

Review

When tumors move the body: tic symptoms, emotional distress, and psychosocial burden in children with brain tumors

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Abstract: Paediatric brain tumors are increasingly recognized as conditions with profound psychological and psychosocial consequences extending beyond neurological and cognitive impairments. Among the less frequently discussed neuropsychiatric manifestations, tic symptoms (referred to herein as "tic symptoms" to distinguish them from primary tic disorders such as Tourette syndrome) in children with brain tumors across different stages of the disease trajectory. The review is based on case reports and small case series, as no systematic prevalence studies or controlled trials are currently available. Although relatively uncommon, these symptoms are highly visible and unpredictable, and may contribute substantially to emotional distress, social difficulties, and family burden. This narrative review synthesizes existing literature on tic symptoms in children with brain tumors, with a particular focus on their psychological and psychosocial impact within a psycho-oncological framework. Drawing primarily from case reports and case series, the review examines clinical characteristics of tic symptoms, their temporal relationship to tumor diagnosis and treatment, and proposed neuroanatomical mechanisms involving cortico-striato-thalamo-cortical circuits. Beyond biological considerations, the review highlights how tic symptoms may exacerbate anxiety, embarrassment, and social withdrawal in affected children, while increasing parental uncertainty and caregiver stress. Clinical implications for psycho-oncology practice are discussed, emphasizing early recognition, interdisciplinary collaboration, clear communication with families, and targeted psychosocial support. The review also identifies significant gaps in the literature, including the absence of systematic prevalence data and limited attention to emotional and family-level outcomes. Causal relationships cannot be inferred from the available evidence, and all associations described are observational and descriptive in nature.

Keywords: brain tumors; children; neuropsychiatric symptoms; psycho-oncology; psychosocial burden; tic symptoms

1. Introduction

Advancements in diagnosis and treatment have significantly improved survival rates among children with brain tumors, leading to increased clinical and research focus on the psychological and psychosocial consequences of the disease. The growing population of long-term survivors highlights non-motor and non-cognitive sequelae such as emotional wellbeing, behaviour, and family functioning that impact the illness experience as profoundly as tumor-directed physical symptoms (e.g., neurological impairment or seizures) [1–3]. In paediatric neuro-oncology, survivors and patients undergoing treatment often face a range of emotional, behavioural, and social challenges that extend beyond classic neurocognitive deficits, making these psychosocial dimensions crucial components of quality-of-life (QoL) assessments and survivorship care planning [2,4].

Non-motor manifestations including emotional dysregulation, anxiety, social

withdrawal, and altered peer relationships are increasingly recognized as integral to the survivorship trajectory, influencing functioning at school, within families, and in social contexts (e.g., friendships and participation in activities) [1,2,5]. These psychosocial challenges are affected by tumor biology, treatment exposures (such as cranial irradiation and chemotherapy that can have neurotoxic effects), and the stress associated with facing a life-threatening illness, creating a complicated interplay between medical sequelae and family dynamics [3,4,6]. The visibility and interpretive ambiguity of certain neuropsychiatric phenomena like sudden, involuntary motor or vocal presentations can heighten distress for children and their families due to increased social scrutiny and uncertainty regarding prognosis and functional trajectory [7].

Within this framework, tic symptoms (i.e., sudden, rapid, recurrent, non-rhythmic motor movements or vocalizations) have been reported in paediatric medical populations, including those with neurological insult or autoimmune neuropsychiatric features, and they are often noticeable and socially relevant. Managing and interpreting such manifestations requires careful consideration of differential diagnosis and contextual factors, emphasizing the need for integrated psychosocial and neuropsychiatric care in paediatric brain tumor programs. While direct reports of tic symptoms specifically linked to paediatric brain tumors are limited to isolated case reports and small case series, with no systematic prevalence data available, the broader paediatric neuropsychiatric literature underscores that tic presentations can be associated with emotional distress, social impairment, and functional disruptions, requiring thorough clinical evaluation and targeted psychosocial support [8,9].

This review synthesizes current evidence on psychosocial burdens and related neurobehavioural presentations among paediatric brain tumor survivors and patients, with a specific focus on emotional distress, social functioning, family dynamics, and QoL. By framing tic-like phenomena within a psycho-oncological context and referencing a wider body of literature on psychosocial outcomes in paediatric neuro-oncology, the goals are to (a) clarify the scope and nature of non-motor manifestations in this population, (b) identify key determinants of emotional and psychosocial adjustment, (c) underscore knowledge gaps at the intersection of tic-related and broader neuropsychiatric presentations with cancer care, and (d) inform more comprehensive family-centered care models that integrate psychosocial screening and intervention throughout the illness trajectory.

