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Predictors of Adaptive Functioning and Psychosocial Adjustment in Children with Pediatric Brain Tumor: A Report from the Brain Radiation Investigative Study Consortium

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Abstract

Background—Children are at risk for psychosocial and adaptive morbidities following diagnosis of and treatment for a pediatric brain tumor. This study examined whether familial/demographic, developmental, diagnostic, or treatment-related variables best predict the acute psychosocial adjustment and adaptive functioning of children soon after an initial diagnosis.

Procedure—Participants included 56 children (mean age=10.72, SD=4.02) newly diagnosed with a pediatric brain tumor. Parents completed background/demographic forms and completed ratings of children's behavioral and emotional symptoms, and adaptive behavior. Diagnostic and treatment-related information was abstracted from medical records.

Results—Parent ratings of behavioral symptoms and adaptive functioning were within normative expectation, although rates of clinical impairment in adaptive functioning exceeded expected rates. A combination of familial/demographic and diagnostic variables were associated with acute functioning. In multiple regressions, tumor size best predicted adaptive functioning after initial diagnosis, whereas tumor location best predicted variance in behavioral symptoms.

Conclusions—Children may be more vulnerable to acute impairment in adaptive functioning following diagnosis of a pediatric brain tumor, but rates of behavioral symptoms were within expectation. Familial, sociodemographic, and diagnostic variables may help to identify those most at risk of impairment. Screening of these factors within tertiary care settings will be useful to identify those most in need of psychosocial care during the initial phases of treatment.

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Keywords

Brain tumor; Pediatric; Malignancy; Adjustment; Psychosocial

Introduction

Pediatric brain tumors are the most common solid tumor diagnosis of childhood, and malignant brain tumors are the second most common cancer diagnosis under the age of 20. [1,2] Pediatric brain tumors occur at an incidence rate of approximately 5.26 cases per 100,000 children per year, and approximately 4,300 new cases of childhood primary non-malignant and malignant brain and central nervous system (CNS) tumors were expected to be diagnosed in the United States in 2013.[3] Despite remaining the second leading cause of death by disease in children, the overall 5-year survival rate now exceeds 72%, largely because of improvements in multimodal treatment regimens. Concurrently, growing attention has focused on child and family adjustment during treatment, and ways to facilitate best outcomes across both medical and psychosocial domains.

Although a range of psychosocial and adaptive “late-effects” has been consistently documented in survivors of pediatric brain tumors, scant literature addresses the functioning of children during acute treatment, and findings have been inconsistent. However, research on acute adjustment to other pediatric cancers may provide a framework for understanding the impact of tumors more specifically. For example, in one study, children currently on chemotherapy for pediatric cancer were similar to peers in terms of behavioral problems, emotional functioning, and social adjustment, with outcomes in the normal range for both groups.[4] In contrast, Sawyer and colleagues found that children and parents endorsed significantly more emotional distress than community controls immediately after a cancer diagnosis and during initial treatment phases.[5] Ratings of distress gradually improved throughout the course of treatment and were similar to ratings by community controls within one year of diagnosis.

Two studies have specifically explored the impact of pediatric brain tumors on acute functioning. One such study found that within the first several weeks after surgery, children displayed deficits in adaptive functioning, particularly daily living skills. These deficits persisted across the first six months after surgery.[6] Hardy and colleagues compared social competence and psychosocial functioning in fifteen children on treatment for pediatric brain tumor with fifteen children recently off treatment and found that children off-treatment reported more concerns about social competence.[7] Across groups, lower social acceptance was associated with higher ratings of aggression, somatization, and internalizing symptoms; medical variables (i.e., age at diagnosis, time since treatment) were unrelated to social functioning.

Although research on acute functioning is sparse, research on long-term adaptive and behavioral sequelae following pediatric cancer could shed light on areas of difficulty. Overall, whereas some children demonstrate resilience, other children experience significant psychosocial and adaptive sequelae following diagnosis. In the long term, increased psychological distress is predicted by demographic factors (e.g., low family income, low

educational attainment, female gender).[8,9] Treatment with cranial radiation, with or without intrathecal chemotherapy, is also associated with increased psychological distress, [9,10] and impairment in physical and adaptive functions.[11,12] Because cranial radiation is typically a method of treatment reserved for children with central nervous system disease, children with pediatric brain tumor may be most vulnerable.

