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ORIGINAL ARTICLE

Are we friends? Best friend nominations in pediatric brain tumor survivors and associated factors

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Abstract

Background Pediatric brain tumor survivors (PBTSs) are at risk of impairments in social competence. Limited information is available regarding nominations and reciprocated nominations of PBTSs as best friends and factors which may predict these.

Procedure Caregivers of children ($n = 32$) aged 8–16 (38% low-grade glioma, 34% medulloblastoma, 28% other) completed ratings of child adjustment at baseline (T1) and PBTSs and classmates completed the Three Best Friends measure approximately 12 months later (T2). Sociometric data yielded ratings of best friend nominations and reciprocated best friend nominations.

Results Nominations of PBTSs as best friends were not significantly different than controls, but PBTSs had fewer reciprocated best friend nominations than controls. Approximately half of PBTSs in this study did not have any reciprocated best friend nominations and 25% were not nominated by any peer as a best friend. Greater symptoms of depression and lower social skills in PBTSs were associated with fewer nominations as a best friend by peers and a greater likelihood of no reciprocal best friend nominations. Greater difficulties in emotional control were associated with fewer nominations as a best friend by peers.

Conclusions The discrepancy between reciprocated best friend nominations and best friend nominations highlights a need to attend to reciprocal friendships in PBTSs and further understand social information processes in this population. Longitudinal analyses illustrate the impact of emotional adjustment on PBTS friendships.

Keywords Pediatric cancer · Brain tumor · Peer nominations · Depression

Introduction

Progress in medical treatments for pediatric brain tumors has led to a significant decrease in mortality rate over the past several decades [1]. However, pediatric brain tumor survivors (PBTSs) may experience a host of cognitive and psychosocial sequelae [2–4]. One area in which PBTSs are likely to be particularly impaired is that of social competence [5, 6]. Difficulties in social competence in PBTSs have been found relative to healthy controls [7], children with other chronic illnesses [8], and children with other cancer diagnoses [9, 10]. A standard of psychosocial care in pediatric oncology mandates opportunities for social interaction into survivorship [11]. This is particularly important for PBTS, given their reported social isolation [7], and reports that their social competence decreases over time [12]. Greater attention to their peer relationships is needed given that adequate development of social competence is essential for later successful social, emotional, academic, and vocational performance [6, 13–15].

Whereas social competence broadly encompasses cognitions, behaviors, and adjustment related to one's interpersonal relationships, social adjustment refers to others' perceptions and self-perceptions of the quality of a child's social relationships and how well they attain socially desirable and developmentally appropriate goals [16]. The preponderance of evidence regarding the social competence of PBTSs has relied on parent or self-report, which has often yielded deficits in broad measures of social adjustment [5, 6]. With regard to

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friendships, there is some evidence that parents of pediatric cancer survivors are more likely to rate their child as having no close friends relative to healthy controls [17]. Because children and adolescents spend a significant amount of time with their same-age peers, who provide opportunities for socialization, peer reports provide a unique and invaluable perspective on the social relationships of PBTSs. Importantly, information provided by peers offers the opportunity to assess if peers perceive PBTSs as friends, and if friendships perceived by PBTSs are reciprocated by their peers. Reciprocated friendship nominations occur when children mutually nominate each other as friends. One study found PBTSs to be selected significantly less often than controls as a best friend, but no significant difference was found in reciprocated friendships [18]. Having at least one friend may serve as a protective factor against a myriad of difficulties, such as peer victimization [19] and internalizing symptoms [20, 21].

Of further importance is understanding what factors may influence friendships in PBTSs. Several factors may account for difficulties in peer relationships in PBTSs, including difficulties in internalizing symptoms [22], executive functioning [23], emotional control [24], and social skills [25], as well as factors such as tumor type [24], cranial radiation [26], and age at diagnosis and gender [17, 27]. These factors may be important determinants of PBTSs' risk for having fewer friends.

For example, internalizing symptoms such as depression and anxiety may contribute to greater social withdrawal [28]. Additionally, cranial radiation may lead to neurocognitive impairments [29] which may impede the enactment of complex interpersonal skills [30].

