Inequality by Race/Ethnicity in Survival Improvement of Children with Acute Lymphoblastic Leukemia in the United States and Canada

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Background and Objectives

- Acute lymphoblastic leukemia (ALL) is the most common childhood cancer: approximately 2,900 children in the United States and 300 children in Canada and are diagnosed with ALL every year (3-4 cases per 100,000 children aged 0-19 years old)
- It is also one of the most curable childhood cancers (Figure 1)
- However, children of different race/ethnicity groups benefit unequally in the United States, with adverse prognosis reported in Blacks, Hispanics, and American Indian/Alaska Natives (AIANs) as compared to Whites

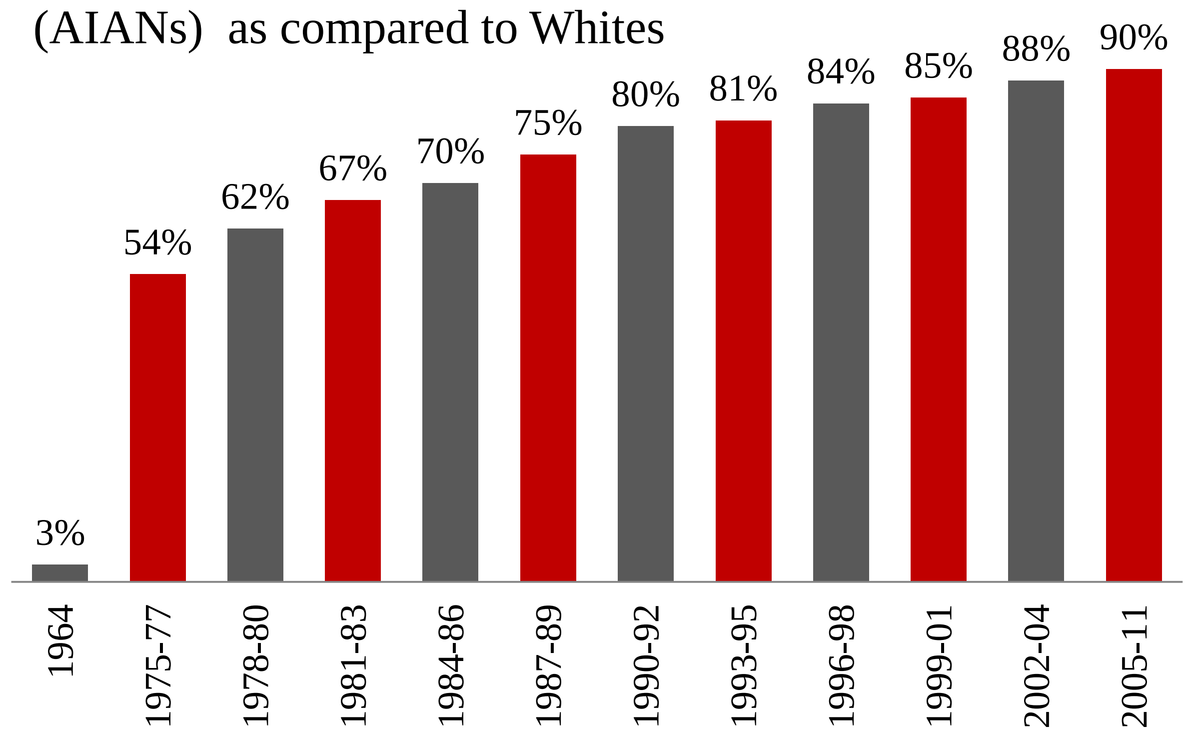

Figure 1. Five-Year Relative Survival Rates for Acute Lymphoblastic Leukemia

- **Objectives : 1) investigate the changes in survival inequalities among US children with ALL over time by race/ethnicity 2) compare the survival between US children, Canadian Children, and US White children over time**

