

Supplementary Information for

**Population-Based Analysis of Demographic and Socioeconomic Disparities in Pediatric
CNS Cancer Survival in the United States**

Robert Fineberg,^{1*} Shadi Zahedi,^{1,2*} Megan Eguchi,^{1,3} Muriel Hart,¹ Myles Cockburn,^{1,3} Adam L.
Green^{1,2,3,4}

1 University of Colorado School of Medicine, Aurora, CO, USA

2 Morgan Adams Foundation Pediatric Brain Tumor Research Program, Aurora, CO, USA

3 University of Colorado Comprehensive Cancer Center, Aurora, CO, USA

4 Center for Cancer and Blood Disorders, Children's Hospital Colorado, Aurora, CO, USA

* These authors contributed equally.

Supplemental Table 1 Overall Survival, Univariate Analysis, By Tumor Category

Value	Ependymoma					Glioma					PNET/Pineal/ATRT					Medulloblastoma				
	N	Survival Estimate	HR	HR 95% CI	p-value	N	Survival Estimate	HR	HR 95% CI	p-value	N	Survival Estimate	HR	HR 95% CI	p-value	N	Survival Estimate	HR	HR 95% CI	p-value
Female (ref)	204	74.51%				359	34.34%				94	56.56%				160	67.59%			
Male	214	67.57%	1.34	(0.90, 1.99)	0.1458	429	30.88%	1.06	(0.88, 1.26)	0.5549	102	46.23%	1.34	(0.87, 2.07)	0.1839	233	62.85%	1.19	(0.82, 1.73)	0.3675
White (ref)	320	72.77%				607	33.37%				146	52.03%				328	64.38%			
Black	57	62.51%	1.55	(0.93, 2.60)	0.0955	115	25.38%	1.31	(1.03, 1.67)	0.0263	31	48.38%	1.21	(0.68, 2.17)	0.5148	35	67.09%	0.90	(0.47, 1.73)	0.7566
Other	40	68.61%	1.03	(0.52, 2.06)	0.9288	62	36.16%	0.98	(0.70, 1.38)	0.9211	17	45.61%	1.41	(0.68, 2.96)	0.3562	29	66.81%	0.92	(0.45, 1.88)	0.8099
Non-Hispanic (ref)	292	74.28%				576	34.02%				143	54.23%				283	67.65%			
Hispanic	126	63.05%	1.59	(1.06, 2.38)	0.0253	212	27.81%	1.20	(0.98, 1.47)	0.0706	53	40.95%	1.35	(0.84, 2.17)	0.2183	110	57.51%	1.51	(1.03, 2.22)	0.0365
00 years	28	66.73%	1.32	(0.62, 2.81)	0.4765	33	56.74%	0.95	(0.53, 1.71)	0.8600	26	25.18%	2.62	(1.48, 4.63)	0.0010	15	38.89%	1.72	(0.85, 3.51)	0.1328
01-04 years (ref)	166	71.09%				110	47.35%				77	51.18%				123	53.38%			
05-09 years	98	63.59%	1.26	(0.78, 2.04)	0.3500	217	20.74%	1.96	(1.44, 2.67)	<.0001	41	67.64%	0.49	(0.24, 0.98)	0.0443	142	66.14%	0.62	(0.41, 0.94)	0.0258