In this study, we investigated peer nominations of PBTS as best friends and whether PBTS best friend nominations were reciprocated by their peers. PBTS best friend nominations and reciprocated best friend nominations were compared with that of healthy controls. Longitudinal exploratory analyses of potential factors associated with friendships in PBTSs were also examined. Based on previous findings [18], we hypothesized that PBTSs would have fewer best friend nominations, but similar reciprocated best friend nominations, relative to controls. Regarding our secondary goal (examination of factors associated with best friend nominations and reciprocated best friend nominations), we hypothesized that greater problems with executive functions, lower social skills, and more internalizing symptoms would be associated with fewer best friend nominations and reciprocated best friend nominations in PBTSs. This study is based on a secondary analysis undertaken with data from a large social skills intervention study for PBTSs with two arms, intervention and control. The intervention took place from baseline to 2 months. Therefore, we also examined intervention versus control group as a potential factor associated with friendships in PBTSs.

Methods

Participants

PBTSs were recruited from three sites across Canada as part of a larger study [31]. Inclusion criteria were as follows: (1) diagnosed with a brain/spinal tumor, (2) off treatment for at least 3 months, (3) being 8–16 years of age at enrollment, (4) English fluency, and (5) being in a regular classroom for at least 50% of the time. PBTSs who were identified by the clinical neuro-oncology team (neuro-oncologist and neuropsychologist) as having severe neurocognitive deficits (e.g., IQ < 2 SDs below the mean) or a psychiatric/developmental disorder (e.g., autism) were excluded. Survivors were not selected on the basis of social difficulties.

Caregivers reported on $N = 32$ PBTSs. Classmates ($N = 609$) and PBTSs ($N = 32$) completed a best friend nomination measure in the classroom. Females made up 38% of the sample of PBTSs. The mean age of PBTSs was 10.41 years (SD = 2.63). Participants were on average 4.55 years from diagnosis (SD = 3.06). Participant diagnoses included low-grade glioma (37.5%), medulloblastoma (34.4%), and other (e.g., ependymoma, craniopharyngioma; 28.1%). Further demographic and medical characteristics of the sample are presented in Table 1. One child matched for grade and gender was selected randomly from each classroom for a comparison with the healthy control group.

Recruitment and procedure

Recruitment took place between March 2012 and January 2015. Each participating site obtained local Institutional Ethics Review Board approval. Potential participants were identified locally by the data manager and eligibility was verified by the clinical team before they were approached for the study. After written parent consent and child assent were obtained, the primary caregiver completed several baseline (T1) measures, including assessment of the child's executive functioning, social skills, and psychosocial adjustment. PBTSs then participated in one of two group interventions for eight weekly sessions [31]. Subsequently, PBTSs were invited to participate in a school assessment portion of the study. In total, 79 families of PBTSs consented to participate in the larger study. School data for this study was collected for 32 PBTSs (13 in the social skills intervention and 19 in the attention control group, see [31] for a detailed description of the intervention provided between baseline and 8 weeks). School data was collected on average 5 months (SD = 1.28) following the intervention. No differences were found between PBTSs who provided school data and those who did not in gender, treatment, diagnosis, or tumor location. However, there was a small but significant ($p < 0.05$) difference in age between

Table 1 Demographic and medical characteristics of the sample of PBTSs

	M	SD
Age (years)	10.41	2.63
Time since diagnosis (years)	4.55	3.06
Age at diagnosis (years)	5.87	2.84
	N	%
Gender		
Male	20	62.5
Female	12	37.5
Diagnosis		
Low-grade glioma	12	37.5
Medulloblastoma	11	34.4
Other	9	28.1
Tumor location		
Supratentorial	7	21.9
Suprasellar	6	18.8
Brain stem	2	6.3
Posterior fossa	16	50.0
Cranial radiation		
Yes	21	65.6
No	11	34.4

"Other" includes diagnoses such as ependymoma and craniopharyngioma

those who participated in the school data portion of the study ($M = 10.41$; SD = 2.63) and those who did not ($M = 11.65$, SD = 2.76). The main reasons for non-participation included lack of approval from the school principal or school board, and logistic challenges for scheduling the school visit (e.g., scheduling during active school, winter inclement weather, school labor strike).