Although numerous studies have explored predictors of long-term difficulties, the demographic, diagnostic, and treatment-related factors that predict acute functioning are comparatively unexplored. Many tertiary care centers allocate resources for psychosocial support on inpatient and outpatient care units (e.g., psychology, social work, child life); however, resources are limited and thorough assessment of adaptive and psychosocial functioning necessarily takes a back seat to acute medical care. Identification of factors that may be used to target those families most in need of intervention may facilitate efficient psychosocial service in acute care settings.

The goals of the current study were to examine whether children in the initial stages of treatment for pediatric brain tumor experienced difficulties with psychosocial and adaptive functioning. We also sought to identify whether familial/demographic factors, birth and developmental histories, and/or diagnostic and treatment information best predict acute difficulties in these areas. The study examined data collected as part of a larger project that monitored the psychosocial, adaptive, and neurocognitive functioning of 4- to 17-year old children at several time points during treatment for a pediatric brain tumor, and assessed radiation-related morbidity in these children. The analyses examined the individual and collective predictive values of a range of variables on adaptive and psychosocial functioning at the first assessment time point, an average of 19 days after diagnosis. We predicted that children in the early stages of treatment would display deficits in adaptive functioning and higher levels of internalizing problems related to adjustment to diagnosis. Children were not expected to display elevated externalizing problems during the acute phase of treatment given limited opportunities to engage in such behaviors. We also expected that demographic, developmental, and diagnostic (e.g., presenting symptoms, tumor size and location) variables would predict adaptive and behavioral outcomes. We did not expect an association between treatment-related variables and adaptive and behavioral functioning, because they more likely emerge over time.

Method

Participants

Participants included 56 children ages 4 to 17 years who had recently been diagnosed with a brain tumor (see Table I for participant descriptive data). This age range was selected given the study's focus on the functioning of children and adolescents. Very young children (i.e., 3 years old) were excluded because radiation is much less commonly used with these patients and those young children who did receive radiation would likely be poorly representative of this age range in general. Recruitment took place in the Neuro-Oncology clinics at three urban medical centers: Cincinnati Children's Hospital Medical Center in Cincinnati, Ohio; Nationwide Children's Hospital in Columbus, Ohio; and Kennedy Krieger Institute/Johns Hopkins Hospital in Baltimore, Maryland. During recruitment, 271 potential

participants who had recently undergone resection of a brain tumor were screened for the study. Surgery was required for participation because some surgical intervention (from biopsy to gross total resection) is nearly always included in initial treatment steps. Of these 271 children, 158 did not meet eligibility criteria. Thirty were excluded due to severe pre-existing conditions or ineligible tumor types (e.g., glioblastoma multiforme, intrinsic brain stem gliomas), largely due to the grim prognosis of these tumors and the likelihood that children would not live long enough to participate in a longitudinal study. Ninety-three children were excluded due to severe post-surgical complications. These complications either rendered them too ill to participate in the baseline evaluation or included acute imaging abnormalities that would obscure assessment of acute versus chronic influences on functioning. Finally, 35 were excluded due to a history of neurofibromatosis type 1, as this genetic disorder is independently associated with cognitive and functional difficulties outside of the occurrence of tumors. Forty-four participants were eligible but declined participation for various reasons (e.g., family stress, lived out of state). Of the 69 participants who enrolled in the study, 6 died before data were collected, and 4 dropped out, yielding 59 total participants in the overall study. Because the current analyses focused on functioning during acute phases of treatment, participants who underwent their initial assessment greater than six months post-diagnosis were excluded ($n=3$), yielding a final sample size of 56. Participants received \$75 for completing the evaluation.

Study Procedure

Participants were recruited during regular Neuro-Oncology clinic follow-up visits. Informed consent was obtained prior to participating in the study, and Institutional Review Board approval was obtained at all participating institutions. Parents completed ratings of psychosocial adjustment and adaptive functioning, as well as a background questionnaire that assessed family structure, education, and income, their child's birth and early developmental histories, school and behavioral histories, and relevant family psychiatric histories. For measures of behavior and adjustment at this baseline time point, parents were instructed to rate their child's functioning over the past two weeks. Diagnostic and treatment-related variable were extracted from the participant's medical record, and tumor characteristics were confirmed by a board certified neuroradiologist.

