

# An Examination of Obesity in Pediatric Brain Tumor Survivors: Food for Thought

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## Abstract

**Background:** Great strides have been made in childhood cancer treatment efficacy over the past two decades leading to improved survival rates, and now attention is being directed toward identifying and understanding complications that affect many of these patients as they reach adulthood such as obesity.

**Materials/Methods:** We conducted a retrospective chart review to determine the prevalence of obesity among survivors of pediatric brain tumors 5 years after the completion of therapy and compare this to the general pediatric population of the same age. We also sought to identify potential risk factors for the development of obesity among survivors of childhood brain tumors.

**Results:** Of 43 patients, 5 (11.63%) were obese 5 years after completion of therapy. The CDC sites general population obesity rates in three age groups: 2-5 years (8.4% obesity rate), 6-11 years (18% obesity rate), 12-19 years (21% obesity rate). Using CDC guidelines, we found no significant difference between the obesity rate among the brain tumor survivor population for each age group and the general population, p-values of 0.865, 0.865, and 0.249 respectively.

**Conclusion:** Our small sample size was likely not adequate to find a significant difference between the two groups or identify risk factors associated with the development of obesity. Larger studies are needed to further examine the risk of obesity among pediatric brain tumor survivors and to identify risk factors associated with this late effect.

## Introduction

Children diagnosed with brain tumors typically undergo a variety of aggressive cancer therapies that can produce late effects including metabolic and endocrine disturbances. Increasing survival for childhood cancer patients is associated with both short and long-term morbidity including obesity, disorders of lipid metabolism and numerous other disorders related to neuroendocrine dysfunction.

The mechanism of altered metabolism and the development of obesity in these patients is not well understood and is likely multifactorial involving disease-related, treatment-related, genetic, as well as lifestyle factors. Increased knowledge about risk factors for obesity in brain tumor survivors may lead to a better understanding of its development, and therefore could lead to its prevention.

## Methods

We determined the prevalence of obesity 5 years after the cessation of cancer therapy among a population of pediatric brain tumor survivors and compared it to the general pediatric population as defined by the CDC. We also sought to identify potential risk factors for the development of obesity among survivors of childhood brain tumors. The risk factors examined include age at diagnosis, gender, tumor histology, tumor location, treatment (surgery, chemotherapy, radiation), and presence of an endocrinopathy after therapy.

We review the charts of patients diagnosed with brain tumors between the ages of 2 and 15 years at Phoenix Children's Hospital between the years of 1995-2006. Exclusion criteria included: patients with tumors located within the hypothalamic-pituitary axis (HPA) including, but not limited to, craniopharyngiomas and pituitary adenomas, as well as spinal tumors.

### Statistical Analysis

The prevalence of obesity among brain tumor survivors in each age group was compared to the estimated rates for the general population of the corresponding age groups with proportion calculations. Categorical variables were analyzed using Fisher's exact test. A p-value <0.05 was considered significant.

## Results

We reviewed the charts of 96 patients who met study criteria, 43 of whom had follow-up 5 years after the completion of therapy with height and weight recorded from which a BMI could be calculated.

Age group (years)	Obesity rate, PBTs* (n)	Obesity rate, GP**	P-Value
2 to <6	7.14% (1/13)	8.4%	0.865
6 to <12	16.67% (4/24)	18%	0.865
12 to <20	0.0% (0/5)	21%	0.249

Table 1: The prevalence of obesity based on BMI percentile for our cohort compared to the prevalence of obesity among the general American pediatric population for similar age groups as cited by the CDC.

\*PBTs: pediatric brain tumor survivors

\*\*GP: general population

Variable	Obese (n)	Non-Obese (n)	P-Value
<b>Age at Diagnosis (years)</b>			0.809
2 to <6	1 (7.14 %)	13 (92.86 %)	
6 to <12	4 (16.67 %)	20 (83.33 %)	
12 to <20	0 (0.00 %)	5 (100.00 %)	
Total	5 (11.63 %)	38 (88.37 %)	
<b>Gender</b>			1.000
Male	3 (13.04 %)	20 (86.96 %)	
Female	2 (10.00 %)	18 (90.00 %)	
Total	5 (11.63 %)	38 (88.37 %)	
<b>Tumor Location</b>			0.575
Posterior/cerebellar	3 (9.09 %)	30 (90.91 %)	
All other	2 (20.00 %)	8 (80.00 %)	
Total	5 (11.63 %)	38 (88.37 %)	
<b>Tumor Histology</b>			0.400
Medulloblastoma	1 (5.56 %)	17 (94.44 %)	
Low grade glioma	4 (20.00 %)	16 (80.00 %)	
Other	0 (0.00 %)	5 (100.00 %)	
Total	5 (11.63 %)	38 (88.37 %)	
<b>Surgery</b>			0.241
Biopsy	0 (0.00 %)	1 (100.00 %)	
Partial resection	2 (33.33 %)	4 (66.67 %)	
Gross total resection	3 (8.33 %)	33 (91.67 %)	
Total	5 (11.63 %)	38 (88.37 %)	
<b>Chemotherapy</b>			1.000
No	2 (10.00 %)	18 (90.00 %)	
Yes	3 (13.04 %)	20 (86.96 %)	
Total	5 (11.63 %)	38 (88.37 %)	
<b>Radiation</b>			0.570
None	3 (16.67 %)	15 (83.33 %)	
Focal	1 (14.29 %)	6 (85.71 %)	
Craniospinal	1 (5.56 %)	17 (94.44 %)	
Total	5 (11.63 %)	38 (88.37 %)	
<b>Endocrinopathy</b>			0.145
No	5 (17.86 %)	23 (82.14 %)	
Yes	0 (0.00 %)	15 (100.00 %)	
Total	5 (11.63 %)	38 (88.37 %)	

Table 2: Patient characteristics by proportion of obese and non-obese 5 years after completion therapy. Each categorical variable was assessed to determine if there was an effect on the development of obesity. We found no significant association between any of these factors and the development of obesity.

## Discussion and Conclusions

We found that obesity rates among the brain tumor survivor population for each age group were not significantly different from that of the general population. Previous studies that have looked at obesity among survivors of childhood cancers have noted there to be an increased rate of obesity among survivors of childhood cancers, particularly survivors of acute lymphoblastic leukemia and brain tumors.<sup>1,2</sup> Though our results do not reproduce these findings, this could be explained by our small sample size and limited years of follow-up.

Previous studies have found patients diagnosed at a younger age, and those who received chemotherapy or craniospinal radiation to be a greater risk of late effects, particularly endocrinopathies, metabolic syndrome and obesity.<sup>3,4</sup> Though our population does not show similar risk, this could again be explained by our small sample size compared to other studies.

The complications of childhood cancer and cancer therapies may have an impact on quality of life, morbidity and mortality. Therefore it is crucial that these survivors have long-term and possibly lifelong follow-up. It is also important that future studies continue to examine the risk factors related to obesity among pediatric brain tumor survivors and potential interventions to prevent complications for these survivors.

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