Methods

Study Population and Outcomes

- Children diagnosed at age 0-19 with a first primary malignant ALL in 1975-2010 in one of nine original cancer registries in the Surveillance, Epidemiology and End Results program (SEER) in the US
- Outcomes: death due to ALL (ALL mortality) and overall survival
- Canadian survival statistics: obtained from publications using Canadian Cancer Registries data (all Canada excluding Quebec)

Statistical Analysis

- Cumulative mortalities due to ALL were estimated using the cumulative incidence function, and overall 5-year survival probabilities were estimated using Kaplan-Meier Method
- Multivariable Cox regression analyses were applied to estimate hazard ratios (HRs) by race/ethnicity and diagnosis period, adjusting for age at diagnosis and sex

Results

- A total of 7,365 children diagnosed with ALL during 1975-2010 at age younger than 20 were included

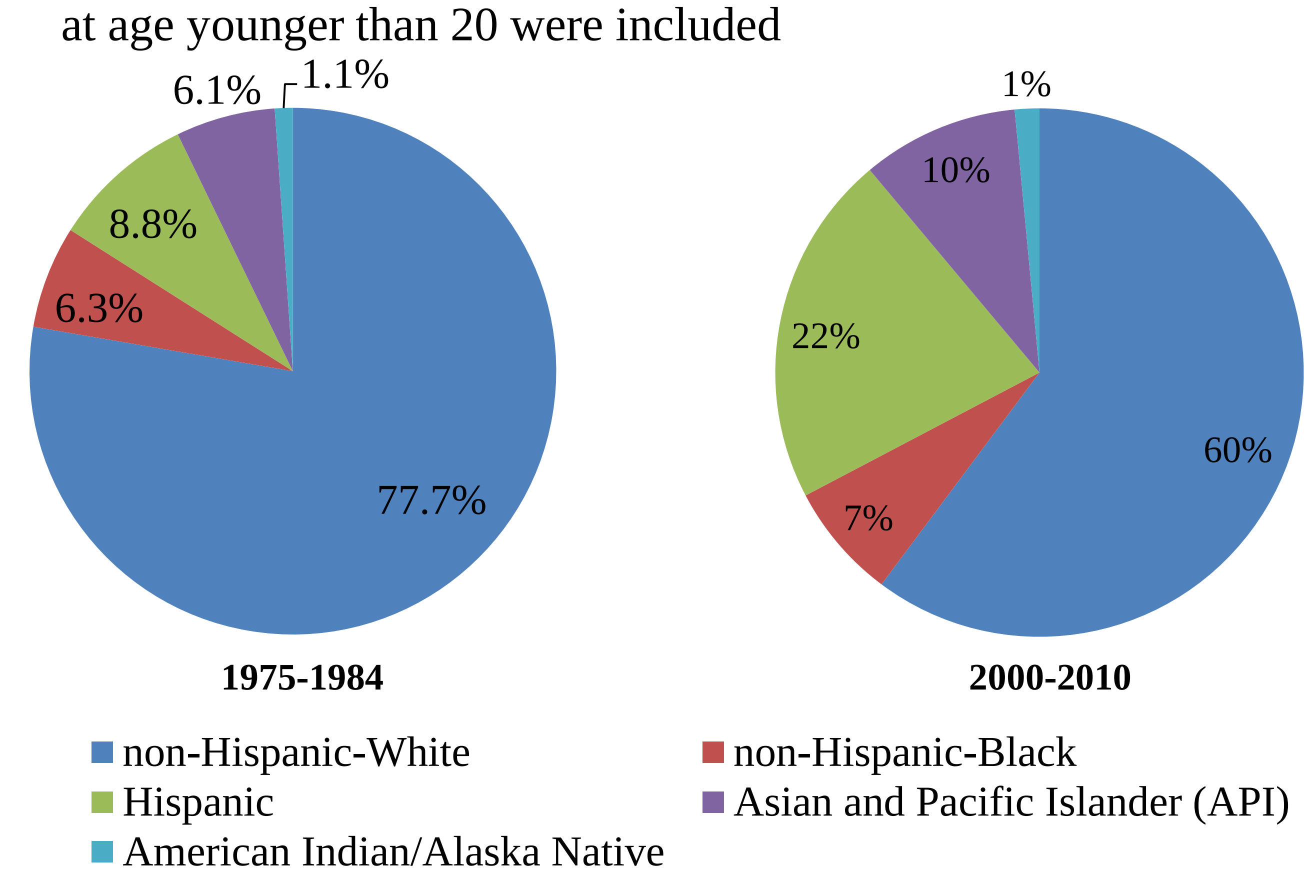

