

Introduction

The Adverse Childhood Experiences (ACE) Study first looked at exposure to childhood emotional, physical, or sexual abuse and household dysfunction and their relationship with long-term disease¹. Since then, ACEs have been repeatedly linked to negative health outcomes in children and adulthood, including an increased risk for cardiovascular disease²⁻⁵. ACEs have been associated with increased resting heart rate, body mass index (BMI), and weight circumference in children which are associated with obesity and thus risk factors for cardiovascular disease⁶. Multiple mechanisms have been suggested to explain how these early adverse experiences disrupt psychosocial development for children, increasing their risk of behavioral and physical health issues that subsequently increased the risk of cardiovascular disease. These include low medication adherence, smoking to cope with stress, eating as a coping mechanism, and physical inactivity leading to obesity and physiologic alterations in their nervous, neuroendocrine, and immune systems' response to stress⁷. Although multiple studies have examined cardiovascular disease in adults who were exposed to ACE^{2,4}. To our knowledge, this is the first time the association between ACE and children with heart disease is evaluated. The objectives of our study were to describe the prevalence of ACEs among children with heart disease in the United States, describe the association between ACEs and severity of heart disease among children in the U.S., and evaluate how ACEs impact overall health status among children with heart conditions in the United States. Understanding the relationship between these and the impact of ACE in children with heart disease will allow for targeted screening and intervention to improve health outcomes in this population.

Methods

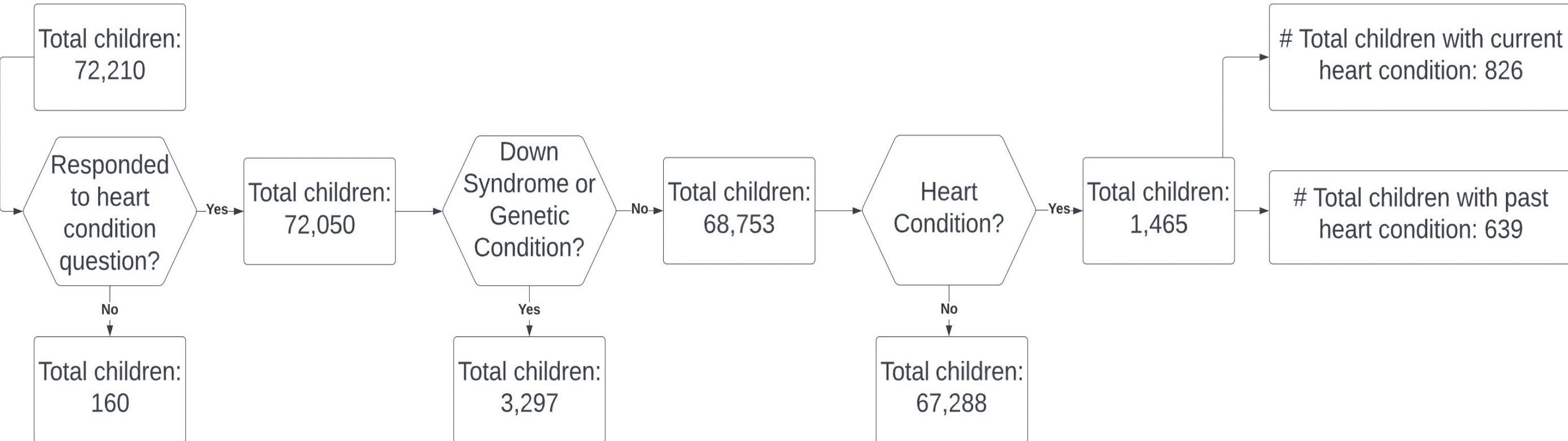


Fig. 1. Flow chart of the sample included from the 2019-2020 National Survey of Children's Health

Data on children ages 3 to 17 years reported by parents/guardians to have current heart conditions were analyzed. Descriptive statistics were generated for the demographic characteristics using the chi-square of independence. Multivariate logistic regression models were generated to determine the associations between ACEs and heart conditions, the severity of heart conditions, and overall health status. All analyses were performed using STATA 17 (Stata Corp) accounting for the complex sampling designs and weights in NSCH data.

Results

There were 826 children with a current heart condition surveyed, which corresponds to an estimate of 1.13% of the children in the U.S. (Table 1). In the multivariate logistic models, several ACEs including household economic hardship, parental/guardian's alcohol/drug abuse, severe mental health illness of parents/guardians, racial/ethnic discrimination, exposure to neighborhood violence, and accumulation of two or more ACEs were significantly associated with heart conditions among children (Table 2).