1.1. Methods of literature search

This narrative review was conducted by searching PubMed, PsycINFO, and Scopus databases for articles published up to December 2024. Search terms included combinations of the following keywords: "tic", "Tourette", "involuntary movement", "vocal tic", "motor tic", "brain tumor", "brain tumour", "central nervous system (CNS) tumor", "central nervous system neoplasm", "pediatric", "paediatric", "child", "adolescent", "psycho-oncology", "psychosocial", "emotional distress", and "family burden". Inclusion criteria were: (1) studies reporting tic symptoms in children and adolescents (age ≤ 18 years) with brain tumors; (2) peer-reviewed articles, including case reports, case series, and observational studies; (3) English language publications. Exclusion criteria were: (1) studies focusing exclusively on adults (> 18 years); (2) studies of primary tic disorders without brain tumor diagnosis; (3) non-peer-reviewed publications (e.g., conference abstracts, dissertations). The initial search yielded 87 records. After title and abstract screening, 24 full-text articles were assessed for eligibility. Ultimately, 12 articles met inclusion criteria and were included in this

narrative synthesis.

2. Paediatric brain tumors and neuropsychiatric manifestations

2.1. Overview of paediatric brain tumors

Paediatric brain tumors remain the most common solid malignancies in childhood and continue to be a leading source of cancer-related morbidity and mortality in this population [1]. Over the past decades, advances in neuroimaging, surgical techniques, chemotherapy, and radiotherapy have collectively contributed to improved survival rates, shifting the emphasis in clinical care and research toward understanding and mitigating long-term neurocognitive, emotional, and psychosocial sequelae that extend beyond tumor control [10,11]. The heterogeneity of paediatric CNS tumors encompassing posterior fossa, supratentorial, and midline lesions results in differential impacts on developing neural circuits, with location-related variation in presenting symptoms and trajectories of recovery or decline [1].

Cognitive sequelae are among the most consistently documented long-term effects of treatment, particularly in children who receive cranial irradiation or intensive chemotherapy. Difficulties commonly include attention, executive function, processing speed, and memory, which can interfere with academic performance and social participation [11]. Importantly, these cognitive deficits frequently co-occur with emotional and behavioural challenges, underscoring the interdependence of neurocognitive and psychosocial functioning in paediatric brain tumor survivors and the need for integrated, multidisciplinary survivorship care [2,4,12].

Emotional wellbeing and behaviour are increasingly recognized as essential components of the survivor experience. Emotional distress, anxiety, depressive symptoms, irritability, and behavioural dysregulation have been reported at various stages of diagnosis, treatment, and survivorship, reflecting tumor biology, neurotoxic treatment effects, and the psychosocial stress associated with a life-threatening illness during critical developmental periods [11]. Sleep disturbances and fatigue further complicate daytime functioning and quality of life in this population [13]. Collectively, these factors interact to shape the overall experience of illness for children and their families [11].

The paediatric neuro-oncology field has increasingly embraced a biopsychosocial framework that prioritizes systematic psychosocial screening and family-centered care. Early family mental health screening and ongoing assessment of caregiver burden have been shown to be feasible and clinically valuable in informing timely psychosocial and medical interventions for families facing a paediatric brain tumor diagnosis [14,15]. Family dynamics and caregiver stress are critical determinants of child adjustment and long-term outcomes, influencing treatment adherence and quality of life for survivors [13,15]. The impact of the COVID-19 pandemic has further highlighted the vulnerability of paediatric brain tumor survivors and their families to educational disruption and increased psychosocial stress, reinforcing the need for resilient, adaptable psychosocial supports integrated into standard care [16].

In sum, the contemporary psycho-oncological literature advocates for a holistic, family-centered approach to paediatric brain tumors that integrates emotional health, behavioural adjustment, and family dynamics with conventional medical management. This integrated model remains essential as tic-like and other neuropsychiatric manifestations are recognized within paediatric brain tumor survivors, requiring careful differential diagnosis and coordinated medical-psychosocial care [8,9].