Measures

Medical and demographic factors Child medical variables examined were tumor type (low-grade glioma, medulloblastoma, other) and cranial radiation (present—whole or focal versus absent). Child demographic characteristics examined included age at enrolment and gender.

Three Best Friends Children were asked to choose the three peers in their class whom they thought of as their best friends. The total best friend nomination score was based on the number of times they were chosen as a best friend by peers. The reciprocal best friend nomination score indicated, of the three best friends each child could nominate, how many of their nominated best friends mutually nominated them as a best friend [32].

Anxiety and depression Anxiety and depressive symptoms were measured by the age-appropriate version of the Behavior Assessment System for Children (BASC-2 [33]), parent proxy-report. The BASC-2 is a standardized measure of behavior with well-established psychometric properties. Summary *T*-scores for anxiety symptom and depressive symptom scales were used in this study, with higher scores reflecting greater difficulties.

Executive function difficulties Parents reported on their child's difficulties in executive functioning via the Behavior Rating Inventory of Executive Function (BRIEF [34]). The overall Global Executive Composite (GEC) and the Emotional Control (EC) subscale were used in analyses, based on their previously found association with social adjustment in PBTSs [35]. The GEC is an overarching summary score that incorporates all of the BRIEF clinical scales. The EC subscale measures the impact of executive function problems on emotion expression and assesses a child's ability to modulate their emotional responses. Higher scores reflect greater problems in executive function abilities.

Social skills Social skills were measured by the Social Skills Rating System (SSRS [36]), proxy-report version. The SSRS provides an age- and gender-normed total standard score representing four subscale scores: cooperation, assertion, self-control, and responsibility. The SSRS has adequate reliability and validity and, compared with other measures used to assess social competence, SSRS has the most comprehensive data within pediatric brain tumor survivors [37]. Lower scores on the total scale reflect greater problems in social skills.

Statistical analysis

Preliminary analyses provide descriptive statistics of the primary independent and dependent variables. The Mann-Whitney test was used to compare PBTSs and healthy controls on nominations as best friends and reciprocated best friend nominations. For the PBTS group, the Mann-Whitney test was also used to compare the two intervention groups on best friends and reciprocated best friend nominations. Also, for the PBTS group, nonparametric (Kendall's Tau-b and Mann-Whitney) analyses were used to test associations between T1 variables (age, emotional control, executive function, social skills, anxiety and depression symptoms, cranial radiation, gender, tumor type, intervention group) and T2 nominations as best friends. For the associations between T1 and T2, PBTS reciprocated best friend nominations were dichotomized to none (47%) versus any (53%). *t* test and chi-square analyses were used to test the association between T1 variables and the dichotomized T2 reciprocated best friend nomination variable.

Data availability The authors have full control of all primary data and we agree to allow the journal to review the data if requested.

Results

Descriptive statistics

Descriptive statistics for T1 independent variables (anxiety and depression symptoms, social skills, emotional control, and global executive composite) are presented in Table 2. All PBTS group means were within the average range. The percentage of PBTSs in the borderline/clinical range largely approximated that of normative data on the BASC Anxiety scale (18.7% PBTSs; 16% expected), SSRS Social Skills (18.8% PBTSs; 16% expected), BRIEF Emotional Control (9.4% PBTSs; 7% expected), and BRIEF GEC (12.6% PBTSs; 7% expected) scales. The percentage of PBTSs in the borderline/clinical range on the BASC Depression scale (25%) appeared slightly above that of normative data (16%). There were no significant differences between the two intervention groups for best friends or reciprocated best friend nomination ($ps > 0.05$).

Nominations as best friends 12 months post Best friend nomination data for PBTSs and controls are presented in Fig. 1. Median levels of nominations as best friends were not significantly different between PBTSs and controls ($p > 0.05$).

Reciprocated best friend nominations 12 months post Reciprocated best friend nomination data for PBTSs and controls are presented in Fig. 2. PBTSs had fewer reciprocated best friend nominations (Mdn = 1.00) than controls (Mdn = 2.00) ($U = 368.00$, $p < 0.05$). Among healthy controls, 81.2% of children had at least one reciprocated best friend nomination. Among PBTSs, only 53.1% had at least one reciprocated best friend nomination.