Figure 2. Distribution of Cases by Race/Ethnicity in 1975-1984 vs. 2000-2010

Table 1. Characteristics of Children Diagnosed with Acute Lymphoblastic Leukemia by Race/Ethnicity, SEER 9, 1975-2010

	NH-White	NH-Black	Hispanic	API	AIAN	
	No. (%)					P-value
All Cases	5000 (67.9)	532 (7.2)	1096 (14.9)	626 (8.5)	111 (1.5)	
Sex						0.639
Girls	2179 (43.6)	237 (44.5)	460 (42.0)	264 (42.2)	43 (38.7)	
Boys	2821 (56.4)	295 (55.5)	636 (58.0)	362 (57.8)	68 (61.3)	
Age at Diagnosis						**0.002**
<1	154 (3.1)	23 (4.3)	43 (3.9)	19 (3.0)	1 (0.9)	
1-9	3558 (71.2)	345 (64.9)	766 (69.9)	480 (76.7)	82 (73.9)	
10-19	1288 (25.7)	164 (30.8)	287 (26.2)	127 (20.3)	28 (25.2)	
Diagnosis Period						**<0.001**
1975-1983	1140 (22.8)	93 (17.5)	129 (11.8)	90 (14.4)	16 (14.4)	
1984-1991	1133 (22.7)	115 (21.6)	174 (15.9)	137 (21.9)	32 (28.8)	
1992-1999	1155 (23.1)	138 (25.9)	228 (20.8)	147 (23.5)	23 (20.7)	
2000-2010	1572 (31.4)	186 (35.0)	565 (51.6)	252 (40.3)	40 (36.0)	

