Research Square

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Risks for Excessive Daytime Sleepiness in Pediatric Brain Tumors

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Research Article

Keywords: Brain tumors, excessive daytime sleepiness, central disorders of hypersomnolence, pediatrics

Posted Date: August 26th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10656651/v1

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Additional Declarations: No competing interests reported.

Abstract

Purpose.

Excessive daytime sleepiness (EDS) was previously found to be the most common sleep complaint for youth with central nervous system neoplasms and may occur in up to 82% of youth with brain tumors, depending on diagnosis type. Established risk factors for the development of EDS include grade 2 hypothalamic involvement and high body mass index; however, the identification of additional risk factors across various brain tumor types is limited.

Methods.

A total of 209 individuals diagnosed with pediatric brain tumors within the last 15 years at an academic medical center in the south were study eligible. Due to no longer receiving medical care, EDS and risk factors were coded through retrospective chart review only for 145. For those receiving active medical care (n = 64), EDS was screened using the Modified Epworth Sleepiness Scale and the Pediatric Hypersomnolence Survey. Risk factors were then coded using retrospective chart review.

Results.

A total of 147 (70.3%) reported EDS or were diagnosed with a CDH. Independent predictors identified by multivariable logistic regression included higher cancer treatment intensity level, younger age (≤ 6 years), and use of anti-seizure medications.

Conclusions.

Increased medical provider awareness of EDS, as well as screening at various time points during cancer treatment and survivorship are needed to support more timely detection and intervention. Those diagnosed at a young age with higher treatment burden, and those that are taking ASMs should be given special care and attention with regular monitoring of EDS throughout the care continuum.

Introduction

Survivors of pediatric cancer commonly experience sleep issues, with almost half reporting a form of sleep disturbance.[1] Youth with brain tumors may be especially at risk due to tumor location and the potential effect on the hypothalamic or pituitary region, damaging the sleep-wake system.[2] Surgical interventions, cranial irradiation, chemotherapy and tumor-related complications such as hydrocephalus, may contribute to additional dysfunction of the hypothalamic-pituitary-adrenal axis. [2]

Excessive Daytime Sleepiness (EDS) was previously found to be the most common sleep complaint in youth with a history of neoplasm of the Central Nervous System. [3] EDS is estimated to occur in 20–30% of youth with brain tumors and is as high as 82% in pediatric craniopharyngioma.[4] EDS impairs daily functioning and leads to decline in quality of life and mood.[2] Central Disorders of Hypersomnolence (CDH, i.e., hypersomnia, narcolepsy) may also be common in youth with pediatric brain tumors with the prevalence across studies ranging from 42 to 80%.[2]

Established risk factors for EDS and CDH include Grade 2 hypothalamic involvement, which increases the risk for EDS and narcolepsy diagnosis when compared to Grade 0 or 1.[2] High body mass index (BMI) is also associated with increased daytime sleepiness, daytime dysfunction, and impaired sleep quality in craniopharyngioma, when compared to healthy controls.[5] Youth with craniopharyngioma who were overweight or obese were more likely to receive a diagnosis of hypersomnia or narcolepsy when compared to youth who were not overweight or obese.[6]

In addition, it is hypothesized that sleep problems develop within the context of pediatric cancer secondary to medications, such as steroids. Dexamethasone is associated with increased time spent napping, disruption of Rapid Eye Movement (REM) sleep, poorer sleep quality, insomnia, increased fatigue, and changes in circadian rhythm activity.[1] Further, dexamethasone is believed to have a stronger impact on sleep when compared to prednisone, due to the increased penetration into the central nervous system. Despite these hypotheses, no studies could be located directly assessing the relationship between steroid use and EDS or CDH in pediatric brain tumors.