Factors associated with best friend nominations in PBTSs Greater depressive symptoms ($r_\tau = -.41$, $p < 0.05$), greater problems in emotional control ($r_\tau = -.27$, $p < 0.05$), and fewer social skills ($r_\tau = -.29$, $p < 0.05$) in PBTSs were associated with fewer peer nominations of PBTSs as best friends. Age, anxiety symptoms, global executive composite, gender, tumor type, cranial radiation, and intervention were not significantly associated with peer nominations of PBTSs as best friends (all $ps > 0.05$; see Table 3).

Factors associated with reciprocated best friend nominations in PBTSs PBTSs who had no reciprocated best friend nominations had higher depressive symptoms ($M = 58.93$; SD = 49.58) than PBTSs who had at least one reciprocated friendship ($M = 49.58$; SD = 9.33) ($t = 2.30$, $p < 0.05$). PBTSs who had no reciprocated best friend nominations were rated as having fewer social skills ($M = 91.20$; SD = 18.58) than PBTSs who had at least one reciprocated best friend nomination ($M = 103.76$; SD = 12.45) ($t = -2.36$, $p < 0.05$). Age, anxiety symptoms, emotional control, global executive composite, gender, tumor type, cranial radiation, and intervention were not significantly associated with reciprocated best friend nominations (all $ps > 0.05$; see Table 4).

Discussion

This study aimed to investigate peer nominations of PBTSs as a best friend, as well as the reciprocated best friend nominations of PBTSs. Best friend nominations reflected the extent to which PBTSs were selected by their peers as one of three best friends each classmate could nominate. Nominations as a best friend likely indicate a perception of a more positive and close relationship with that peer relative to other peers. Reciprocated best friend nominations required PBTSs and their classmates to have mutually selected each other as one of their three best friends, which may be particularly important given that friendships are shared relationships involving mutual liking. Approximately half of PBTSs in this study did not have any reciprocated friendships and 25% were not nominated by any peers as a friend. Previous research has indicated that PBTSs are more likely than healthy controls to have no close friends [17]. These findings are particularly striking in light of evidence that having at least one friend can serve as a protective factor [19–21]. It is possible that PBTSs have friends who are not captured by this assessment, in that they may have friends outside their classroom, through social activities outside of school, or possibly even social relationships

Table 2 Descriptive statistics of baseline variables

	M	SD	Range	Borderline/clinical
Depression (BASC)	53.97	12.24	37–83	25%
Anxiety (BASC)	52.78	10.78	34–77	18.7%
Total Social Skills (SSRS)	97.88	16.63	59–130	18.8%
Emotional Control (BRIEF)	50.22	10.81	36–78	9.4%
Global Executive Composite (BRIEF)	54.42	14.36	32–92	12.6%

All measures were administered at baseline (T1). BASC and BRIEF scores are presented as normalized *T*-scores. SSRS scores are presented as standard scores. Borderline/clinical is ≥ 60 for the BASC, ≥ 65 for the BRIEF, and ≤ 85 for the SSRS

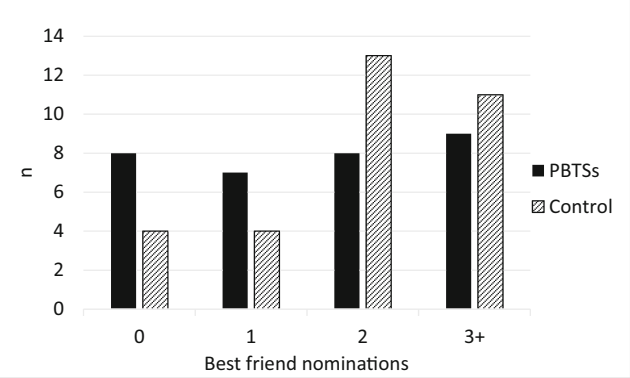

Fig. 1 Best friend nominations received by pediatric brain tumor survivors and controls

with other children with similar conditions, sometimes fostered through camp or activity programs through their hospital. However, given that PBTSs will spend a significant amount of their day with their classmates, these limited social relationships are worth highlighting.