Measures

Child psychosocial adjustment was measured using the parent-report version of the Behavior Assessment System for Children-Second Edition (BASC-2).[13] The BASC-2 is a multidimensional questionnaire that assesses parent report of adaptive and problem behaviors through Likert-scale ratings. There are three forms, which have comparable structures, for various ages levels: preschool (4-5), child (6-11) and adolescent (12-18). For the present study, the BASC-2 Internalizing Problems Composite, Externalizing Problems Composite, and Behavioral Symptoms Index (BSI) were used to measure behavioral adjustment. Scores on the subscales and composite scores are standardized by age. The BASC-2 has adequate convergent validity with other established child behavior questionnaires, and adequate criterion validity in distinguishing clinical from nonclinical samples.[13]

The Adaptive Behavior Assessment System-Second Edition (ABAS-II) is a norm-referenced rating scale designed to assess typical daily adaptive living skills of individuals 5 to 21 years of age.[14] The parent version used for the study has a total of 232 questions divided into 10 sections in a Likert scale format. The ABAS-II assesses the parent's perception of the adaptive skill areas of communication, community use, functional academics, home living, health and safety, leisure, self-care, self-direction, social, and work. For the present study, the ABAS-II Conceptual Composite, Practical Composite, Social Composite, and Global Adaptive Composite (GAC) were used to measure domain-specific and global adaptive functioning. The ABAS-II demonstrates a high degree of internal consistency across all ages and adaptive skill areas. Test-retest reliability ranged from .75 to .96 and inter-rater reliability was .83.

Data Analysis

Predictor variables within broad domains (e.g., demographics, diagnostic variables) were selected based on previous literature and theory on coping and adjustment in pediatric chronic illness populations. Preliminary correlational analyses were used to examine predictors within each of these aforementioned domains to identify the most salient predictors as well as to screen for multicollinearity among predictors. Predictors were selected for inclusion in regression analyses based on empirical relationships with outcome variables; if significant predictors were correlated within a domain, the most salient predictor was retained.

Linear multiple regression analyses were conducted to assess the individual and combined predictive validity of the retained predictor variables for domain-specific and global composites on the ABAS-II and BASC-2. Binary logistic regression analyses were conducted to assess whether any of the retained variables individually predicted the odds of impairment in behavioral or adaptive functioning. To conform with recommendations for running logistic regression, multicollinearity of predictor variables and ratios of cases to variables (i.e., cell counts) were examined for categorical predictors. Independent variables with less than three cases per cell were excluded; multicollinearity was addressed by eliminating the offending variable from the analysis.

Results

Behavioral and Adaptive Outcomes

Means, standard deviations, and rates of impairment for behavioral and adaptive outcome measures are presented in Table II. Means for all outcome measures were within the average range. Rates of impairment in overall behavioral symptoms, internalizing, and externalizing were similar to expected rates in the general population. Rates of impairment in global adaptive functioning exceeded expectations; impairment in social and conceptual skills was within expectation, whereas impairment in practical skills exceeded expectation.

Predictors of Behavioral and Adaptive Outcome

Correlation among predictors and adaptive and behavioral outcomes are presented in Tables III and IV, respectively. On the ABAS-II, lower overall adaptive functioning was associated

with lower family income, lower parent education, and larger tumor size. The ABAS-II Conceptual, Social, and Practical composites were all significantly predicted by these three factors as well. In addition, lower conceptual skills were significantly associated with the child having a history of attention problems.

Greater reported behavioral symptoms on the BASC-2 BSI were significantly associated with lower family income, lower parent education, a parent history of psychiatric problems, and supratentorial tumor location. Greater internalizing problems were significantly associated with supratentorial tumor location and treatment with chemotherapy, whereas greater externalizing problems were associated with lower family income, lower parent education, and supratentorial tumor location. Birth and early developmental histories, and presenting symptoms did not significantly predict any outcome.

Significant and marginally significant individual predictors for each outcome variable were retained and entered into multiple linear regression to determine the independent and shared variance in outcome accounted for by each predictor (Table V). In the regression model predicting overall adaptive functioning on the ABAS-II, tumor size emerged as the sole significant independent predictor. The overall regression model explained 28% of the variance in adaptive outcome. In the regression model predicting conceptual skills on the ABAS-II, family income, history of a developmental delay (i.e., in sitting, walking, and/or talking), history of attention problems, and tumor size emerged as significant predictors; the overall model explained 53% of the variance in conceptual skills. In the model predicting social skills on the ABAS-II, parent education and tumor size emerged as significant predictors; the overall model explained 38% of the variance in social skills. Finally, in the regression model predicting practical skills on the ABAS-II, history of behavioral problems and tumor size emerged as significant predictors. The overall model explained 43% of the variance in practical skills.