2.2. Neuropsychiatric and behavioural symptoms in paediatric neuro-oncology

In addition to established neurological and cognitive sequelae, paediatric brain tumor patients and survivors frequently experience a broad spectrum of neuropsychiatric and behavioural symptoms. Emotional distress, anxiety, depressive symptoms, irritability, and behavioural dysregulation are commonly observed across diagnostic and treatment phases, reflecting disruption of neural networks by tumor biology, neurotoxic treatment effects, or the psychological impact of living with a cancer diagnosis during childhood or adolescence [2,11]. Anxiety and mood disturbances, along with procedural fears and disruptions to daily routines, can contribute to heightened emotional vulnerability and social withdrawal in some youth [11,16].

Visible neuropsychiatric manifestations such as abrupt behaviour changes or disruptive affective presentations pose unique challenges for school reintegration and family functioning. Stigma and misconceptions about illness can amplify distress for both children and caregivers, reinforcing the need for proactive psycho-oncological assessment and education within paediatric brain tumor programs [7]. Several studies highlight that psychosocial functioning is a critical determinant of health-related quality of life (HRQoL) and long-term adaptation, independent of tumor progression or overt neurological deficits [11].

Research on psychosocial risk and resilience emphasizes that self-esteem, social competence, and peer integration are particularly relevant domains for paediatric brain tumor survivors. Compared with healthy peers, survivors often exhibit deficits in social functioning, which can influence academic engagement [6,17]. Moreover, treatment-related factors such as cranial irradiation have been linked with neurocognitive inefficiencies impacting functional outcomes [17,18].

Family systems are central to paediatric brain tumor care and outcomes. Caregiver distress and altered family functioning are well-documented, with evidence suggesting that routine family mental health screening and family-centered interventions can identify risks early and support child adjustment and quality of life over time [11,15]. Caregiver burden is intricately tied to the child's psychosocial and educational outcomes and the overall effectiveness of survivorship care [15]. The pandemic has highlighted the importance of flexible psychosocial service delivery to support families navigating educational and healthcare disruptions [16].

Tic-like phenomena and related neuropsychiatric presentations in paediatric brain tumor populations are underexplored in the oncology literature. However, literature from paediatric neuropsychiatry indicates that tic disorders and acute-onset neuropsychiatric syndromes (e.g., paediatric autoimmune neuropsychiatric disorders associated with streptococcal infections (PANDAS) / paediatric acute-onset neuropsychiatric syndrome (PANS)) demonstrate that behavioural presentations can drive significant impairment and necessitate integrated medical-psychosocial management [8,9,19]. Although direct, systematic data linking tic manifestations to paediatric brain tumors are limited, these broader literatures illuminate the potential psychosocial burden of visible neuropsychiatric phenomena in survivors and support the need for coordinated care pathways [8].

Predicting and monitoring neuropsychological late effects in paediatric brain tumor survivors have become essential for tailoring rehabilitation and support. Tools such as the Paediatric Neuro-Oncology Rating of Treatment Intensity (PNORTI) and related predictive models offer structured approaches to quantifying treatment

exposure and medical factors that elevate risk for cognitive and psychosocial difficulties, informing targeted interventions and educational accommodations [17]. Research on executive dysfunction and processing speed demonstrates associations with diminished HRQoL, emphasizing the need for early neuropsychological assessment as part of comprehensive survivorship care [5,17]. Recovery trajectories and quality of life are influenced not only by clinical variables but also by family functioning, social support, and access to resources, highlighting disparities that necessitate equitable psychosocial supports [13].

In conclusion, paediatric brain tumors impose a multi-layered burden that spans neurocognitive, emotional, behavioural, and familial domains. An integrated care framework combining vigilant neuropsychological monitoring, proactive psychosocial screening, and family-centered supports appears essential to optimize quality of life and long-term adjustment for paediatric brain tumor survivors across the illness continuum.

3. Tic symptoms in children with brain tumors

3.1. Definition and clinical characteristics of tic symptoms

Tic symptoms are characterized by sudden, rapid, recurrent, and non-rhythmic motor movements or vocalizations. Motor tics commonly involve the face, head, neck, or upper limbs, whereas vocal tics may include throat clearing, sniffing, grunting, or other involuntary sounds. Although tic symptoms are often stereotyped, their frequency and intensity may fluctuate over time and are frequently influenced by emotional states such as stress, anxiety, or fatigue. These features contribute to the unpredictability and social visibility of tics, which may be particularly distressing for children coping with serious medical conditions [8].