10-14 years	68	73.80%	0.86	(0.47, 1.58)	0.6288	186	23.69%	1.58	(1.15, 2.17)	0.0046	27	58.98%	0.68	(0.34, 1.37)	0.2828	70	80.83%	0.31	(0.16, 0.59)	0.0004
15-19 years	58	80.57%	0.68	(0.34, 1.36)	0.2722	242	40.25%	0.97	(0.71, 1.34)	0.8733	25	44.65%	0.83	(0.42, 1.64)	0.5950	43	77.09%	0.37	(0.17, 0.78)	0.0087
Localized (ref)	319	74.39%				582	35.62%				99	48.90%				274	72.05%			
Regional/Distant	90	59.79%	1.66	(1.08, 2.56)	0.0207	189	21.48%	1.62	(1.33, 1.99)	<.0001	54	39.40%	1.38	(0.87, 2.21)	0.1739	113	49.50%	2.11	(1.45, 3.05)	<.0001
Less than 6 cm (ref)	225	69.85%				406	34.91%				104	53.34%				298	67.18%			
6 cm or greater	85	71.58%	0.92	(0.55, 1.55)	0.7592	100	27.11%	1.18	(0.89, 1.55)	0.2457	32	41.90%	1.34	(0.76, 2.36)	0.3094	16	43.64%	1.47	(0.64, 3.37)	0.3666
No Radiation (ref)	116	70.49%				227	53.48%				72	37.58%				88	51.66%			
Radiation Administered	299	71.09%	0.86	(0.56, 1.31)	0.4842	554	23.54%	1.94	(1.55, 2.42)	<.0001	121	58.23%	0.42	(0.28, 0.65)	<.0001	301	69.79%	0.44	(0.30, 0.65)	<.0001
No Surgery (ref)	8	50.00%				222	16.97%				24	41.61%				7	28.57%			
Surgery	409	71.35%	0.38	(0.14, 1.03)	0.0578	566	38.48%	0.50	(0.41, 0.60)	<.0001	172	52.61%	0.58	(0.32, 1.05)	0.0714	385	65.66%	0.23	(0.09, 0.56)	0.0012
All Other HS or less (ref)	296	74.87%				552	33.99%				138	49.88%				296	64.57%			
Highest Quartile % HS or less	122	61.10%	1.56	(1.04, 2.34)	0.0315	236	28.95%	1.11	(0.92, 1.35)	0.2765	58	54.36%	0.84	(0.52, 1.37)	0.4839	97	65.53%	1.00	(0.65, 1.53)	0.9942
All Other Below Poverty Level (ref)	287	73.76%				540	35.04%				133	53.45%				298	66.77%			
Highest Quartile % Below Poverty Level	131	64.46%	1.44	(0.96, 2.15)	0.0813	248	26.77%	1.23	(1.02, 1.49)	0.0285	63	46.00%	1.14	(0.73, 1.80)	0.5670	95	58.72%	1.33	(0.90, 1.99)	0.1567
All Other Language Isolation (ref)	298	74.63%				572	32.99%				141	50.67%				302	66.63%			
Highest Quartile % Language Isolation	120	61.48%	1.52	(1.01, 2.28)	0.0453	216	31.09%	1.04	(0.85, 1.27)	0.7253	55	52.52%	0.89	(0.55, 1.45)	0.6528	91	58.19%	1.33	(0.88, 2.00)	0.1778
Private Insurance (ref)	143	82.05%				265	29.70%				69	52.55%				156	75.91%			
Public/No Insurance	88	63.39%	2.56	(1.37, 4.81)	0.0033	167	35.42%	0.89	(0.69, 1.16)	0.4062	35	56.23%	0.99	(0.49, 2.00)	0.9678	83	50.30%	1.90	(1.12, 3.21)	0.0169