In the regression model predicting behavioral symptoms on the BASC-2, tumor location emerged as the sole significant independent predictor; the overall regression model explained 40% of the overall variance in behavioral outcome. For the model predicting externalizing problems, parent education, history of attention problems, and number of presenting symptoms emerged as significant independent predictors; the overall model explained 45% of variance in externalizing problems. Finally, for the model predicting internalizing problems, tumor location was the sole independent predictor; the model explained 18% of the variance in internalizing problems.

Given the elevated rates of impairment on the ABAS-II composites, exploratory logistic regression analyses were conducted to predict impairment (Table VI). Predictors from the linear regression analyses were assessed for multicollinearity and adequate case to variable ratio as described above. Family income and tumor size were marginal predictors of impairment, such that the odds of impairment in overall adaptive functioning were 4.31 times higher if family income was \$70,000 per year and 1.07 times higher for every 1 cubic centimeter increase in tumor size. When predicting impairment on the ABAS-II Conceptual composite, tumor size was a significant predictor, such that the odds of impairment in conceptual adaptive skills were 1.15 times higher for every 1 cubic centimeter

increase in tumor size. When predicting the ABAS-II Social composite, tumor size was again a marginal predictor, such that the odds of impairment were 1.12 times higher for every 1 cubic centimeter increase in tumor size. When predicting the ABAS-II Practical composite, tumor size was a significant predictor such that the odds of impairment in practical adaptive skills were 1.37 times higher for every 1 cubic centimeter increase in tumor size. In addition, a history of behavior problems was marginally significant, such that the odds of impairment in practical adaptive skills were 47.29 times higher if the child had a pre-existing history of behavior problems.

Discussion

Pediatric brain tumors are associated with a range of psychosocial and behavioral late effects, but the functioning of children during the initial months of treatment is relatively unexplored. In this study, parents reported that children displayed significantly poorer adaptive functioning than expected normatively, while reports of behavioral symptoms were within age-expectation. This is consistent with previous research documenting difficulties with adaptive behavior but relatively spared behavioral functioning, at least during the initial phases of treatment.[6] Also consistent with Vago and colleagues, when aspects of adaptive functioning were examined more specifically, practical skills (e.g., self-care) were the area of greatest difficulty for children. This result is somewhat intuitive, as acute treatment is likely to impact these day-to-day activities more so than basic communication skills, functional academics, or social skills so immediately after diagnosis.

Behavioral symptoms and rates of behavioral impairment were consistent with normative expectations in this sample of children. Although some studies have found rates of emotional distress to be elevated immediately after diagnosis, clinical levels of internalizing and externalizing symptoms were not observed in the present cohort. Children may lack the energy or opportunity to engage in problematic behaviors during acute treatment. Elevated anxious and depressive symptoms may not have emerged to the extent that they affected parents' reporting. Alternatively, the emergence of these difficulties may parallel those of other late effects (e.g., neurocognitive deficits), which also are not immediate but instead develop over time.

A combination of familial/demographic and diagnostic factors were significantly related to both adaptive functioning and behavior. Parent education and family income predicted each outcome measure independently, and parent education remained a significant predictor after multivariate regression. This finding is consistent with a number of studies linking socioeconomic factors to the functioning of children.[15,16] Further, a parent history of psychiatric problems predicted child behavior problems, but not adaptive functioning. This pattern is also consistent with existing literature[16-18] and may be driven by a combination of familial-genetic factors and a lower tolerance threshold for problematic behavior in parents with their own psychiatric problems.