In clinical practice, it is essential to distinguish between primary tic disorders and secondary tic symptoms. Throughout this manuscript, the term "tic symptoms" is used to refer to secondary tic phenomena occurring in the context of brain tumors, whereas "primary tic disorders" refers to neurodevelopmental conditions without an identifiable organic cause. Primary tic disorders, including Tourette syndrome and chronic tic disorders, are neurodevelopmental conditions that typically emerge in early childhood and follow a characteristic course. In contrast, secondary tic symptoms arise in association with identifiable neurological or medical conditions, such as structural brain lesions, infections, metabolic disorders, or exposure to certain medications. In paediatric brain tumor populations, tic symptoms are best conceptualized as secondary manifestations, reflecting underlying neuropathological or treatment-related processes rather than primary neurodevelopmental disorders [20].

This distinction has important psycho-oncological implications. While primary tic disorders are often managed within psychiatric or neurological frameworks, secondary tic symptoms in children with brain tumors occur in the context of an existing cancer diagnosis and its psychological burden. Misclassification of these symptoms may delay appropriate evaluation and contribute to family distress, particularly when new or worsening tics are interpreted as behavioural or emotional reactions rather than potential neurobiological signals [7].

Tic symptoms may present as initial features, develop during active treatment, or persist as part of long-term survivorship. In paediatric brain tumor populations, tic symptoms have been described as presenting features prompting neurological evaluation and tumor diagnosis, may arise during treatment, or emerge in the post-treatment phase, underscoring their potential relevance across the illness trajectory [20].

To assist clinicians in differential diagnosis, the following distinguishing features are proposed:

Tumor-related tics: Often acute or subacute onset, may be unilateral or focal, may progress or fluctuate with tumor growth/treatment, frequently accompanied by other neurological signs (e.g., headache, focal deficits, seizures).

Functional tics: Typically abrupt, dramatic onset, often in older children/adolescents, suggestible and distractible, may improve with distraction, often accompanied by other functional neurological symptoms.

Medication-induced movements: Temporal association with medication initiation or dose change (e.g., antipsychotics, anticonvulsants, corticosteroids), often stereotyped (e.g., orofacial dyskinesias).

PANS/PANDAS: Acute onset with obsessive-compulsive symptoms and/or eating restriction, associated with infectious trigger (e.g., streptococcal infection), often accompanied by other neuropsychiatric symptoms (anxiety, emotional lability, sleep disturbances).

3.2. Reported cases of tic symptoms associated with brain tumors

The literature describing tic symptoms in children with brain tumors is limited to case reports and small case series; no systematic prevalence studies, controlled trials, or large cohort studies have been published to date. Although no prevalence data currently exist, the recurring appearance of tic symptoms across independent reports suggests that they represent a meaningful, albeit uncommon, neuropsychiatric manifestation in paediatric neuro-oncology [21].

Age at onset of tic symptoms varies across reported cases, spanning early childhood to adolescence. In some children, tics have been described as early or presenting symptoms that prompted neurological evaluation and subsequent tumor diagnosis. In other cases, tic symptoms developed during active treatment or emerged in the post-treatment phase, raising the possibility of treatment-related effects or delayed neurobehavioural sequelae. This temporal heterogeneity underscores the complexity of attributing tic symptoms to a single causal mechanism. Although most reported cases are in children, one adult case of vocal tic secondary to brain metastasis has also been described, providing limited background context [21].

Tumor types associated with tic symptoms include both low-grade and high-grade neoplasms, as well as lesions affecting deep brain structures or cortical-subcortical pathways. Importantly, tic symptoms have been reported both in the absence of overt neurological deficits and alongside other neuropsychiatric changes, such as emotional lability or cognitive decline. The variability in clinical presentation may contribute to under recognition, particularly when tic symptoms are mild or overshadowed by more prominent oncological concerns [20]. A summary of published case reports of tic symptoms in children with brain tumors is presented in **Table 1**.

Table 1. Summary of Reported Case Reports of Tic Symptoms in Children with Brain Tumors

Author (Year)	Age/Sex	Tumor Location	Tumor Type	Tic Type	Onset Timing	Other Features
Chen et al. (2024) [20]	Child (NS)	Thalamus	Ganglioglioma	Simple motor tics	Presenting symptom	NS
Fairaq & Alsalem (2024) [21]	Adult case	Brain metastasis	Metastatic	Vocal tic	New onset	Note: adult case, included for reference

Note: NS = not specified; systematic case-level data are limited across publications. Due to the scarcity of published pediatric cases, a comprehensive quantitative synthesis is not possible at this time.