Tumor and treatment consequences such as pain, nausea, or hydrocephalus are believed to be risk factors for EDS.[2] Pain is known to disturb sleep, while poor sleep can heighten pain sensitivity. [7] Survivors of Hodgkin Lymphoma with high BMI and significant body pain were more likely to endorse EDS[8]; however, no studies could be located that studied the relationship between pain and EDS or CDH in pediatric brain tumor populations. Finally, individuals undergoing treatment for cancer may experience changes in their mood, and previous research has connected mood issues to sleep problems. Mood disturbance was previously found to be associated with a shorter nocturnal sleep duration in pediatric medulloblastoma.[9]

Environmental factors such as extended hospital stays or sleep disruption due to medical care may be additional risk factors for EDS.[2] In general, hospitalized youth with cancer report greater levels of fatigue, more nighttime disruptions to sleep, and greater time spent sleeping during the day.[1] Youth between the ages of 4 to 19-years-old with medulloblastoma had actigraphically-documented shorter sleep duration, prolonged time to sleep onset, and extended daytime sleep.[9] Despite this, no studies could be located that examined the relationship between extended hospital stays and EDS in pediatric brain tumor populations.

The current study aimed to examine risk factors for the development of EDS and/or CDH for youth with pediatric brain tumors. More specifically, the intensity of cancer-directed therapy, steroid use, cancer-directed therapy treatment consequences (e.g., nausea, pain), mental health concerns, extended hospital stays were examined as potential risk factors for EDS in pediatric and adolescent and young adult brain tumor patients and survivors.

Methods

Procedures

Potential risk factors for EDS were examined through a combination of retrospective chart review and patient-reported outcome measures. Chart review was conducted for youth with brain tumors and brain tumor survivors ≤ 15 years from diagnosis who were no longer presenting for medical follow-up at a southern academic medical center and were already diagnosed with hypersomnia or narcolepsy or endorsed symptoms of EDS, per review of their medical records. The presence of EDS or a sleep disorder diagnosis was coded if these issues were described in the medical record following the diagnosis of a pediatric brain tumor through clinical notes, outside medical records included within the academic medical center's electronic health records system, or International Classification of Disease codes. EDS was not coded as being present if it was due to a temporary reaction or side effect of a medication, or if it predated the brain tumor diagnosis.

Additional review of the medical records was conducted to identify whether potential risk factors for EDS were present. Coding of risk factors (e.g., intensity of cancer-directed therapy received, prolonged steroid use, treatment consequences, and extended hospital stay) was completed by a member of the research team. Extended hospital stays were coded as being present if the participant was hospitalized ≥ 14 days for a resection and ≥ 10 days if they were hospitalized for any other reason. [10] Treatment intensity was classified into 4 levels: Level 1 (lowest: surveillance or surgery alone), Level 2 (low-moderate: single-modality adjunctive therapy), Level 3 (high-moderate: multi-modality without bone marrow transplant or craniospinal radiation), and Level 4 (highest: bone marrow transplant or craniospinal radiation). Steroid use was considered prolonged if it was prescribed for > 2 weeks. [11] Treatment consequences were coded as being evident if they were listed or described in the medical record and included hypothalamic involvement, hydrocephalus, obesity, nausea, decrease in physical performance, pain, and mental health symptoms. Hypothalamic involvement, hydrocephalus, nausea, and pain were coded as being evident through review of clinical notes and/or magnetic resonance imaging reports, as well as consultation with a neuro-oncologist who served on the research team. Nausea and pain were only coded as being present if they occurred during the time of EDS, fatigue, or a sleep disorder, if present. To determine whether obesity was present, body mass index (BMI) was recorded or computed using the National Institutes of Health BMI calculator and classification system. Decrease in physical performance was coded as present when a decline occurred in the Lansky Play-Performance Scale or The Karnofsky Performance Status score as documented in clinical notes in the medical record.

Eligible participants presenting for medical follow-up (surveillance and active treatment) in inpatient or outpatient settings were approached and completed the Pediatric Hypersomnolence Survey (PHS) and the Modified Epworth Sleepiness Scale (M-ESS) to assess symptoms of EDS. The PHS is a 14-item survey for individuals between the ages of 8 and 18-years. A total score greater than 24 suggests high risk for CDH. It also provides a Sleepiness Subscale score, and scores over 8 indicate that daytime sleepiness is a concern. The PHS was found to be reliable and valid for use with pediatric patients. [12] The M-ESS is an 8-item screening tool commonly used to measure daytime sleepiness and modified from the traditional ESS for use with pediatric patients, as it removes wording related to alcohol. This measure was utilized with all participants aged 6 years and older. While the M-ESS typically uses a cut-off score of 10, a cut-off score of 6 led to some improvement in EDS detection in pediatric brain tumors, therefore, this was the cut-off score used in the present study.[13] As a result, the score of 6 was the cut-off score utilized in the current study.

