, fatigue, sleep problems, and physical symptoms that may occur in the post-transplant period can also negatively affect children's emotional well-being (Y. M. Wang et al., 2024). However, due to the fact that a significant portion of current studies have assessed depressive symptoms using self-report scales instead of standardized diagnostic interviews, and because symptoms related to physical illness may overlap with depressive symptoms, the results must be interpreted with caution (Döring et al., 2023).

The HSCT process can be perceived as a traumatic experience for some children and their caregivers; post-traumatic stress symptoms related to invasive procedures, intensive care experiences, and fear of death may be observed (Harman & Shoemark, 2024). Additionally, adjustment problems due to long-term isolation, disconnection from school life, and disruption of daily routines are also clinically significant in this patient group (Evans et al., 2021).

However, a significant portion of current studies have been conducted with small sample sizes and exhibit notable heterogeneity in terms of the psychiatric assessment methods used, follow-up periods, and transplant processes. Therefore, comparing the findings and determining their generalizability becomes challenging (Penny et al., 2026).

Neurocognitive Effects after HSCT: Executive Function, Attention, and Memory Problems

Given the ongoing neurodevelopmental processes of childhood, intensive chemotherapy protocols, total body irradiation (TBI), immunological processes, and prolonged hospital stays can have lasting effects on the developing central nervous system (Harrison et al., 2021; Phillips et al., 2021). Various difficulties are reported, especially in the areas of attention, executive functions, processing speed, working memory and academic performance (Ansari et al., 2024). It is thought that children who receive transplants, especially at a younger age, may be more neurocognitively fragile (Kelly et al., 2018). Attention problems and executive dysfunctions are among the most frequently reported neurocognitive areas in the literature (Schofield et al., 2022). Follow-up studies after hematopoietic stem cell transplantation (HSCT) have shown that cognitive impairments typically become apparent within the first two years following transplantation and may worsen over time (Jacola et al., 2016). The most common neurocognitive challenges encountered in clinical practice are attention deficit, impaired working memory, and disturbances in executive functions such as planning and organization, resulting in decreased academic performance (Parris et al., 2021).

Persistent neuroinflammatory processes, endothelial injury, and immune dysregulation following HSCT have been proposed as potential mechanisms contributing to these long-term neurodevelopmental effects (Milone et al., 2022; Moreno-Castaño et al., 2022). Long-term follow-up data demonstrate that neurocognitive effects in pediatric HSCT recipients are not limited to acute neurotoxicity accompanying the transplantation process. Difficulties have been identified, particularly in higher-level cognitive domains such as attention, processing speed, executive functions, and academic skills, which become more pronounced during the developmental process (Kelly et al., 2018). This suggests that existing damage becomes more visible over time and appears consistent with a progressive neurodevelopmental pattern described in the literature as growing into deficit (Jacola et al., 2016). Cognitive effects may be more pronounced, especially in children who undergo total body irradiation; It is suggested that chemotherapy-induced neurotoxicity, neuroinflammation, and oxidative stress mechanisms may play a role in this process (Kelly et al., 2018). Also, treatment-related complications such as chronic graft-versus-host disease(GVHD), prolonged systemic corticosteroid use, and admissions to intensive care units have been reported as potential contributors to adverse neurocognitive outcomes after (Khan et al., 2022; Shin et al., 2021; Zaidman et al., 2022).