Tumor size and location were also related to outcomes. Children with a larger tumor were more likely to be rated by parents as having poorer adaptive functioning. This association may be because of the impact of larger tumors on motor functioning and/or mobility, and

thereby on children's ability to engage in activities of daily living. Larger tumors may be associated with complications (e.g., compression injury, greater surgical trauma) or the presence of hydrocephalus. Although these more specific variables did not emerge as independent predictors of adaptive functioning, tumor size may serve as a more global “proxy” for such characteristics. Tumor location, in contrast, significantly predicted behavioral symptoms in children, with elevated rates of behavior problems observed in children with supratentorial tumors. This observation is inconsistent with some previous literature, which found greater impairment in adaptive functioning, but not in emotional and behavioral adjustment, in children treated for hemispheric brain tumors.[19] However, participants in the 2008 study were treated for a low-grade tumor, whereas the current sample is more diverse both diagnostically and in terms of associated treatment. Additionally, the classification of tumor location differed slightly across the two studies (i.e., the 2008 study distinguished supratentorial midline from hemispheric tumors), which may contribute to the inconsistent findings. The association found in the current analyses is somewhat intuitive, as supratentorial tumors are more likely to encroach upon brain regions involved in mood and behavioral regulation. Unfortunately, the limited sample available in this study precluded subgroup analyses, but further research in this area is certainly warranted.

Characteristics of acute treatment did not predict adaptive or functional outcome in regression. Although treatment with intrathecal chemotherapy and cranial radiation have been linked with these outcomes,[10,20,21] deficit in these domains likely emerge over time and would not be expected so early in treatment. However, close monitoring of the extent to which these factors predict *long term* emotional, behavioral, and adaptive functioning may be desirable to determine whether intervention earlier in treatment is beneficial and to inform the timing of such interventions.

These findings may be useful in informing acute psychosocial care in tertiary care settings. When managing the limited resources available in inpatient and outpatient clinic settings, psychosocial care teams may target interventions toward families based on these socioeconomic, familial, and diagnostic factors in combination with other screening approaches (e.g., in-clinic brief questionnaires). Indeed, the few studies of functioning during acute treatment, and a wealth of research on long-term outcomes, all suggest that only a subgroup of children with brain tumors experience clinical levels of distress. Children with larger tumors may also benefit from assessment of adaptive functioning to determine whether consultation of specialty therapies (e.g., occupational or physical therapy) is warranted. Unfortunately, rates of participation in such therapies was not collected in the current study, but whether or not participation in these programs affects behavioral or adaptive functioning is worthy of further study. In contrast, children with supratentorial tumors may benefit from closer assessment of emotional and behavioral functioning to determine whether individual or family-based psychotherapy is indicated.

Although these findings contribute to our understanding of the acute functioning of children with brain tumors immediately after diagnosis, several limitations should be acknowledged. The lack of a healthy control group allowed statistical comparison only to normative samples. We also relied solely on parent-reported behavioral and adaptive functioning.

Although parents were asked to rate the child's behavior over the previous two weeks to capture recent functioning, this window does not reflect the identical two week period across participants. In other words, it may encompass diagnosis for some, but not others. That said, time since diagnosis was included in analyses and was not significantly associated with outcome. Parent-report of a child's functioning can also be influenced by parents' own psychological functioning; although a parent history of psychiatric problems was assessed as a predictor, parents' acute stress level or emotional functioning was not assessed but certainly may have an impact on their ratings. Correlations were found among socioeconomic, familial, and diagnostic variables, but additional unstudied variables may account for such associations. Although the number of brain tumor survivors exceeds that of many previous studies in this area, our power to detect subgroup differences (e.g., by tumor histology) was insufficient given the sample size. We also limited participation to children between 4-17 years of age, and children who had undergone surgical intervention; the extent to which these predictive patterns extend to very young children or adults, or those who did not undergo surgery, is unknown. Additionally, children with particularly poor prognosis were not recruited and it is possible that a distinct set of factors best predict functioning for this especially vulnerable subset of children.

In summary, the current study lays the groundwork for future research to further characterize the onset, timing, and magnitude of behavioral and adaptive sequelae during the course of treatment and survivorship in pediatric brain tumor. These studies will be important in informing intervention during acute care, planning, and effective utilization of clinical resources.