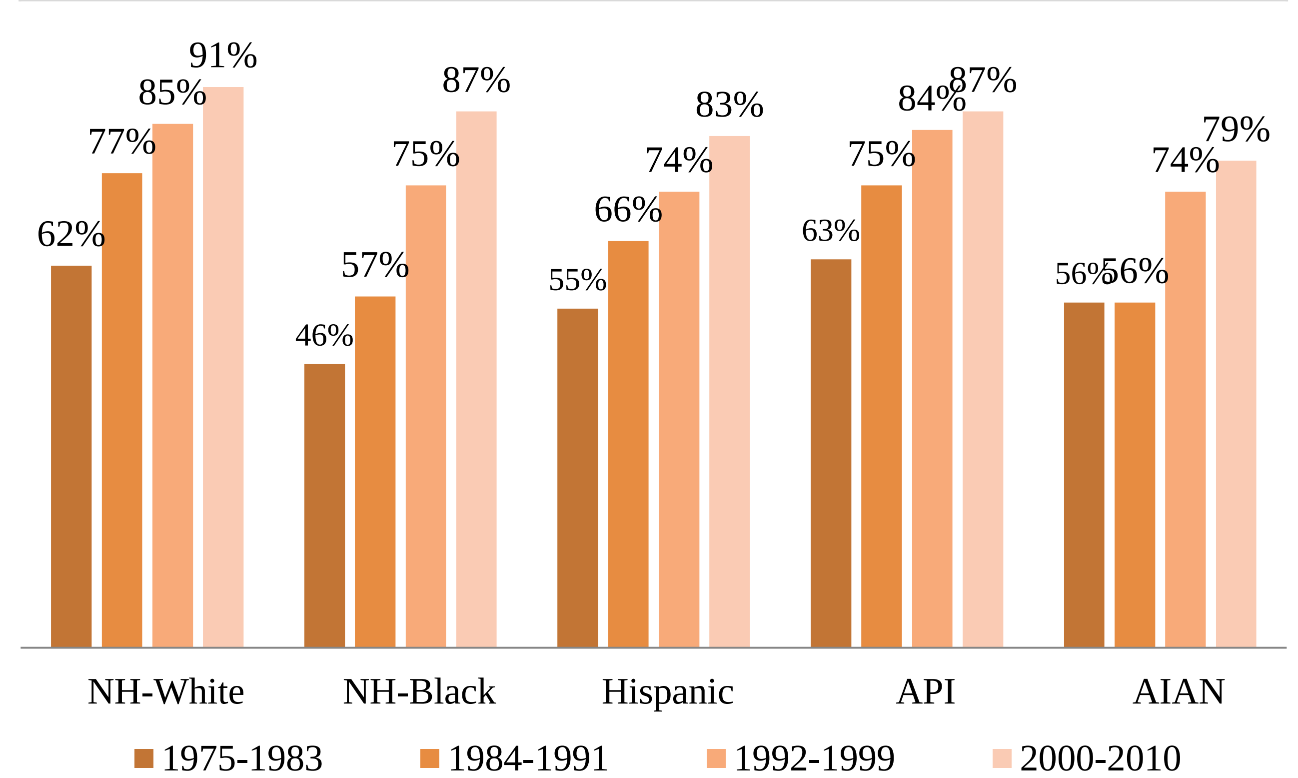

Figure 3. Five-Year Overall Survival by Race/Ethnicity and Diagnosis Period

Results

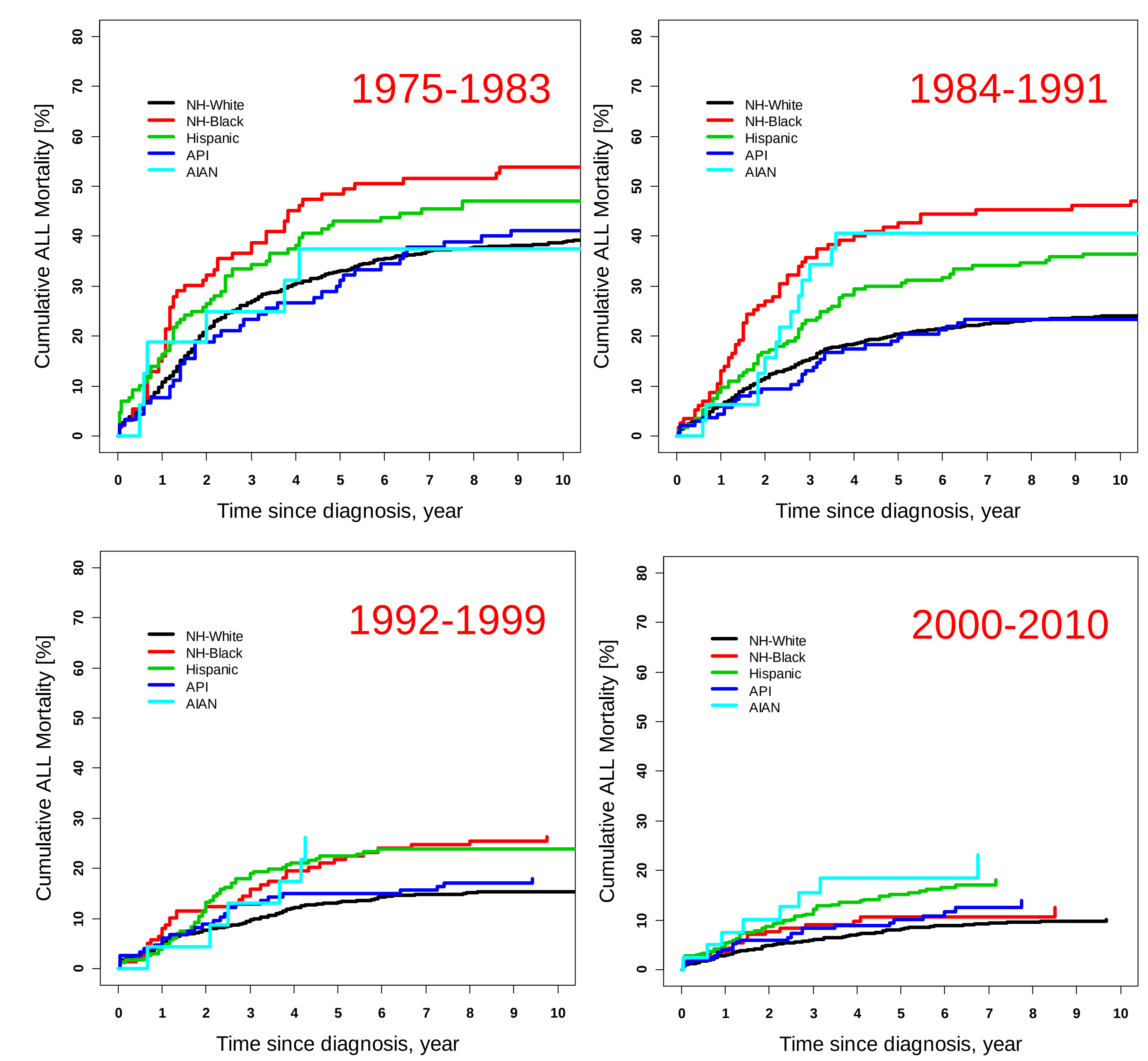

Figure 4. Cumulative Mortality due to Acute Lymphoblastic Leukemia, by Diagnosis Period and Race/Ethnicity, SEER 9 Registries, 1975-2010

Table 2. Hazard Ratios of Acute Lymphoblastic Leukemia Mortality among Race/Ethnicity Groups (Compared to NH-Whites), by Diagnosis Period, SEER 9

	1975-1983	1984-1991	1992-1999	2000-2010	
	Adjusted HR (95% CI)				Trend P
[1]Age 0-19					
NH-Black	1.46 (1.09, 1.94)	2.09 (1.57, 2.79)	1.62 (1.13, 2.32)	**1.21 (0.74, 1.96)**	0.655
Hispanic	**1.28 (0.98, 1.66)**	**1.58 (1.21, 2.07)**	**1.66 (1.23, 2.25)**	**1.95 (1.48, 2.58)**	0.023
API	1.05 (0.76, 1.46)	1.11 (0.77, 1.59)	1.22 (0.81, 1.85)	1.37 (0.91, 2.08)	0.275
AIAN	1.26 (0.60, 2.65)	**2.19 (1.28, 3.75)**	**2.10 (0.93, 4.75)**	**2.28 (1.11, 4.67)**	0.279