However, current findings on neurocognitive sequelae in pediatric HSCT survivors are not entirely consistent. While some long-term studies and systematic reviews describe clear and global deficits across domains such as intelligence, attention, memory, executive functioning, and processing speed (Pierpont et al., 2017; Zając-Spychała et al., 2020), other cohorts report average-range performance overall, with only subtle or domain-specific weaknesses or impairment restricted to subgroups (e.g., those with GVHD or neurologic comorbidities) (Buchbinder et al., 2018; Gruber et al., 2022). Interpretation is further complicated by substantial methodological heterogeneity between studies. Neuropsychological test batteries differ markedly, follow-up durations vary from a few years to several decades, and heterogeneous patient populations (malignant vs. non-malignant indications, different conditioning regimens, varying presence/severity of GVHD and neurologic complications) are often analyzed together, limiting comparability across reports (Ansari et al., 2024; Gabriel et al., 2021). In addition, in several studies baseline (pre-transplant) cognitive functioning is poorly characterized or not assessed with standardized measures, making it difficult to disentangle the contribution of HSCT itself from the effects of the underlying disease, prior CNS-directed therapies (e.g., cranial or craniospinal irradiation, intensive chemotherapy), or pre-existing neurologic injury (Gabriel et al., 2021; Shin et al., 2021; Zając-Spychała et al., 2020). Consequently, to better delineate the neurocognitive impact of pediatric HSCT, there is a clear need for prospective, long-term studies that employ standardized neuropsychological assessment protocols, include rigorous pre-transplant baseline evaluations, and systematically account for treatment-related complications and comorbid neurologic events (Ansari et al., 2024; Parris et al., 2021).

Psychosocial Assessment and Intervention Approaches

Psychosocial assessment and intervention in the pediatric HSCT process require a phase-specific framework that targets not only the child but also caregivers and the entire family system. Current data indicate that families face

intense psychological distress, caregiving burden, and adaptation demands from the pre-transplant period through at least the first 6 months–100 days post-HSCT, whereas structured psychosocial screening and clinical care pathways are still used only to a limited extent (Kazak et al., 2019; Maleki et al., 2024; Pai et al., 2019; Wiener et al., 2023).

Survey studies show that although psychosocial assessment is conducted for patients in the pre-transplant period in the majority of HSCT centers, validated transplant-specific risk scales (such as the PAT-HCT) (Psychosocial Assessment Tool for Hematopoietic Cell Transplantation) are implemented in very few centers and rates of repeated assessment over the course of follow-up remain low (Wiener et al., 2023). The same study reported that approximately half of caregivers do not receive regular psychosocial evaluation even in the pre-HSCT period, with even lower rates of longitudinal follow-up (Wiener et al., 2023).

Yet, in pediatric HSCT, the PAT-HCT was developed as a validated tool that allows rapid screening of family-level psychosocial risk and facilitates both risk stratification and intervention planning. The PAT-HCT–based Pediatric Psychosocial Preventative Health Model (PPPHM/PCCP) recommends universal psychosocial screening for all patients, stepwise interventions of varying intensity according to the family's identified risk level, and structured collaboration within a multidisciplinary team composed of child psychiatry, psychology, social work, and nursing (Kazak et al., 2019). Studies focusing on caregiver experiences make the clinical consequences of this structural gap clearly visible.

In a multicenter longitudinal study, pediatric HSCT caregivers reported acute distress during hospitalization related to the restrictive environment, hypervigilant caregiving demands, financial strain, and separation from the rest of the family; after discharge, uncertainty, complex home-based care, fear of infection and relapse, and the need to rebalance family roles came to the forefront (Bhatt et al., 2025; Phelan et al., 2025). These studies highlight caregivers' demands for universal psychosocial risk screening, family-inclusive care, access to interdisciplinary teams, and practices that take into account the financial burden (Bhatt et al., 2025; Kazak et al., 2019). To address this needs profile, family- and caregiver-focused approaches developed at both the assessment and intervention levels have gained importance.

The finding that approximately half of caregivers in the pre-HSCT period present with anxiety above the clinical threshold, a proportion with depressive symptoms, and that these symptoms are closely associated with poorer physical well-being, reduced leisure time, and inadequate coping indicates that intervention targets should focus on these modifiable domains (Waldman et al., 2021).