If either subscale on the PHS or the M-ESS were elevated, the youth who were diagnosed with brain tumors and his or her parent completed measures of anxiety and depression. More specifically, Patient-Reported Outcomes Measurement Information System (PROMIS) measures were given. For individuals ages 8 to 17-years-old, the PROMIS Pediatric Short Form General Population version 3.0, Anxiety 8a, and Depressive Symptoms measures were completed. Parents of participants ages 5 to 17-years-old completed the PROMIS Parent Proxy Short Form General Population version 3.0, Anxiety 8a, and Depressive Symptoms 6a. Individuals 18 years and older completed the PROMIS Short Form version 1.0, Anxiety 8a and Depression 8a forms. An additional chart review was conducted to assess whether risk factors for EDS were evident in the medical record and were coded in the same manner as described above.

Analysis

Participants that were analyzed using retrospective chart review only versus screened in person for EDS and mental health symptoms were aggregated together to assess risk factors for sleepiness. Patient characteristics for patients with and without sleepiness (EDS/CDH) were analyzed using Wilcoxon rank-sum tests for continuous variables and chi-square or Fisher's exact tests for categorical variables. Results are reported as median (interquartile range) or frequency (column percentage), as applicable.

Multivariable logistic regression was employed to identify independent predictors of sleep issues. The full model included all variables from the a priori hypotheses: treatment intensity level (ordinal, 4 levels), age group (0–6 years vs. 7 + years), gender, race, prolonged steroid use, anti-seizure medication (ASM), hypothalamic involvement, obesity, anxiety, depression, and extended hospital stays.

We tested model fit using the Hosmer-Lemeshow goodness-of-fit test, and discrimination was evaluated using the c-statistic (area under the receiver operating characteristic curve). Results are presented as adjusted odds ratios (aOR) with 95% confidence intervals (CI). A two-sided p-value < 0.05 was

considered statistically significant. All analyses were conducted using SAS [Version 9.4M9 (TS1M9), SAS Institute Inc., Cary, NC].

Results

A total of 209 brain tumor patients were included, of whom 147 (70.3%) reported EDS or were diagnosed with a CDH. Of those, 145 had variables coded from retrospective chart review only, whereas 64 were screened for EDS and mental health symptoms in person due to receiving active medical care related to their brain tumor and risk factors were then coded using retrospective chart review (see Fig. 1).

Patients with sleepiness or CDH were significantly younger (median age 14.0 vs. 16.0 years, $p = 0.044$) and more likely to be in the youngest age group (0–6 years: 20.4% vs. 3.2%, $p = 0.002$). Prolonged ASM use was significantly more common in the sleep issue group (56.5% vs. 24.2%, $p < 0.0001$). Patients with sleep issues also had more hydrocephalus (60.5% vs. 42.6%, $p = 0.018$), nausea (79.6% vs. 63.9%, $p = 0.018$), worse physical performance status (82.5% vs. 67.9%, $p = 0.031$), and longer hospital stays (39.6% vs. 24.1%, $p = 0.038$). Higher cancer treatment intensity levels (3–4) displayed more frequent sleepiness (63.9%) compared to the no sleepiness group (43.7%; $p = 0.001$). There were no significant differences in gender, race, obesity, BMI, steroid use, hypothalamic involvement, pain, or mental health disorders (all $p > 0.05$; see Table 1).

Table 1
Patient Characteristics by Sleepiness in Brain Tumor Patients (N = 209)