3.3. Neuroanatomical and pathophysiological considerations

The neuroanatomical substrates implicated in tic symptoms are well described in primary tic disorders and provide a useful framework for understanding secondary tic symptoms in paediatric brain tumors. Central to tic generation are cortico-striato-thalamo-cortical circuits, particularly involving the basal ganglia, thalamus, and frontal cortical regions. Disruption of these networks may result in impaired inhibitory control and abnormal motor output, manifesting as involuntary movements or vocalizations [8].

In children with brain tumors, several mechanisms may contribute to dysfunction within these circuits. Tumors located in or near the basal ganglia, thalamus, or frontal lobes may directly interfere with neural pathways responsible for motor regulation. Mass effect, local edema, and increased intracranial pressure may further alter network connectivity, even when lesions do not directly involve canonical tic-related structures. These effects may be dynamic, fluctuating with tumor growth, treatment response, or perioperative changes [20].

Treatment-related factors also warrant consideration. Neurosurgical intervention, radiotherapy, and chemotherapy may produce transient or persistent alterations in neural function, potentially unmasking or exacerbating tic symptoms. The broader psychiatric and social context such as stress and heightened anxiety common in paediatric oncology may modulate tic expression and severity, reinforcing the need for integrated medical and psychosocial assessment in paediatric brain tumor care [8].

From a psycho-oncological perspective, tic manifestations should be understood within an emotional and social context. Recognizing tic symptoms as potential neurobiological signals rather than solely as behavioural reactions highlights the importance of multidisciplinary evaluation and family-centered care in paediatric neuro-oncology programs [7]. **Figure 1** summarizes a psycho-oncological framework linking tumor-related neurobiological factors to tic symptoms and their psychological and psychosocial consequences in children with brain tumors.

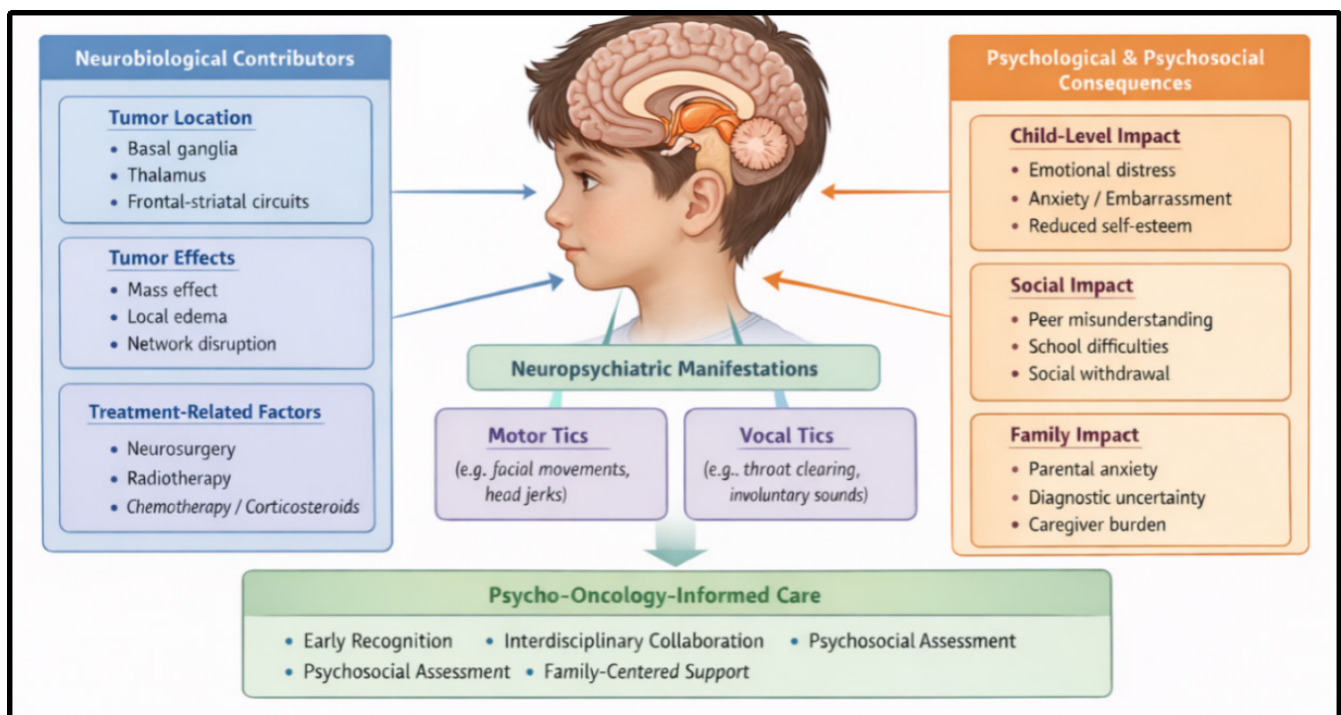


Figure 1. Conceptual Framework of Tic Symptoms as a Psycho-Oncological Phenomenon in Paediatric Brain Tumors

4. Emotional distress and psychological impact on affected children

Children diagnosed with brain tumors face profound emotional challenges related to illness uncertainty, invasive treatments, and disruptions to daily life. The emergence of tic symptoms within this context may intensify psychological distress by adding an additional, highly visible, and difficult-to-control manifestation of illness [12,13,22].