CI= confidence interval;; HR=hazard ratio; HS= high school; N=number of individuals in each category.

Notes: Highest Quartile % of county-level factors indicates the lowest level of disadvantage. Hazard ratio (HR) indicates the ratio of hazard of death by levels of covariates. Significant values (P<0.05) have been marked with bold.

Supplemental Table 2 Overall Survival, Multivariable Analysis, by Tumor Category

	Ependymoma (N = 405)			Glioma (N = 760)			PNET/Pineal/ATRT (N = 148)			Medulloblastoma (N =382)		
Variable	HR	HR 95% CI	p-value	HR	HR 95% CI	p-value	HR	HR 95% CI	p-value	HR	HR 95% CI	p-value
Year of Diagnosis	0.96	(0.91, 1.01)	0.1213	0.99	(0.97, 1.01)	0.2675	1.01	(0.95, 1.07)	0.7740	0.96	(0.91, 1.01)	0.1055
Male vs. Female (ref)	1.47	(0.97, 2.25)	0.0716	1.10	(0.91, 1.32)	0.3252	1.29	(0.78, 2.13)	0.3242	1.00	(0.67, 1.49)	0.9898
Black vs. White Race (ref)	2.05	(1.15, 3.65)	0.0153	1.21	(0.93, 1.58)	0.1633	1.38	(0.66, 2.91)	0.3948	0.76	(0.36, 1.58)	0.4621
Other vs. White Race (ref)	1.11	(0.52, 2.39)	0.7882	1.10	(0.77, 1.57)	0.6075	1.07	(0.45, 2.56)	0.8771	0.71	(0.32, 1.58)	0.4074
Hispanic vs. Non-Hispanic Ethnicity (ref)	1.62	(0.99, 2.66)	0.0550	1.18	(0.93, 1.48)	0.1715	1.51	(0.83, 2.74)	0.1729	1.23	(0.77, 1.97)	0.3949
Age 00 vs. Age 01-04 (ref)	1.05	(0.46, 2.38)	0.9023	2.00	(1.03, 3.87)	0.0393	3.76	(1.92, 7.37)	0.0001	2.09	(0.89, 4.90)	0.0917
Age 05-09 vs. Age 01-04 (ref)	1.22	(0.71, 2.10)	0.4679	1.18	(0.84, 1.65)	0.3422	0.34	(0.15, 0.76)	0.0092	0.80	(0.50, 1.27)	0.3453
Age 10-14 vs. Age 01-04 (ref)	1.10	(0.58, 2.09)	0.7804	0.75	(0.50, 1.12)	0.1605	0.26	(0.08, 0.88)	0.0303	0.42	(0.21, 0.84)	0.0144
Age 15-19 vs. Age 01-04 (ref)	0.63	(0.30, 1.31)	0.2156	0.31	(0.18, 0.53)	<0.0001	0.14	(0.03, 0.67)	0.0136	0.38	(0.16, 0.90)	0.0279
6 cm or greater vs. < 6 cm (ref)	0.91	(0.53, 1.56)	0.7277	1.20	(0.90, 1.60)	0.2068	1.15	(0.62, 2.13)	0.6559	1.52	(0.63, 3.69)	0.3517
Missing tumor size vs. < 6 cm (ref)	0.78	(0.47, 1.28)	0.3221	1.03	(0.84, 1.27)	0.7484	0.95	(0.51, 1.77)	0.8802	1.11	(0.68, 1.82)	0.6674
Regional/Distant vs. Localized (ref)	1.69	(1.06, 2.67)	0.0259	1.37	(1.11, 1.69)	0.0032	1.59	(0.94, 2.67)	0.0828	1.80	(1.20, 2.70)	0.0044
Radiation Tx v. No Radiation Tx (ref)	0.25	(0.11, 0.61)	0.0021	0.91	(0.59, 1.40)	0.6713	0.58	(0.32, 1.06)	0.0782	0.30	(0.15, 0.62)	0.0010
Surgery vs. No Surgery (ref)	0.42	(0.12, 1.47)	0.1748	0.53	(0.43, 0.65)	<0.0001	0.68	(0.30, 1.56)	0.3622	0.46	(0.15, 1.37)	0.1630
Highest Quartile Percent Less than HS Ed vs. All Others (ref)	1.11	(0.58, 2.10)	0.7599	1.05	(0.80, 1.39)	0.7115	0.54	(0.23, 1.24)	0.1442	0.43	(0.21, 0.89)	0.0221
Highest Quartile Percent Language Isolation vs. All Others (ref)	0.61	(0.25, 1.48)	0.2719	0.99	(0.77, 1.27)	0.9106	0.87	(0.48, 1.58)	0.6488	1.22	(0.74, 2.00)	0.4410
Highest Quartile Percent Below Poverty vs. All Others (ref)	1.11	(0.59, 2.09)	0.7505	1.24	(0.95, 1.61)	0.1144	1.69	(0.77, 3.68)	0.1905	1.99	(1.02, 3.87)	0.0425
Time-dependent Radiation	1.05	(1.02, 1.09)	0.0018	1.05	(1.02, 1.08)	0.0002				1.05	(1.02, 1.09)	0.0035
Time-dependent Highest Quartile Language Isolation	1.03	(1.00, 1.06)	0.0313									
Time-dependent Age				1.02	(1.01, 1.03)	<0.0001	1.04	(1.02, 1.07)	0.0001			

CI=confidence level; HR=hazard ratio; HS= high school; N=number of individuals in each category.

Notes: Highest Quartile % of county-level factors indicates the lowest level of disadvantage. Hazard ratio (HR) indicates the ratio of hazard of death by levels of covariates. Significant values (P<0.05) have been marked with bold.

Supplemental Table 3 Overall Survival, Multivariable Analysis, by Tumor Category and Extent of Disease