Contrary to our hypotheses, PBTSs in this study did not differ significantly from controls with regard to being nominated as a best friend, but PBTSs had fewer reciprocated best friend nominations relative to controls. These hypotheses were based on a previous study examining best friend nominations in PBTSs [18]. The initial article was published approximately two decades ago. It is possible that the lack of differences in best friend nominations in the current study reflects a positive change over time in attitudes towards PBTSs, who may have a range of physical or cognitive impairments. Although no differences were found in how often PBTSs were nominated as a best friend, they had fewer reciprocated best friend nominations. The difference in the findings regarding reciprocated friendships may have been influenced by a greater time since diagnosis in this study ($M = 4.55$ years; SD = 3.06) versus the previous study ($M = 3.00$; SD = 1.08), given that greater impairment in neurocognitive functioning over time [12] may affect social information processing [16].

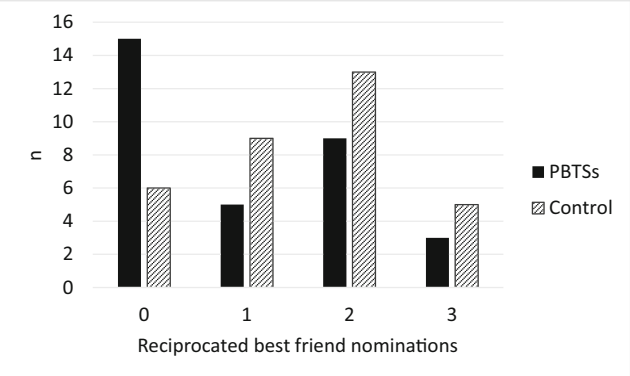

Fig. 2 Number of mutually reciprocated best friend nominations in pediatric brain tumor survivors and controls

Table 3 Associations between baseline variables and best friend nominations at 12 months

		Best friend nominations
Age	r_τ	− .05
T1 Depression (BASC)	r_τ	− .29*
T1 Anxiety (BASC)	r_τ	.04
T1 Total Social Skills (SSRS)	r_τ	.29*
T1 Emotional Control (BRIEF)	r_τ	− .27*
T1 Global Executive Composite (BRIEF)	r_τ	− .16
Gender	r_τ	.19
Cranial radiation	r_τ	− .13
Intervention group	r_τ	− .25
Tumor type	U	.71

*$p < 0.05$

It is noteworthy that 75% of PBTSs in this study were nominated by at least one peer as a best friend, although 47% of PBTSs did not have any reciprocated best friend nominations. This highlights that at least some PBTSs did not reciprocate a best friendship they were nominated for. It is possible that impairment in social information processing (e.g., recognition of social cues, facial expressions) may impede reciprocated friendships in PBTSs. For example, some PBTSs may be missing social cues that allow them to identify peers with whom they may have more mutually reciprocated friendships. Notably, PBTSs have been found to be impaired in recognition of facial cues, and that this is associated with their social adjustment [38]. Greater understanding of the social information processing of PBTSs is needed, including their processing of verbal and non-verbal cues. Consistent with a conceptual model of social competence [16] and previous findings [5], PBTS social skills were significantly

Table 4 Associations between baseline variables and presence or absence of reciprocated best friend nominations at 12 months

		Reciprocated best friend nominations (0 vs. 1–3)
Age	t	−0.82
T1 Depression (BASC)	t	2.30*
T1 Anxiety (BASC)	t	0.04
T1 Total Social Skills (SSRS)	t	−2.36*
T1 Emotional Control (BRIEF)	t	1.71
T1 Global Executive Composite (BRIEF)	t	0.24
Gender	$\chi(1)$	0.08
Cranial radiation	$\chi(1)$	0.39
Intervention group	$\chi(1)$	4.39
Tumor type	$\chi(2)$	0.41

*$p < 0.05$

associated with fewer nominations as best friends and a greater likelihood of not having any reciprocated best friend nominations. Poor social skills may lead to disengagement or exclusion from social interactions with peers. Future studies are needed in order to identify what specific social skills may be underlying difficulties in peer relationships.