[2]Age 1-9					
NH-Black	1.81 (1.21, 2.69)	2.63 (1.77, 3.89)	2.09 (1.27, 3.42)	**1.90 (0.93, 3.89)**	0.805
Hispanic	1.42 (1.00, 2.01)	1.62 (1.11, 2.35)	1.81 (1.20, 2.73)	2.12 (1.33, 3.38)	0.143
API	1.23 (0.83, 1.85)	1.19 (0.77, 1.82)	1.47 (0.89, 2.44)	**2.02 (1.10, 3.69)**	0.175
AIAN	1.01 (0.38, 2.71)	2.06 (1.01, 4.19)	1.87 (0.69, 5.09)	0.94 (0.13, 6.84)	0.696
[2]Age 10-19					
NH-Black	1.47 (0.95, 2.27)	1.74 (1.09, 2.77)	1.19 (0.68, 2.11)	0.77 (0.36, 1.68)	0.151
Hispanic	1.02 (0.66, 1.60)	1.57 (1.02, 2.42)	1.74 (1.09, 2.77)	1.87 (1.28, 2.71)	**0.043**
API	0.93 (0.51, 1.72)	1.14 (0.58, 2.24)	0.95 (0.44, 2.05)	1.16 (0.61, 2.18)	0.683
AIAN	1.72 (0.55, 5.39)	2.42 (1.07, 5.52)	3.02 (0.74, 12.3)	2.42 (1.05, 5.58)	0.633

[1]Adjusted for diagnosis period-specific age at diagnosis and sex;
[2]Adjusted for diagnosis period-specific sex.