Classic stress-management and cognitive-behavioral programs have demonstrated that it is possible to achieve moderate reductions in perceived stress, anxiety, and depression among allogeneic HSCT caregivers over the first 100 days (Laudenslager et al., 2015). The BMT-CARE program (Blood and Marrow Transplantation Clinical and Research Excellence Program), specifically structured for the transplant trajectory, combines education, self-care, and cognitive-behavioral coping skills and has been shown to rapidly improve caregiver quality of life, reduce caregiver burden, significantly decrease anxiety and depression, and enhance self-efficacy and coping abilities (El-Jawahri et al., 2020). More specifically, the Parent Social-Cognitive Processing Intervention Program (P-SCIP), despite being a brief intervention, has been superior in reducing early distress and trauma-related symptoms among caregivers with high pre-transplant anxiety or whose child developed GVHD (Manne et al., 2016).

Nurse-led, telehealth-delivered meaning-centered psychotherapy has been highly acceptable to adult HSCT caregivers; the presence of a nurse familiar with the transplant context and the opportunity for remote access have been identified as key facilitators of engagement (McAndrew et al., 2025). Similarly, a nine-week telephone-based positive psychology program delivered within the first 100 days post-transplant was found to be feasible and beneficial, offering caregivers a structured space to recognize emotions, allocate time for self-care, and nurture relationships (Amonoo et al., 2024).

Reviews examining flexible, technology-enabled, remote interventions report that, although the number of existing studies is still limited, such interventions are perceived as useful and acceptable by caregivers and hold promising potential for improving quality of life and psychological symptoms (Osburn, Ms, Aprn, Agacnp-Bc, Ocn et al., 2025). This specific HSCT literature is also consistent with broader evidence on family-centered interventions. A recent meta-analysis covering various chronic illness populations demonstrated that family-centered interventions can significantly reduce caregiver burden, depression, and stress while improving quality of life, with larger effect sizes reported particularly among families of adolescent patients (Z. Wang et al., 2024).

In the context of pediatric HSCT, it can therefore be suggested that a multidisciplinary care model, beginning with standardized risk screening and proceeding with stepped, family-centered, often remotely accessible psychosocial programs according to risk level, represents a robust approach to supporting the mental health of both the child and the family (Bhatt et al., 2025; Maleki et al., 2024). This model emphasizes that child psychiatry and hematology-oncology teams should organize assessment and intervention not as a one-time consultation, but as a continuous, time-sensitive, and family-oriented process throughout the transplant course.

Needs, Problems and Future Views

We must use various methods to maintain mental health after long and arduous medical procedures like HSCT. Psychiatric help should continue not only when a diagnosis is made but also during and after the treatment process. Despite being important for treatment, it contains deficiencies and challenges. Healthcare personnel working in pediatric hematology-oncology units generally do not have sufficient time and resources to meet the mental health needs of children. This leads to delays in diagnosis and intervention. The lack of full integration of psychiatry, nursing, social services, education, and rehabilitation services in the HSCT process disrupts the procedure (Randall et al., 2025).

In the psychosocial follow-up processes after pediatric hematopoietic stem cell transplantation (HSCT), differences in practice are observed due to the lack of standard follow-up guidelines. Although current approaches primarily focus on the child's mental health, critical elements such as family support and caregiver fatigue are often overlooked (West et al., 2020).

In the literature, the lack of a sufficient number of cohort studies examining the long-term effects on mental health and the absence of comprehensive databases documenting the impact of concurrent psychiatric care on survival, quality of life, and academic success are the most fundamental gaps in this field. In this context, the development of comprehensive follow-up models that cover multiple areas and provide clear guidance for implementation is a necessity. Psychiatric screenings should be structured in three critical phases: pre-transplant, immediately post-transplant, and long-term post-transplant. Additionally, the use of digital health tools such as online therapy and mobile monitoring systems should be promoted, and multidisciplinary programs should be designed to encourage the full integration of child mental health services into cancer care plans.

Conclusion

HSCT is a challenging treatment procedure that affects the body, mind, social life, and cognitive abilities. Long-term functioning may be hampered by mental health issues that people frequently ignore during this time. These effects can be lessened with early detection, thorough follow-up, family support, and interdisciplinary collaboration. The goal of the methodical integration of pediatric hematology-oncology and child psychiatry practices is to improve overall quality of life as well as individual survival.

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