Variable	Total (N = 209)	Sleepiness: Yes (n = 147)	No Sleepiness: (n = 62)	P-value*
Age (years), median (IQR)	15.0 (9.0–20.0)	14.0 (7.0–19.0)	16.0 (11.0–22.0)	**0.044**
Age group, n (%)				**0.002**
0–6 yr	32 (15.3)	30 (20.4)	2 (3.2)	
7–28 yr	177 (84.7)	117 (79.6)	60 (96.8)	
Gender, n (%)				0.298
Male	120 (57.4)	81 (55.1)	39 (62.9)	
Female	89 (42.6)	66 (44.9)	23 (37.1)	
Race, n (%)				0.301
White, Non-Hispanic	160 (76.6)	108 (73.5)	52 (83.9)	
Black, Non-Hispanic	26 (12.4)	22 (15.0)	4 (6.5)	
Hispanic	14 (6.7)	10 (6.8)	4 (6.5)	
Other Non-Hispanic	9 (4.3)	7 (4.8)	2 (3.2)	
Obesity, n (%)	19 (9.2)	12 (8.3)	7 (11.3)	0.491
BMI, median (IQR)	18.5 (16.2–24.2)	18.4 (16.0–23.2)	18.7 (16.6–27.5)	0.3682
Prolonged use of steroids, n (%)	58 (27.5)	43 (29.3)	15 (24.2)	0.456
Anti-seizure medication, n (%)	98 (46.5)	83 (56.5)	15 (24.2)	**< 0.0001**
Hypothalamic involvement, n (%)	39 (18.8)	28 (19.1)	11 (18.0)	0.864
Hydrocephalus, n (%)	115 (55.3)	89 (60.5)	26 (42.6)	**0.018**
Nausea, n (%)	156 (75.0)	117 (79.6)	39 (63.9)	**0.018**
Decreased physical performance status, n (%)	140 (78.2)	104 (82.5)	36 (67.9)	**0.031**
Pain during treatment, n (%)	173 (86.1)	126 (88.7)	47 (79.7)	0.091

**P-values: Wilcoxon rank-sum for continuous variables; Chi-square or Fisher's exact for categorical variables. Percentages are column percentages. Abbreviations: EDS = excessive daytime sleepiness; IQR = interquartile range; NH = non-Hispanic; MH = mental health.*

Variable	Total (N = 209)	Sleepiness: Yes (n = 147)	No Sleepiness: (n = 62)	P-value*
Anxiety, n (%)	155 (73.5)	113 (76.9)	42 (65.6)	0.089
Depression, n (%)	66 (31.3)	42 (28.6)	24 (37.5)	0.199
ADHD, n (%)	47 (22.3)	31 (21.1)	16 (25.0)	0.530
Adjustment disorder, n (%)	17 (8.1)	13 (8.8)	4 (6.3)	0.525
Any Mental Health problem, n (%)	172 (81.5)	122 (83.0)	50 (78.1)	0.402
Extended hospital stays, n (%)	71 (35.2)	57 (39.6)	14 (24.1)	**0.038**
Treatment intensity level, n (%)				**0.004**
1 (Lowest)	13 (6.2)	4 (2.7)	9 (14.5)	
2 (Low-Moderate)	75 (35.9)	50 (34.0)	25 (40.3)	
3 (High-Moderate)	79 (37.8)	63 (42.9)	16 (25.8)	
4 (Highest)	42 (20.1)	30 (20.4)	12 (19.4)	

**P-values: Wilcoxon rank-sum for continuous variables; Chi-square or Fisher's exact for categorical variables. Percentages are column percentages. Abbreviations: EDS = excessive daytime sleepiness; IQR = interquartile range; NH = non-Hispanic; MH = mental health.*

Unadjusted analyses revealed a significant association between treatment intensity and sleep issues (Table 1, p = 0.004). After adjusting for potential confounders in multivariable logistic regression, the relationship between treatment intensity and sleep issues became stronger (unadjusted ORs ranging 4.5–8.8 vs. adjusted ORs ranging 14.1–19.2), suggesting that covariates were suppressing the true effect. The odds of having sleep issues (EDS/CDH) were 14 times higher among patients who received treatment intensity level 2 compared to those with level 1 and 19 times higher for patients who received treatment intensity level 3 compared to level 1 after adjusting for other covariates. Finally, the odds of having sleep issues were 14 times higher among patients who received treatment intensity level 4 compared to those with level 1 after adjusting for other covariates.

Older children (7 + years-old) were 91% less likely to experience sleep issues than very young children (≤ 6-years-old). Patients who received ASM had nearly 4.5 times higher odds of sleep issues compared to those with no ASM, adjusting for treatment intensity and other factors (see Table 2).