Variable	Ependymoma						Glioma					
	Localized (N = 315)			Regional/Distant (N = 90)			Localized (N = 572)			Regional/Distant (N = 188)		
	HR	HR 95% CI	p-value	HR	HR 95% CI	p-value	HR	HR 95% CI	p-value	HR	HR 95% CI	p-value
Year of Diagnosis	0.932	(0.874, 0.994)	0.0310	1.012	(0.903, 1.134)	0.8334	0.990	(0.964, 1.016)	0.4397	0.957	(0.915, 1.001)	0.0543
Male vs. Female (ref)	1.466	(0.875, 2.455)	0.1465	1.661	(0.703, 3.927)	0.2474	1.015	(0.816, 1.263)	0.8946	1.368	(0.946, 1.978)	0.0958
Black vs. White Race (ref)	1.784	(0.927, 3.436)	0.0833	4.672	(1.105, 19.753)	0.0361	1.125	(0.823, 1.537)	0.4600	1.558	(0.901, 2.692)	0.1122
Other vs. White Race (ref)	0.947	(0.371, 2.415)	0.9093	1.018	(0.201, 5.166)	0.9826	1.331	(0.892, 1.986)	0.1612	0.623	(0.265, 1.464)	0.2776
Hispanic vs. Non-Hispanic Ethnicity (ref)	1.245	(0.680, 2.280)	0.4785	2.408	(0.850, 6.820)	0.0979	1.129	(0.856, 1.490)	0.3897	1.335	(0.852, 2.092)	0.2073
Age 00 vs. Age 01-04 (ref)	1.654	(0.540, 5.063)	0.3780	0.842	(0.237, 2.995)	0.7901	2.660	(1.264, 5.596)	0.0099	0.701	(0.152, 3.233)	0.6484
Age 05-09 vs. Age 01-04 (ref)	1.469	(0.782, 2.757)	0.2316	0.719	(0.193, 2.679)	0.6225	1.148	(0.768, 1.716)	0.5013	1.633	(0.890, 2.995)	0.1133
Age 10-14 vs. Age 01-04 (ref)	1.056	(0.480, 2.323)	0.8928	1.315	(0.367, 4.709)	0.6737	0.775	(0.485, 1.237)	0.2853	0.849	(0.428, 1.684)	0.6394
Age 15-19 vs. Age 01-04 (ref)	0.835	(0.365, 1.913)	0.6705	0.151	(0.016, 1.445)	0.1009	0.240	(0.126, 0.455)	<.0001	1.088	(0.561, 2.110)	0.8040
6 cm or greater vs. < 6 cm (ref)	1.000	(0.522, 1.913)	0.9991	0.467	(0.133, 1.636)	0.2341	1.169	(0.827, 1.653)	0.3765	0.935	(0.528, 1.657)	0.8176
Missing tumor size vs. < 6 cm (ref)	0.632	(0.335, 1.192)	0.1566	1.319	(0.515, 3.382)	0.5639	1.056	(0.831, 1.342)	0.6569	0.871	(0.581, 1.304)	0.5016
Regional/Distant vs. Localized (ref)												
Radiation Tx v. No Radiation Tx (ref)	0.321	(0.114, 0.898)	0.0305	0.187	(0.031, 1.110)	0.0650	1.003	(0.603, 1.666)	0.9921	0.570	(0.248, 1.309)	0.1851
Surgery vs. No Surgery (ref)	0.322	(0.069, 1.490)	0.1470	0.292	(0.029, 2.974)	0.2984	0.495	(0.385, 0.636)	<.0001	0.624	(0.420, 0.927)	0.0195
Highest Quartile Percent Less than HS Ed vs. All Others (ref)	0.991	(0.430, 2.282)	0.9822	1.834	(0.549, 6.125)	0.3240	1.021	(0.740, 1.410)	0.8992	1.310	(0.678, 2.532)	0.4211
Highest Quartile Percent Below Poverty vs. All Others (ref)	0.994	(0.460, 2.150)	0.9880	1.519	(0.424, 5.438)	0.5203	1.227	(0.904, 1.665)	0.1887	1.239	(0.681, 2.253)	0.4824
Highest Quartile Percent Language Isolation vs. All Others (ref)	1.246	(0.637, 2.436)	0.5208	0.170	(0.024, 1.184)	0.0735	1.032	(0.762, 1.396)	0.8406	0.801	(0.503, 1.277)	0.3516
Time-dependent Site												
Time-dependent Age							1.027	(1.016, 1.038)	<.0001			
Time-dependent Radiation	1.048	(1.007, 1.091)	0.0212	1.069	(1.002, 1.140)	0.0428	1.047	(1.019, 1.076)	0.0010	1.089	(1.024, 1.158)	0.0069
Time-dependent Surgery												
Time-dependent Highest Quartile Language Isolation				1.082	(1.021, 1.148)	0.0080						

Supplemental Table 3 (continued)