Greater symptoms of depression were also associated with both fewer nominations as a best friend and a greater likelihood of no reciprocated best friend nominations. Some previous studies have indicated that PBTSs are at risk for difficulties in emotional adjustment [4, 25, 39]. In this study, while the mean depression symptom score was in the average range, a substantial subset (25%) experienced elevated symptoms (i.e., *T*-score ≥ 60). Depression symptoms are typically associated with withdrawal from activities, changes in mood, and irritability. PBTSs who experience elevated symptoms of depression may be inclined to avoid participation in social activities with peers and may be more likely to have poor-quality interactions with peers when they do interact. These PBTSs may also be more likely to interpret social behaviors or verbal comments from peers negatively. Findings from this study indicate that interventions to promote emotional adjustment may also influence the social adjustment of PBTSs.

Further supporting the importance of PBTS emotional adjustment to their social adjustment, fewer difficulties in emotional control were associated with more nominations as best friends by peers. Emotional control has been previously found to be associated with social competence in PBTSs [25]. The ability to modulate emotional responses may be particularly relevant to PBTSs, who face many illness-related stressors [40] not faced by their health control counterparts. Consistent with this, coping has been found to be associated with greater social adjustment in PBTSs [41].

Surprisingly, some clinical factors such as cranial radiation treatment were not significantly associated with peer-nominated friendships, even at the bivariate level. Although cranial radiation treatment and executive functions have been previously associated with the social competence of PBTSs [25, 27], they were not significantly associated with best friend nominations or reciprocated best friend nominations in this study. It is possible that the low statistical power limited the ability to detect small but meaningful effects. It may also be that certain independent variables may be more proximally related to more specific facets of social competence. Cranial radiation has been associated with increased risk for neurocognitive deficits due to compromised white matter integrity [12]. Cognitive executive functions in turn are proposed to interact with other social information processing variables, which then influence social interaction components, which may subsequently influence social adjustment [16]. Greater investigation of pathways of mechanisms underlying social competence deficits in PBTSs is needed.

There are several potential limitations of this study. First, the sample size of participants who agreed or were able to participate in the school data collection was small relative to children eligible at baseline, limiting statistical power. Some school board refusals and other logistical reasons (e.g., scheduling during active school, winter inclement weather) reduced participants in this study. In light of the small sample size and multiple analyses, the results of this study should be considered as exploratory and in need of further replication. Second, a small but significant difference in age was found between PBTSs who participated in school data collection and those from the larger study who did not, with PBTSs who participated being on average approximately 1 year younger in age. It is possible that some of the older teenagers were averse to agreeing to have sociometric data collected in their class. Importantly, groups did not differ in terms of gender, diagnosis type, or cranial radiation. Third, this study included participants recruited as part of an intervention study. Only families who were interested in participating in weekly sessions were included in the study. However, participants were not screened based on specific impairment criteria and baseline characteristics were collected prior to the beginning of the intervention. Further, the intervention group was not found to be significantly associated with best friend nominations or reciprocated best friend nominations in this study. Fourth, this study included parent measures of child social skills and executive function; future studies may benefit from the inclusion of child self-report data and objective measures of these constructs.

These limitations notwithstanding, this study also has several strengths. First, this study included comparison data for best friend nominations and reciprocated best friend nominations. Second, this study included longitudinal data, which allowed for the examination of predictors of PBTS friendships. Third, we examined several possible predictors of social adjustment and psychological distress, based on conceptual models and previous empirical research. Fourth, this study included data from multiple informants, including peers, caregivers, and participant self-report.

Overall, these findings offer some important insights into the peer relationships of PBTSs. The discrepancy between nominations as best friends and reciprocated best friend nominations warrants further investigation. Longitudinal analyses highlighted depression symptoms, emotional control, and social skills as influencing peer relationships across time. These findings suggest that interventions addressing both social and emotional adjustment may greatly benefit PBTSs.

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Compliance with ethical standards

Each participating site obtained local Institutional Ethics Review Board approval.

Conflict of interest The authors declare that they have no conflict of interest.

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