Table 2
Multivariable Logistic Regression for Predictors of Sleepiness in Brain Tumor Patients (N = 209)

Covariate	aOR	95% CI	P-value
Treatment intensity			
Level 2 vs Level 1	**14.11**	**(2.76–97.04)**	**0.003**
Level 3 vs Level 1	**19.15**	**(3.81–129.76)**	**0.001**
Level 4 vs Level 1	**14.4**	**(2.44–112.72)**	**0.006**
Age group (7–28 year vs 0–6 year)	**0.09**	**(0.01–0.41)**	**0.007**
Anti-seizure medication (yes vs no)	**4.47**	**(2.04–10.46)**	**< 0.001**
Gender (male vs female)	0.81	(0.36–1.80)	0.612
Race			
Black Non-Hispanic vs White Non- Hispanic	3.9	(1.04–20.33)	0.066
Hispanic vs White Non-Hispanic	0.84	(0.18–4.44)	0.826
Other Non-Hispanic vs White Non- Hispanic	2.4	(0.37–25.66)	0.403
Prolonged steroid use (yes vs no)	0.72	(0.29–1.75)	0.46
Hypothalamic involvement (yes vs no)	1.03	(0.40–2.74)	0.954
Obesity (yes vs no)	0.85	(0.27–2.79)	0.782
Anxiety (yes vs no)	1.79	(0.70–4.65)	0.226
Depression (yes vs no)	0.67	(0.29–1.56)	0.353
Extended hospital stays (yes vs no)	2.14	(0.90–5.30)	0.091
Model performance: Hosmer-Lemeshow goodness-of-fit $\chi^2(8) = 7.22$, $p = 0.513$; c-statistic = 0.814.			
Abbreviations: aOR = adjusted odds ratio; CI = confidence interval; NH = non-Hispanic; EDS = excessive daytime sleepiness.			

In sum, independent predictors identified by multivariable logistic regression included higher treatment intensity level (Levels 2–4 vs. Level 1: aOR 14.1–19.2), younger age (≤ 6 years: aOR 0.09 for older vs. younger), and ASM use (aOR 4.47). Prolonged steroid use, hypothalamic involvement, obesity, anxiety, depression, and extended hospital stays were not independently associated with sleep issues after adjustment. The model demonstrated excellent discrimination (c = 0.814) and good fit (Hosmer-Lemeshow p = 0.513).

Discussion

Over seventy percent of the study sample reported symptoms of EDS or CDH at various points in their cancer care continuum. Significant risk factors suggest that treatment burden and ASM are key drivers of sleep disturbances in brain tumor patients, with very young children being particularly vulnerable. Findings that greater treatment burden and younger age (≤ 6 years old) were risk factors for EDS/CDH are consistent with the extant literature. Mandrell and colleagues previously recommended sleep assessment and intervention for pediatric craniopharyngioma patients following surgical resection.[5] These individuals are known to be at increased risk in terms of functional outcomes, which is aligned with previous findings that neurosurgery, cranial irradiation, and additional treatment consequences are a mechanism for the development of sleep issues in pediatric cancer. [2, 13] Young pediatric brain tumor survivors (≤ 6-years-old) have also been found to experience high levels of impairment across functioning.[14]

ASM was also more common in those who reported EDS or CDH. Khan et al. reported a similar result in their 2019 publication.[15] When evaluating hypersomnia in pediatric brain tumor patients, compared to control patients with brain tumors but without EDS, they found an association with ASM use in the patients who were diagnosed with hypersomnia or narcolepsy. ASMs generally reduce neuronal excitability and as a result commonly have sedation as a side effect. Even newer ASMs such as brivaracetam and cannabidiol have this adverse effect.[16, 17] Additionally, EDS is the most reported sleep problem in children with epilepsy.[18] Likely, this is multifactorial from ASM use, their effects on sleep architecture and decreased sleep quality in children with epilepsy.[16]

Inconsistent with previous findings was that hypothalamic involvement was not a significant risk factor for the development of EDS/CDH. This is very likely due to coding the presence of hypothalamic involvement as a simple “yes” or “no,” rather than through determining the grade, which has been done in previous studies. [2] This represents a limitation in the current study, as this variable was coded through chart review and simple coding was conducted due to the nature of medical records available. The non-significance of prolonged steroid use, prolonged hospital stays, and the presence of obesity as independent risk factors was also inconsistent with previous studies, [1, 2, 5, 9] although Khan and colleagues were also unable to establish a relationship between BMI and hypersomnia and narcolepsy. [15] Small sample size may have impacted our power for some variables.