Variable	PNET/Pineal/ATRT						Medulloblastoma					
	Localized N = 97			Regional/Distant (N = 51)			Localized (N = 270)			Regional/Distant (N = 112)		
	HR	HR 95% CI	p-value	HR	HR 95% CI	p-value	HR	HR 95% CI	p-value	HR	HR 95% CI	p-value
Year of Diagnosis	1.002	(0.924, 1.087)	0.9652	1.040	(0.924, 1.171)	0.5116	0.969	(0.907, 1.035)	0.3519	0.956	(0.876, 1.042)	0.3038
Male vs. Female (ref)	0.985	(0.505, 1.922)	0.9639	1.345	(0.462, 3.915)	0.5864	1.074	(0.608, 1.898)	0.8053	0.824	(0.427, 1.589)	0.5627
Black vs. White Race (ref)	2.078	(0.858, 5.033)	0.1049	1.903	(0.166, 21.854)	0.6054	0.465	(0.136, 1.583)	0.2203	0.797	(0.288, 2.205)	0.6619
Other vs. White Race (ref)	0.485	(0.105, 2.239)	0.3541	1.344	(0.396, 4.563)	0.6355	0.524	(0.164, 1.667)	0.2736	0.919	(0.274, 3.089)	0.8920
Hispanic vs. Non-Hispanic Ethnicity (ref)	1.949	(0.900, 4.221)	0.0905	1.163	(0.246, 5.500)	0.8494	1.514	(0.812, 2.823)	0.1914	0.835	(0.381, 1.832)	0.6531
Age 00 vs. Age 01-04 (ref)	6.588	(2.662, 16.308)	<.0001	1.892	(0.548, 6.537)	0.3133	1.333	(0.364, 4.881)	0.6646	3.809	(1.045, 13.877)	0.0426
Age 05-09 vs. Age 01-04 (ref)	0.314	(0.090, 1.092)	0.0686	0.324	(0.081, 1.298)	0.1115	0.759	(0.389, 1.480)	0.4183	0.800	(0.394, 1.624)	0.5372
Age 10-14 vs. Age 01-04 (ref)	0.154	(0.029, 0.817)	0.0280	0.868	(0.086, 8.788)	0.9047	0.463	(0.189, 1.130)	0.0908	0.369	(0.119, 1.145)	0.0844
Age 15-19 vs. Age 01-04 (ref)	0.106	(0.011, 0.987)	0.0487	0.033	(0.001, 1.067)	0.0544	0.589	(0.230, 1.504)	0.2683	0.000	(0.000, .)	0.9887
6 cm or greater vs. < 6 cm (ref)	0.664	(0.279, 1.581)	0.3552	1.113	(0.327, 3.788)	0.8643	2.054	(0.572, 7.383)	0.2700	1.240	(0.342, 4.495)	0.7434
Missing tumor size vs. < 6 cm (ref)	0.636	(0.281, 1.439)	0.2774	0.970	(0.273, 3.448)	0.9622	0.987	(0.504, 1.935)	0.9696	1.250	(0.503, 3.107)	0.6310
Regional/Distant vs. Localized (ref)												
Radiation Tx v. No Radiation Tx (ref)	0.603	(0.274, 1.327)	0.2083	0.432	(0.132, 1.413)	0.1649	0.158	(0.055, 0.453)	0.0006	0.967	(0.476, 1.967)	0.9271
Surgery vs. No Surgery (ref)	0.902	(0.317, 2.564)	0.8469	0.184	(0.028, 1.204)	0.0773	0.043	(0.009, 0.204)	<.0001	1.795	(0.226, 14.263)	0.5800
Highest Quartile Percent Less than HS Ed vs. All Others (ref)	0.803	(0.280, 2.304)	0.6833	0.141	(0.016, 1.250)	0.0785	0.390	(0.141, 1.078)	0.0695	0.323	(0.108, 0.965)	0.0430
Highest Quartile Percent Below Poverty vs. All Others (ref)	0.977	(0.359, 2.654)	0.9629	9.209	(1.121, 75.649)	0.0388	1.538	(0.613, 3.856)	0.3589	4.180	(1.404, 12.441)	0.0102
Highest Quartile Percent Language Isolation vs. All Others (ref)	1.429	(0.636, 3.211)	0.3878	0.569	(0.151, 2.141)	0.4046	1.681	(0.855, 3.305)	0.1321	0.601	(0.263, 1.375)	0.2280
Time-dependent Site												
Time-dependent Age	1.058	(1.022, 1.095)	0.0012	1.042	(1.006, 1.079)	0.0220						
Time-dependent Radiation							1.078	(1.019, 1.140)	0.0092			
Time-dependent Surgery												
Time-dependent Highest Quartile Language Isolation												

CI=confidence interval; HR=hazard ratio; HS= high school; N=number of individuals in each category.

Notes: Highest Quartile % of county-level factors indicates the lowest level of disadvantage. Hazard ratio (HR) indicates the ratio of hazard of death by levels of covariates. Significant values (P<0.05) have been marked with bold.

Supplemental Fig. 1 Kaplan-Meier curves illustrating the overall survival for patients with and without radiation therapy.