Results

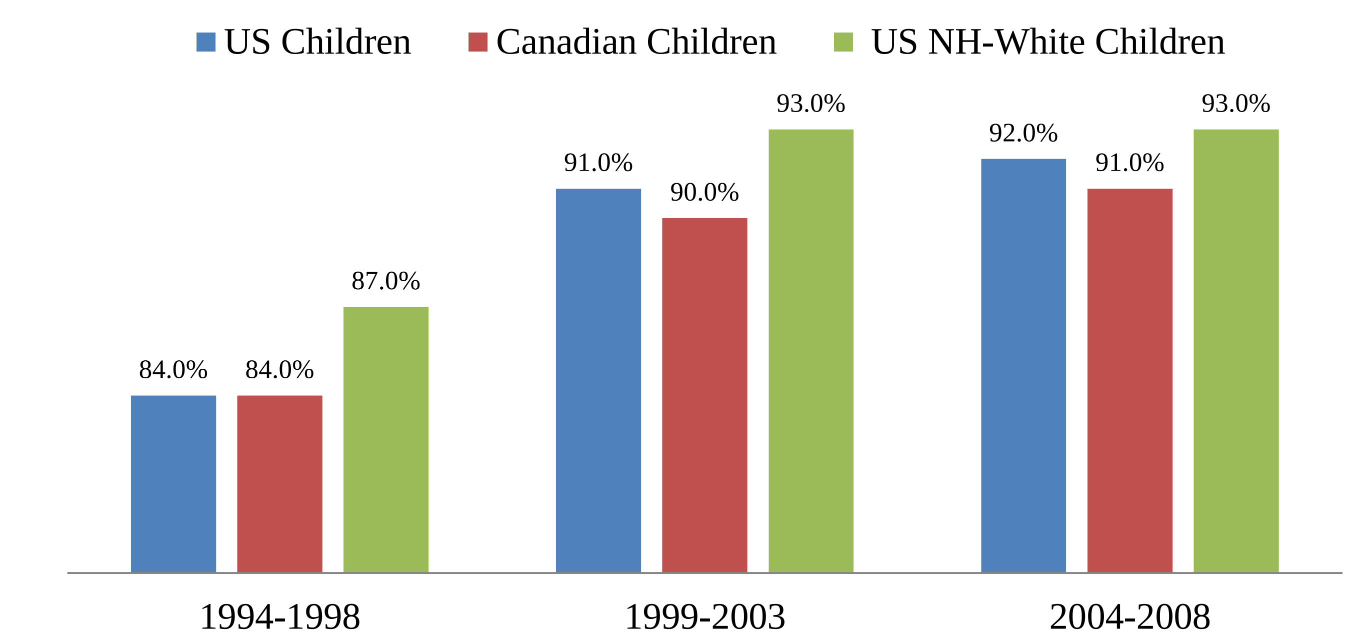

Figure 5. Comparison of Five-Year Survival among US children, Canadian children [3,4] and US NH-White children with Acute Lymphoblastic Leukemia

Conclusions

Among US children in SEER 9

- **Inequalities in ALL mortality diminished in NH-Blacks**, but **increased in Hispanics** (significantly), APIs, and AIANs
- The largest racial/ethnic inequality existed among age 1-9 group, who have experienced the greatest survival improvements, implying **the survival improvements were not enjoyed by all race/ethnicity groups equally**

For Canadian Children

- Survival improvement between 1990s and 2000s appears similar as US children, but **the absolute 5-year survival remains slightly lower than US NH-Whites**

Overall

- Underlying causes need to be examined, such that targeted interventions can be developed to reduce inequalities

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Acknowledgement

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