Study limitations include the use of a single academic medical center in the south, which may limit generalizability across various geographic regions. A portion of the study was also conducted through a retrospective design and based on interpretation of medical records, which could limit full understanding of participant’s sleep problems or the larger clinical picture. EDS was also measured through screening tools, and although these have been found to be reliable and valid, objective measurements such as polysomnography or multiple sleep latency tests were not utilized. It should be noted that patients who received a sleep disorder diagnosis may have completed this assessment as part of their routine clinical care. Finally, potentially confounding variables, such as genetic factors or radiation fields, were not collected.

In sum, significant risk factors for the development of EDS and CDH following a diagnosis of pediatric brain tumors included treatment burden and ASM with very young children being particularly vulnerable. Despite established findings that survivors of pediatric brain tumors have a higher prevalence of hypersomnia and narcolepsy when compared to the general population, [15] we were unable to identify any recommendations for assessing or screening for EDS or CDH during active cancer treatment in the extant literature. Rosen and colleagues emphasize that sleep problems are likely to develop soon after diagnosis and treatment for youth with neoplasms of the central nervous system. [3] They emphasize that a delay in detecting these issues reduces the ability to provide the individual with much needed intervention.[3] As survivors of pediatric brain tumors have ongoing surveillance and follow-up, routine medical appointments should include screening for EDS and general sleep disruption. Similar routine screening for sleep problems has previously been recommended for youth with epilepsy, whereas the cause of sleep disruption is said to be multi-factorial, but potentially due to the adverse effect of ASMs.[19]

We were unable to identify potential strategies to mitigate the risk of EDS and CDH during active cancer treatment. While Khan and colleagues identify recommendations for treating hypersomnia or narcolepsy for pediatric brain tumor survivors, no studies or recommendations for clinical care guidelines for EDS or CDH on active treatment for pediatric brain tumors could be located. Increased awareness of these concerns within the youth's medical care team, screening at various time points in treatment and survivorship, and referral to a specialist in Sleep Medicine for further evaluation when needed are likely to support more timely detection and appropriate intervention. Particular attention to those who are diagnosed at a young age, have higher treatment burden, and are taking ASMs should be given.

The current study confirms that youth undergoing treatment for pediatric brain tumors commonly experience EDS and CDH. Further attention is needed to develop clinical care guidelines for routine screening during cancer treatment and into survivorship, as well as whether further sleep assessment and intervention are needed. Improved screening and detection of these symptoms earlier in the cancer care continuum may help guide multi-disciplinary care team efforts in reducing, or potentially preventing, the impact these symptoms have on an individual's functioning and quality of life.

Declarations

Funding

This study is supported by the Kentucky Pediatric Cancer Research Trust Fund.

Competing Interests

The authors have no relevant financial or non-financial interests to disclose.

Ethics Approval

This study was performed in line with the principles of the University of Louisville Institutional Review Board. Approval was granted by the Ethics Committee of the University of Louisville on April 17, 2024. The study was performed in accordance with the ethical standards as outlined in the 1964 Declaration of Helsinki.

Consent to Participate

Informed consent was obtained from all individual participants included in the study.

Data Availability

The datasets generated during and/or analyzed during the current study may be available from the corresponding author on reasonable request.

Author Contribution

K.L. served as the principal investigator of the study and led the development, data collection, analysis, and the development of the manuscript, including writing the manuscript text.K. N. led data coding and assisted with data analysis and the development of the manuscript.K. J. served as a consultant for data coding and led the data analysis and formation of the results. He led the writing of the results section and created Table 1 and 2.M.B. acted as a neuro-oncologist consultant to assist with decision making around coding of risk factors and provided recommendations for data analysis, as well as clinical care recommendations. He reviewed the manuscript.V. M. C. provided expertise on EDS and CDH and pediatric brain tumors, as well as interpretation of study findings. She reviewed the manuscript.E.S. served as a consultant on Sleep Medicine and Neurology, as well as provided expertise on previous findings and recommendations as it pertains to the use of anti-seizure medications and central disorders of hypersomnolence. She reviewed the manuscript.L. A. H provided expertise as it pertains to psychosocial oncology and reviewed the manuscript.All authors significantly contributed to the manuscript.