For affected children, tic symptoms may evoke feelings of embarrassment, frustration, or loss of control. The involuntary nature of these movements or vocalizations can challenge a child's developing sense of autonomy and self-regulation, particularly in social or school environments. Children may attempt to suppress tics in public settings, which can lead to increased internal tension, anxiety, and emotional exhaustion. Over time, these experiences may contribute to diminished self-esteem and heightened emotional sensitivity [23,24].

Social interactions represent a critical domain of psychological impact. The conspicuous nature of tic symptoms may attract attention, provoke peer misunderstanding, or lead to teasing and social exclusion. In the context of pediatric cancer, where children may already feel different from peers due to treatment-related absences or visible changes, tic symptoms can further amplify feelings of isolation. Difficulties with peer relationships and school reintegration may, in turn, reinforce emotional distress and withdrawal [23,25].

Emotional distress associated with tic symptoms may also interact with cancer-related stressors, creating a bidirectional relationship that exacerbates symptom burden. Periods of heightened psychological stress are known to influence tic expression and severity, reinforcing a cycle of distress that is challenging to interrupt without targeted psychosocial support [26,27].

Within a psycho-oncological framework, recognizing tic symptoms as meaningful contributors to emotional distress underscores the importance of holistic assessment [28]. Addressing psychological responses to tic symptoms—not only their neurological basis—may help mitigate anxiety, support emotional regulation, and improve overall quality of life for children with brain tumors.

5. Psychosocial burden and family impact

The psychological impact of pediatric brain tumors extends beyond the affected child to encompass the family system as a whole. When tic symptoms emerge, they may introduce additional layers of uncertainty, concern, and emotional strain for caregivers. Families are often required to interpret new or fluctuating behaviors while simultaneously managing the demands of cancer treatment [13,22,29,30].

Parents and caregivers may experience heightened anxiety when confronted with tic symptoms, particularly when these behaviors are sudden, persistent, or poorly explained. In the absence of clear clinical guidance, tic manifestations may be interpreted as signs of tumor progression, neurological deterioration, or treatment failure. Such interpretations can amplify fear and uncertainty, even when medical evaluations do not indicate disease worsening [22,25,31].

Diagnostic ambiguity represents a significant source of family burden. Tic symptoms may be misattributed to psychological reactions, medication side effects, or behavioral issues, leading to delays in recognition and appropriate explanation. Families may struggle to reconcile differing interpretations offered by medical professionals, educators, or extended social networks. This lack of clarity can undermine caregiver confidence and complicate decision-making [22–24].

The presence of tic symptoms may also affect family dynamics and daily routines. Caregivers may modify social activities, school attendance, or family interactions to protect the child from embarrassment or negative social experiences. Siblings may experience confusion or distress in response to visible symptoms, while parental attention may become increasingly focused on symptom monitoring and management [12,13,29,32].

From a psycho-oncological perspective, addressing family impact is essential for comprehensive care. Supporting caregivers through education, emotional support, and clear communication may reduce anxiety and foster adaptive coping. Recognizing tic symptoms as part of the broader psychosocial landscape of pediatric brain tumors highlights the need for family-centered interventions that attend not only to disease management but also to emotional resilience and quality of life across the family system [33].

6. Clinical implications for psycho-oncology practice

The recognition of tic symptoms as meaningful neuropsychiatric manifestations in children with brain tumors carries significant implications for psycho-oncology practice. These symptoms, while relatively uncommon, are highly visible and emotionally salient, potentially influencing a child's psychological adjustment and family wellbeing. Integrating awareness of tic symptoms into routine psycho-oncological care can enhance early identification of distress and support more comprehensive, person-centered management [34,35]. The broader paediatric brain tumor literature underscores that emotional and psychosocial burdens extend well beyond medical control of disease, reinforcing the need for routine psychosocial screening and family-centered approaches within oncology programs [34].