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Table I
Participant Descriptive Data (N = 56)

Demographic	Mean (SD)
Age in years	10.72 (4.02)
Age range in years	4.08-17.31
Time since diagnosis at recruitment in days	19.30 (34.28)
Time since diagnosis range in days	0-135
Gender (male/female)	39/17
Caregiver (biological mother/biological father)	49/7
Only child (no/yes)	51/5
Tumor type	
Medulloblastoma/PNET	11
Anaplastic astrocytoma	9
Low-grade astrocytoma	6
Craniopharyngioma	3
Germ cell tumor	3
Ependymoma	3
Choroid plexus tumor	2
Ganglioglioma	2
Pineal tumor	1
Other	16
Treatment Characteristics	
Surgical resection (biopsy/partial/total) [§]	10/5/32
Cranial radiation (yes/no)	23/33
Average dosage (M, SD) in cGy	5180.87 (981.01)
Chemotherapy (yes/no)	22/34

Note. PNET = primitive neuroectodermal tumor; M = mean; SD = standard deviation; cGy = centigray.

[§]Information on extent of surgical resection was unavailable for 9 participants.

Table II

Descriptive Data for Adaptive Functioning and Adjustment.

Variable	N	Mean	SD	Range	% Impaired [§]
ABAS-II General Adaptive Composite	44	92.89*	18.8	48-120	27.3%
ABAS-II Conceptual Composite	47	95.70	17.6	55-120	17.0%
ABAS-II Practical Composite	46	90.11**	19.7	45-121	28.3%
ABAS-II Social Composite	47	98.94	16.6	52-120	12.8%
BASC-2 Behavioral Symptoms Index	56	47.86	10.7	30-78	7.1%
BASC-2 Externalizing Problems	56	45.29**	11.5	30-82	7.1%
BASC-2 Internalizing Problems	56	52.54	11.4	36-85	12.5%

Note. ABAS-II = Adaptive Behavior Assessment System-Second Edition; BASC-2 = Behavior Assessment System for Children-Second Edition.

* p < 0.05 compared to normative means;

** p < .01 compared to normative means

[§] Impairment defined as > 1.5 SD below the published mean

ABAS-II normative mean = 100, SD = 15, higher scores indicate better functioning. BASC-2 normative mean = 50, SD = 10, higher scores indicate greater difficulties.

Table III

Predictors by Domain and Correlations with Adaptive Functioning Outcomes.

Predictor	ABAS-II GAC	ABAS-II Conceptual	ABAS-II Social	ABAS-II Practical
Demographic Predictors				
Highest parental education (M, SD)	13.84 [†] (1.51)	.33*	.42**	.47**
Family income (M, SD)	11.64 [‡] (3.45)	.37*	.45**	.44**
Birth History Predictors				
Pregnancy Risk Factors (#, SD)	1.82 (1.33)	.10	.25 [‡]	.24
Birth Risk Factors (#, SD)	0.47 (0.72)	.04	-.05	-.07
Birth weight (M, SD)	7.82 [§] (2.07)	-.24	-.28 [‡]	-.22
Developmental History Predictors				
Developmental delay (yes/no)	17/37	-.23	-.25 [‡]	-.22
Infant Temperament Problems (M, SD)	0.67 (1.00)	.09	.20	.11
Toddler Temperament Problems (M, SD)	1.16 (1.42)	.04	.00	.02
Parent Psychiatric History (yes/no)	5/51	-.12	-.06	-.16
Child Psychiatric Medication (yes/no)	8/48	.06	.13	.07
Child History of Special Education (yes/no)	19/37	-.06	-.13	-.04
Child History of Attention Problems (yes/no)	25/15	-.23	-.37*	-.15
Child History of Behavior Problems (yes/no)	13/26	-.21	-.20	-.07
Diagnostic Predictors				
Total Presenting Symptoms (M, SD)	1.41 (0.93)	.09	.07	.14
Tumor Size in cm ³ (M, SD)	11.40 (9.78)	-.46**	-.44**	-.45**
Tumor Location (Supratentorial/Infratentorial/Other)	30/25/1	-.03	.05	.03
Treatment Related Predictors				
Total Radiation Dose in cGy (M, SD)	5180.87 (981.01)	-.01	-.06	.13
Extent of Resection (none/partial/gross total)	10/5/32	-.14	-.12	-.06

Predictor	ABAS-II GAC	ABAS-II Conceptual	ABAS-II Social	ABAS-II Practical
Received Chemotherapy (yes/no)	22/34			
Time since Diagnosis (days) (M, SD)	19.30 (34.28)			

Note. ABAS-II = Adaptive Behavior Assessment System-Second Edition; GAC = General Adaptive Composite; M = mean; SD = standard deviation; cGy = centigrays.