References

1. Sheikh IN, Roth M, Stavinoha PL (2021) Prevalence of sleep disturbances in pediatric cancer patients and their diagnosis and management. Child (Basel) 8(12):1100. 10.3390/children8121100
2. van Litsenburg R, Kamara D, Irestorm E, Partanen M, de Vries R, McLaughlin Crabtree V, Daniel LC (2023) Sleep problems during and after paediatric brain tumours. Lancet Child Adolesc Health 7(4):280–287. 10.1016/S2352-4642(22)00380-7
3. Rosen GM, Bendel AE, Neglia JP, Moertel CL, Mahowald M (2003) Sleep in children with neoplasms of the central nervous system: case review of 14 children. Pediatrics 112(1 Pt 1):e46–e54. 10.1542/peds.112.1.e46

4. Niel KA, Klages KL, Merchant TE et al (2021) Impact of sleep, neuroendocrine, and executive function on health-related quality of life in young people with craniopharyngioma. Dev Med Child Neurol 63(8):984–990. 10.1111/dmcn.14866
5. Pickering L, Main KM, Feldt-Rasmussen U et al (2021) Brain tumours in children and adolescents may affect the circadian rhythm and quality of life. Acta Paediatr 110(12):3376–3386. 10.1111/apa.16080
6. Mandrell BN, LaRosa K, Hancock D et al (2020) Predictors of narcolepsy and hypersomnia due to medical disorder in pediatric craniopharyngioma. J Neurooncol 148:307–316
7. Finan PH, Goodin BR, Smith MT (2013) The association of sleep and pain: an update and a path forward. J Pain 14(12):1539–1552. 10.1016/j.jpain.2013.08.007
8. Rach AM, Crabtree VM, Brinkman TM et al (2017) Predictors of fatigue and poor sleep in adult survivors of childhood Hodgkin's lymphoma: a report from the Childhood Cancer Survivor Study. J Cancer Surviv 11:256–263. 10.1007/s11764-016-0583-y
9. Graef DM, Crabtree VM, Srivastava DK et al (2018) Sleep and mood during hospitalization for high-dose chemotherapy and hematopoietic rescue in pediatric medulloblastoma. Psychooncology 27:1847–1853. 10.1002/pon.4737
10. Anhang Price R, Stranges E, Elixhauser A, Pediatric cancer hospitalizations (2009) *Healthcare Cost and Utilization Project (HCUP).* Agency for Healthcare Research and Quality. 2012(May). Accessed 8/10/2026. https://hcup-us.ahrq.gov/reports/statbriefs/sb132.pdf
11. Aljebab F, Choonara I, Conroy S (2017) Systematic Review of the Toxicity of Long-Course Oral Corticosteroids in Children. *PLoS One*. ;12(1):e0170259. Published 2017 Jan 26. 10.1371/journal.pone.0170259
12. Maski K, Worhach J, Steinhart E et al (2022) Development and Validation of the Pediatric Hypersomnolence Survey. Neurology 98(19):e1964–e1975. 10.1212/WNL.0000000000200187
13. Crabtree VM, Klages KL, Sykes A et al (2019) Sensitivity and specificity of the modified Epworth Sleepiness Scale in children with craniopharyngioma. J Clin Sleep Med 15(10):1487–1493. 10.5664/jcsm.7982
14. Jurbergs N, Harman JL, Kenney AE, Semenkovich K, Molnar AE Jr, Willard VW (2019) Cognitive and Psychosocial Development in Young Children with Brain Tumors: Observations from a Clinical Sample. Child (Basel) 6(11):128 Published 2019 Nov 19. 10.3390/children6110128
15. Khan RB, Merchant TE, Sadighi ZS et al (2018) Prevalence, risk factors, and response to treatment for hypersomnia of central origin in survivors of childhood brain tumors. J Neurooncol 136(2):379–384. 10.1007/s11060-017-2662-y
16. Zaccara G, Bartolini E, Tramacere L, Lattanzi S (2021) Drugs for patients with epilepsy and excessive daytime sleepiness. Epilepsy Behav 124:108311. 10.1016/j.yebeh.2021.108311
17. Yeh WC, Lu SR, Wu MN et al (2021) The impact of antiseizure medications on polysomnographic parameters: a systematic review and meta-analysis. Sleep Med 81:319–326. 10.1016/j.sleep.2021.02.056