Early recognition is a critical first step. Tic symptoms may be subtle, intermittent, or overshadowed by more prominent neurological or oncological concerns, leading to underreporting or misinterpretation. To facilitate detection in routine clinical practice, the following brief screening questions may be useful: (1) "Has your child developed any sudden, repetitive movements or sounds that they cannot control?" (2) "Do these movements or sounds come and go, or get worse when your child is stressed or tired?" (3) "Have you or others noticed any new 'habits' or 'nervous movements' since your child's diagnosis?" These questions can be integrated into routine psychosocial assessments without requiring specialized training. Psycho-oncology professionals, including psychologists, nurses, social workers, and related disciplines are frequently well-positioned to observe behavioural changes during clinical encounters. Incorporating brief behavioural screening and targeted psychosocial assessment into routine care may facilitate timely recognition and reduce diagnostic ambiguity, thereby enabling earlier psychosocial intervention and medical consultation when needed [35,36]. Multidisciplinary collaboration supports accurate interpretation of symptoms and coordinated care planning, which can alleviate caregiver anxiety when messaging is clear about potential etiologies (tumor-related, treatment-related, or stress-modulated) [37].

Interdisciplinary collaboration is essential in managing tic symptoms within paediatric brain tumor care. Close communication between oncology, neurology, psychiatry, and psycho-oncology teams can foster accurate interpretation of symptoms and coordinated care planning. Clarifying whether tic manifestations are likely related to tumor location, treatment effects, or stress-related modulation may alleviate caregiver anxiety and prevent unnecessary escalation of medical investigations. Consistent messaging is crucial for reducing uncertainty and fostering trust [35]. Family-centered collaboration is further supported by studies advocating proactive

mental health screening for families at diagnosis and throughout the illness trajectory, which can inform timely psychosocial supports and care coordination [35].

Effective communication with children and families represents another key clinical implication. Explaining tic symptoms in age-appropriate and non-stigmatizing language can help children understand their experiences and reduce self-blame or embarrassment. For caregivers, receiving clear explanations about the nature and implications of tic symptoms may mitigate fears related to disease progression and support adaptive coping. Psycho-oncology professionals can play a central role in facilitating these conversations and addressing emotional responses, consistent with guidelines emphasizing integrated psychosocial care across paediatric oncology trajectories [8]. Counseling strategies that normalize tic presentations while distinguishing neurobiological signals from behaviour can reduce stigma and promote engagement with psychosocial services [24].

Psychological and behavioural support should be tailored to the individual child's needs and developmental stage. Interventions aimed at emotional regulation, stress management, and coping may help reduce tic-related distress, even when tic frequency or severity cannot be fully controlled. Supporting social reintegration, school participation, and peer understanding is particularly important for minimizing the psychosocial impact of visible symptoms. Such interventions align with established psycho-oncology approaches that prioritize quality of life and functional participation alongside medical management, including family education and coping skills training [38,39,40,41].

Finally, tic symptoms should be considered within the broader context of survivorship and long-term follow-up. As survival rates improve, attention to neuropsychiatric and psychosocial sequelae becomes increasingly important. Monitoring tic symptoms and associated emotional distress over time can inform anticipatory guidance and ongoing support, including educational planning and social reintegration strategies. Integrating tic symptoms into holistic models of paediatric brain tumor care supports ongoing psychosocial surveillance, timely referrals, and coordinated care across oncology, neurology, and psychiatry, thereby addressing the evolving needs of children and their families throughout the illness continuum [42]. **Figure 2** outlines a proposed clinical pathway for the recognition and psycho-oncological management of tic symptoms in children with brain tumors.