Table 1. Demographic characteristics of children with and without the heart conditions

Variables	Current Heart Conditions				p-value
	n	%	n	%	
Age in 3 groups					0.145
0-5	238	28.81	19,264	28.63	
6-11	265	32.08	20,613	30.63	
12-17	323	39.10	27,411	40.74	
Sex					0.340
Male	462	55.93	34,719	51.60	
Female	364	44.07	32,569	48.40	
Race and Ethnicity					0.1705
Hispanic	105	12.71	8,711	12.95	
White, Non-Hispanic	568	68.77	45,264	67.27	
Black, Non-Hispanic	66	7.99	4,448	6.61	
Other/Multi-racial	87	10.53	8,865	13.17	
Country of Birth					0.251
In-USA	782	95.72	64,546	96.76	
Out of US	35	4.28	2,160	3.24	
Family Structure					0.101
Two parents, currently married	533	65.80	46,215	70.41	
Two parents, not currently married	58	7.16	4,035	6.15	
Single parent	175	21.60	12,826	19.54	
Grandparent household	29	3.58	1,942	2.96	
Others	15	1.85	623	0.95	
Highest level of education of any adult in household					0.003
Less than high school	12	1.45	1,741	2.59	
High School degree or GED	137	16.59	8,768	13.03	
Some college or technical school	187	22.64	15,249	22.66	
College degree or higher	490	59.32	41,530	61.72	
Household income as % of federal poverty level					0.539
0-99%	124	15.01	7,945	11.81	
100-199%	151	18.28	11,158	16.58	
200-399%	242	29.30	20,812	30.93	
≥ 400%	309	37.41	27,373	40.68	
Type of health insurance					0.041
Public	224	27.62	13,454	20.31	
Private	516	63.63	47,096	71.08	
Public and Private	40	4.93	2,385	3.60	
Uninsured	31	3.82	3,323	5.02	

Table 2: Multivariate logistic regressions of ACEs and different outcomes

	Heart Conditions			Severity of Heart Conditions			Overall Health Status		
	aOR	C.I	p-value	aOR	C.I	p-value	aOR	C.I	p-value
Internal ACEs									
Parent or guardian died	0.87	0.48-1.58	0.655	0.07	0.009-0.62	0.017	0.32	0.06-1.59	0.166
Parent or guardian divorced or separated	1.12	0.82-1.54	0.459	1.55	0.71-3.38	0.266	1.00	0.50-1.99	0.992
Witnessed domestic violence	1.54	0.87-2.74	0.134	1.50	0.43-5.25	0.517	2.38	0.92-6.19	0.074
Lived with anyone who had a problem with alcohol or drug	2.42	1.58-3.69	<0.01	1.02	0.43-2.43	0.955	1.93	0.94-3.95	0.071
Hard to cover basics like food and housing on family's income	3.13	1.98-4.95	<0.01	2.05	0.72-5.83	0.177	2.96	1.26-6.92	0.012
Parent or guardian served time in jail	1.57	0.95-2.61	0.077	2.47	0.76-7.96	0.130	3.31	1.28-8.54	0.013
Lived with anyone who was mentally ill, suicidal or severely depressed	2.26	1.35-3.79	0.002	0.94	0.38-2.34	0.908	2.98	1.51-5.85	0.001
External ACEs									
Treated or judged unfairly because due to race/ethnicity	3.13	1.28-7.65	0.012	5.66	1.66-19.28	0.006	2.97	0.86-10.27	0.085
Victim of/witnessed neighborhood violence	1.88	1.15-3.08	0.011	0.44	0.13-1.46	0.183	1.74	0.55-5.44	0.341
Number of ACEs									
1	1.98	1.29-3.05	0.002	2.09	0.78-5.62	0.141	1.05	0.40-2.70	0.918
≥ 2	2.75	1.82-4.16	<0.01	1.85	0.74-4.63	0.184	2.31	1.07-4.96	0.031

Discussion

In this study, we have evaluated the associations between ACEs and heart diseases among children in the United States. In doing these, we found out that:

- 1) An estimated 1.13% (780,000) children in the U.S were living with heart diseases in the year 2019 or 2020 and that 57% of these children experienced at least one ACE.
- 2) Several ACEs including household economic hardship, parental/guardian's alcohol/drug abuse, severe mental health illness of parents/guardians, racial/ethnic discrimination, exposure to neighborhood violence, and accumulation of two or more ACEs were significantly associated with heart diseases among children in multivariate analyses.
 - Children living in low-income families have been shown to have worse health outcomes on many health indicators including obesity, mental health, asthma, and low birth weight⁸.
 - Maternal drugs of abuse have been associated with newborns' cardiovascular diseases, including congenital heart diseases, conduction diseases of the heart, and cardiomyopathy⁹.
 - ACE has been shown to have a cumulative effect.¹ Our study found a more than two-fold increase in the risk of heart disease among children who experienced two or more ACEs. Multiple ACEs generally lead to a higher prevalence of diseases in adults such as cardiovascular diseases, neurocognitive, dental, and mental health diseases¹⁰.
- 3) Having two or more ACEs do not have any significant association with the severity of heart condition but racial/ethnic discrimination and parental/guardian death were independently associated with moderate to severe heart conditions.
 - Since studies have linked ACE exposure to worsening cardiovascular health in adulthood^{4,11}, it is likely that these effects are seen in the long-term into adulthood.
- 4) Accumulation of two or more ACEs was significantly associated with caregiver report of undesirable overall health status.

Conclusions

- This study shows that ACEs are significantly associated with heart conditions among children and contribute to unfavorable overall health status among children with heart conditions in the U.S.
- These findings are in keeping with many previous studies on the negative impact of ACEs on health outcomes.
- This study has broadened our understanding that the negative cardiovascular effects of ACEs may not be limited to later life in adulthood.
- There is a need for collaborations among pediatricians, public health workers, and public officials in instituting policies and programs that will promptly identify ACEs and mitigate their negative impacts on children.

References



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