‡ $p < 0.10$;

* $p < 0.05$;

** $p < 0.01$

† Mean parent education roughly equivalent to some college/post-high school education

‡ Mean family income roughly equivalent to \$70,000/year

§ Mean birth weight roughly equivalent to 6.5 lbs

Table IV

Predictors by Domain and Correlations with Behavior Problem Outcomes.

Predictor		BASC-2 BSI	BASC-2 Externalizing	BASC-2 Internalizing
Demographic Predictors				
Highest parental education (M, SD)	13.84 [†] (1.51)	-.36 ^{**}	-.44 ^{**}	-.21
Family income (M, SD)	11.64 [‡] (3.45)	-.30 [*]	-.29 [*]	-.23 [‡]
Birth History Predictors				
Pregnancy Risk Factors (#, SD)	1.82 (1.33)	-.07	-.10	-.10
Birth Risk Factors (#, SD)	0.47 (0.72)	.06	-.08	.06
Birth weight (M, SD)	7.82 [§] (2.07)	.15	.12	.16
Developmental History Predictors				
Developmental delay (yes/no)	17/37	-.01	-.05	-.12
Infant Temperament Problems (M, SD)	0.67 (1.00)	-.10	-.04	-.21
Toddler Temperament Problems (M, SD)	1.16 (1.42)	.13	.18	-.06
Parent Psychiatric History (yes/no)	5/51	.33 [*]	.26 [‡]	.20
Child Psychiatric Medication (yes/no)	8/48	-.03	.10	-.19
Child History of Special Education (yes/no)	19/37	.13	-.01	-.02
Child History of Attention Problems (yes/no)	25/15	.23	.27 [‡]	-.12
Child History of Behavior Problems (yes/no)	13/26	.30 [‡]	.18	.28 [‡]
Diagnostic Predictors				
Total Presenting Symptoms (M, SD)	1.41 (0.93)	-.16	-.25 [‡]	-.15
Tumor Size in cm ³ (M, SD)	11.40 (9.78)	.18	.18	-.11
Tumor Location (Supratentorial/Infratentorial/Other)	30/25/1	-.42 ^{**}	-.37 ^{**}	-.30 [*]
Treatment Related Predictors				
Total Radiation Dose in cGy (M, SD)	5180.87 (981.01)	-.04	.00	-.08
Extent of Resection (none/partial/gross total)	10/5/32	-.03	-.07	-.14

Predictor	BASC-2 BSI	BASC-2 Externalizing	BASC-2 Internalizing
Received Chemotherapy (yes/no)	22/34	-.04	-.07
Time since Diagnosis (days) (M, SD)	19.30 (34.28)	-.17	-.24 [‡]
			-.08

Note. BASC-2 = Behavior Assessment System for Children-Second Edition; BSI = Behavioral Symptom Index; M = mean; SD = standard deviation; cGy = centigrays.

[‡] $p < 0.10$;

* $p < 0.05$;

** $p < 0.01$

[†] Mean parent education roughly equivalent to some college/post-high school education

[‡] Mean family income roughly equivalent to \$70,000/year

[§] Mean birth weight roughly equivalent to 6.5 lbs

Table V

Predictors of Adaptive Functioning and Behavior Problems

Predictors of ABAS-II GAC						
Variable	B	SE (B)	Beta	t	Sig (p)	Partial R ²
Parent Education	3.04	1.94	.26	1.57	.13	.26
Family Income	0.77	0.87	.15	0.89	.38	.15
Tumor Size	-0.79	0.26	-.42	-3.03	.01	-.46
Predictors of ABAS-II Conceptual Composite						
Variable	B	SE (B)	Beta	t	Sig (p)	Partial R ²
Parent Education	0.96	1.86	.08	0.52	.61	.12
Family Income	1.73	0.81	.37	2.13	.04	.39
Pregnancy Risk Factors	0.29	1.73	.02	0.17	.87	.02
Birth Weight	-0.78	1.19	-.10	-0.65	.52	-.29
Developmental Delay	-12.23	4.81	-.36	-2.54	.02	-.52
Attention Problems	-13.10	4.55	-.38	-2.88	.01	-.55
Tumor Size	-0.01	0.00	-.38	-2.66	.01	-.48
Predictors of ABAS-II Social Composite						
Variable	B	SE (B)	Beta	t	Sig (p)	Partial R ²
Parent Education	4.06	1.57	.38	2.59	.01	.39
Family Income	0.67	0.69	.14	0.97	.34	.16
Tumor Size	-0.69	0.21	-.41	-3.27	.00	-.47
Predictors of ABAS-II Practical Composite						
Variable	B	SE (B)	Beta	t	Sig (p)	Partial R ²
Parent Education	-1.90	2.20	-.14	-0.86	.40	-.17
Family Income	1.56	0.90	.28	1.72	.10	.33
Behavior Problems	-12.39	5.72	-.32	-2.17	.04	-.40