18. Özdemir FMA, Çelik H (2024) Evaluation of Sleep Habits and Their Relationship With Quality of Life in Children With Epilepsy. Pediatr Neurol 155:114–119. 10.1016/j.pediatrneurol.2024.03.002
19. El Halal CDS, Nunes ML (2026) Sleep disturbances in children and adolescents with epilepsy: Clinical, polysomnographic and management aspects. Sleep Med 140:108794. 10.1016/j.sleep.2026.108794

Figures

Figure 1

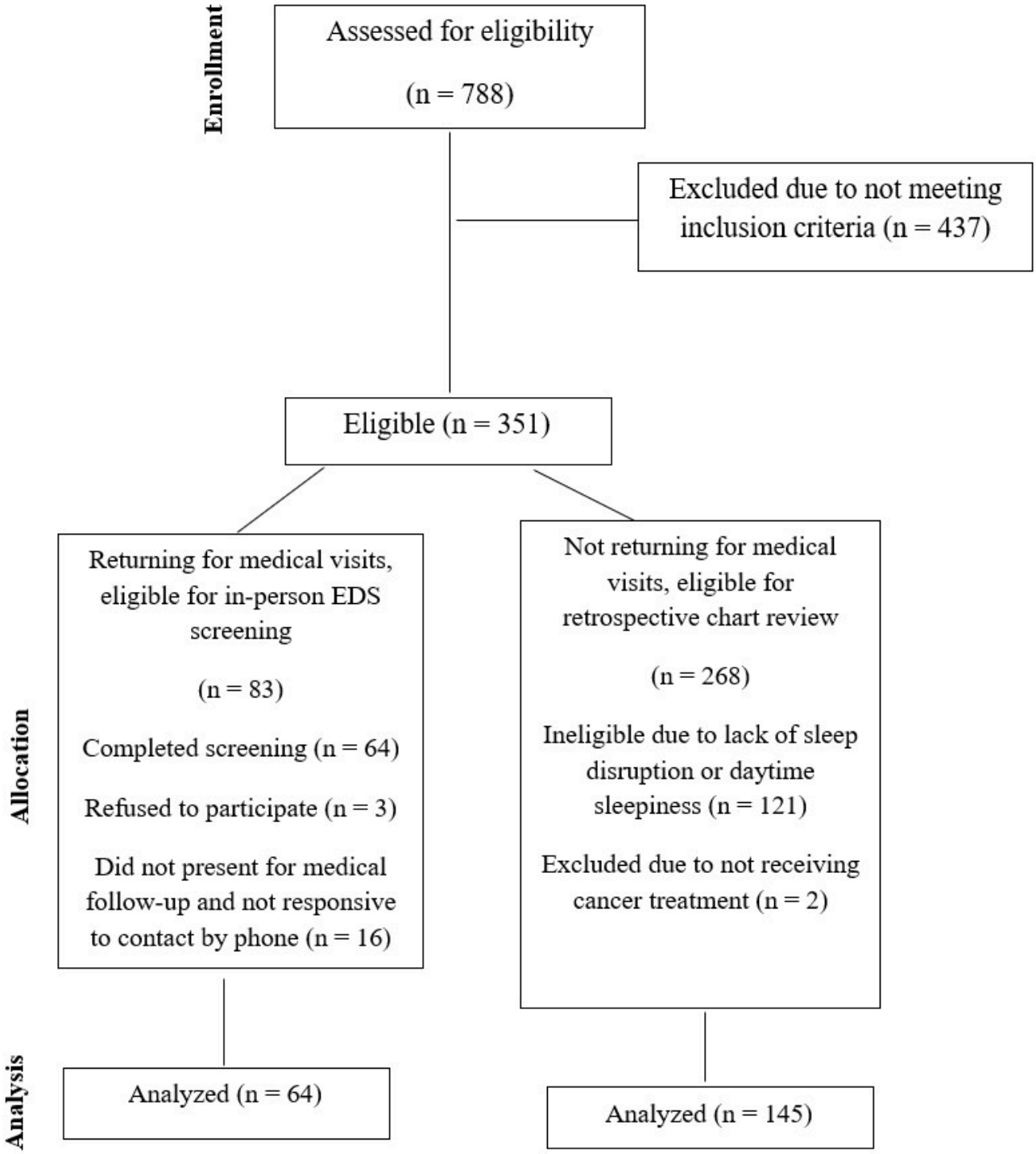


Figure 1