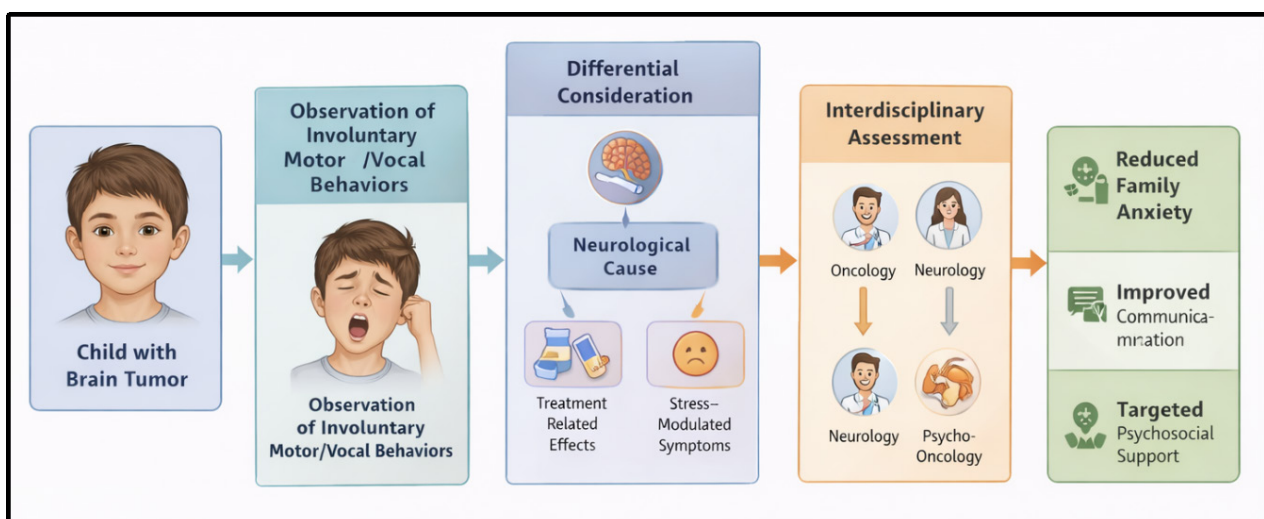


Figure 2. Proposed clinical pathway for the recognition and psycho-oncological management of tic symptoms in children with brain tumors.

7. Gaps in the literature and future research directions

Based on the limitations identified in this review, the following five priority research directions are proposed:

Priority 1: Prospective observational studies – Implement systematic neuropsychiatric screening in pediatric brain tumor cohorts to establish the first prevalence estimates of tic symptoms. Such studies should enroll consecutively treated patients and use standardized assessments.

Priority 2: Development of validated assessment tools – Create and validate tic assessment protocols specifically designed for pediatric neuro-oncology settings, covering tic type, frequency, intensity, and functional impact.

Priority 3: Longitudinal biopsychosocial studies – Examine interactions between tic symptoms, tumor biology, treatment exposures, and psychosocial stressors over time.

Priority 4: Qualitative investigations – Explore lived experiences of children and families dealing with tic symptoms to inform patient-centered interventions.

Priority 5: Intervention pilot studies – Test feasibility and preliminary efficacy of integrated psychosocial care pathways addressing tic-related distress.

The current evidence base has several critical limitations that must be acknowledged. First, there are no systematic prevalence studies of tic symptoms in pediatric brain tumor populations. Second, the literature relies exclusively on case reports and small case series, with no controlled trials or large cohort studies. Third, no validated screening tools for tic symptoms have been developed specifically for this population. Fourth, prospective cohort studies are urgently needed to establish incidence, natural history, and risk factors.

8. Conclusion

Tic symptoms represent a rare but meaningful neuropsychiatric manifestation in children with brain tumors. However, it is critical to emphasize that causal relationships cannot be inferred from the available case reports; all observed associations are descriptive rather than confirmatory. The current evidence base is limited to small case series, and no prevalence data or controlled studies exist. Occurring across different stages of the disease trajectory and contributing to psychological and psychosocial burden. Although often overshadowed by more prominent neurological or oncological concerns, these involuntary motor and vocal behaviours are highly visible and may significantly affect emotional wellbeing, social functioning, and family adjustment.

From a psycho-oncological perspective, tic symptoms should not be viewed solely as neurological curiosities but as experiences that shape how children and families perceive, interpret, and cope with illness. The unpredictability and social salience of tics can intensify distress, amplify caregiver anxiety, and complicate communication within clinical and social environments. Recognizing these symptoms as part of the broader psychosocial landscape of paediatric brain tumors is essential for comprehensive, family-centered care.

The current literature, while limited, highlights the need to move beyond descriptive case reports toward integrative approaches that address both neurobiological mechanisms and psychological impact. Incorporating systematic assessment of tic symptoms and associated emotional distress into paediatric neuro-oncology practice may facilitate earlier recognition, reduce diagnostic uncertainty, and inform tailored psychosocial interventions.

As survival rates continue to improve, attention to neuropsychiatric and psychosocial sequelae becomes increasingly important. Addressing tic symptoms within a psycho-oncological framework offers an opportunity to enhance quality of life, support emotional resilience, and strengthen holistic care for children with brain tumors and their families. Future research must prioritize prospective observational studies and standardized assessment tools to move beyond descriptive reports toward an evidence-based understanding of this phenomenon.

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