Tumor Size	-0.96	0.24	-.58	-4.02	.00	-.63
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Predictors of BASC-2 BSI						
Variable	B	SE (B)	Beta	t	Sig (p)	Partial R ²
Parent Education	-1.90	1.04	-.26	-1.83	.08	-.30
Family Income	0.02	0.45	.01	0.03	.97	.01
Parent Psychiatric History	6.04	3.98	.20	1.52	.14	.26
Behavior Problems	5.06	2.79	.24	1.81	.08	.30
Tumor Location	-8.38	2.38	-.46	-3.53	.00	-.52

Predictors of BASC-2 Externalizing						
Variable	B	SE (B)	Beta	t	Sig (p)	Partial R ²
Parent Education	-3.87	1.10	-.49	-3.54	.00	-.53
Family Income	0.15	0.50	.04	0.29	.77	.05
Parent Psychiatric History	8.15	4.76	.21	1.71	.10	.29
Attention Problems	7.47	2.91	.32	2.57	.02	.41
# Presenting Symptoms	-3.48	1.49	-.30	-2.34	.03	-.38
Time Since Diagnosis	-0.07	0.05	-.21	-1.57	.13	-.27
Tumor Location	-4.60	2.71	-.22	-1.69	.10	-.29

Predictors of BASC-2 Internalizing						
Variable	B	SE (B)	Beta	t	Sig (p)	Partial R ²
Family Income	0.20	0.47	.06	0.42	.68	.07
Behavior Problems	4.34	3.16	.21	1.38	.18	.23
Chemotherapy	3.23	3.14	.16	1.03	.31	.17
Tumor Location	-7.98	2.73	-.45	-2.93	.01	-.45

Note. ABAS-II = Adaptive Behavior Assessment System-Second Edition; GAC = General Adaptive Composite; BASC-2 = Behavior Assessment System for Children-Second Edition; BSI = Behavioral Symptom Index.

Table VI

Predictors of Impairment in Adaptive Functioning

Predictors of Impairment in ABAS-II GAC						
Variable	B	SE (B)	Wald	Sig	OR	95% CI
Family Income [†]	1.46	0.84	3.02	.08	4.31	0.83-22.32
Tumor Size	0.07	0.04	3.01	.08	1.07	0.99-1.16
Predictors of Impairment in ABAS-II Conceptual Composite						
Variable	B	SE (B)	Wald	Sig	OR	95% CI
Parent Education [†]	1.06	0.97	1.19	.28	2.89	0.43-19.48
Pregnancy Risk Factors	-0.28	0.37	0.60	.44	0.75	0.37-1.54
Developmental Delay	-1.11	1.25	0.79	.37	0.33	0.03-3.81
Tumor Size	0.14	0.06	5.03	.03	1.15	1.02-1.30
Predictors of Impairment in ABAS-II Social Composite						
Variable	B	SE (B)	Wald	Sig	OR	95% CI
Family Income [†]	1.83	1.29	2.03	.16	6.26	0.50-78.07
Tumor Size	0.12	0.05	4.81	.03	1.12	1.01-1.25
Predictors of Impairment in ABAS-II Practical Composite						
Variable	B	SE (B)	Wald	Sig	OR	95% CI
Family Income [†]	2.88	1.86	2.40	.12	17.82	0.47-682.92
Behavior Problems	3.86	2.32	2.77	.09	47.29	0.51-4424.49
Tumor Size	0.31	0.15	4.42	.04	1.37	1.02-1.83

Note. ABAS-II = Adaptive Behavior Assessment System-Second Edition; GAC = General Adaptive Composite; OR = Odds ratio (also labeled Exp(B)).
[†] dichotomized around the median value for logistic regression analyses