Prevalence and Trends in Pediatric-Onset Chronic Conditions in the United States, 1999–2018

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Abstract

Objective: We sought to provide an updated estimate of the current prevalence and recent trends (over the past two decades) in pediatric-onset conditions among a nationally-representative sample of youth to identify opportunities for prevention and intervention.

Methods: We performed a secondary data analysis of nationally-representative data on 236,412 participants (ages 5–25 years) from the 1999 to 2018 National Health Interview Survey. Chronic conditions (CCs) and functional limitations (FLs) were self-reported by the participant or a qualified proxy-respondent. We employed multivariate linear probability models to estimate annual average increase in CC/FL prevalence and differences in prevalence across sociodemographic characteristics.

Results: The prevalence of children (5–17 years) with a CC/FL has risen from 22.57% in 1999/2000 to 30.21% in 2017/2018 – an adjusted annual increase of 0.24% points per year ($P < .0001$) or about 130,000 additional children per year. The prevalence of young adults (18–25 years) with a CC/FL has risen similarly (adjusted annual increase of 0.33% points per year, $P < .0001$). Asthma and mental/behavioral health conditions were some of the leading CC and FL (respectively) contributors to this increase for both age groups. We estimate that approximately 1.2 million youth with a CC or FL currently turn 18 each year.

Conclusions: The US is currently seeing an unprecedented number of youth with pediatric-onset conditions. It is incumbent for the US health system to seek ways to treat these patients in pediatric settings and eventually matriculate them into adult care.

Keywords: children; chronic conditions; functional limitation; health care disparities; young adults

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What's New

The prevalence of youth with a chronic condition or functional limitation has risen from 23% to 30% in the past two decades – an adjusted annual increase of 0.24% points per year or about 130,000 additional youth per year.

The prevalence of youth and young adults with chronic conditions (CCs) and functional limitations (FLs) in the United States is growing.[1] Changes to social conditions (eg, increased income inequality)[2] and more recently the COVID-19 pandemic (eg, worsening mental health)[3,4] may contribute to expanded prevalence in years to come. The most recent survey estimates suggest that the prevalence of US youth with a CC or FL ranges from 12% to 30%,[5–11] though there is substantial variation across prior estimates depending on the dataset and questions used, conditions included in the definition, youth versus caregiver report, and assessment period.[12,13] Contemporaneous differences, such as changing diagnostic criteria, access to care, and public awareness/attention, may also influence estimates of prevalence.

Not only do prior reports indicate that many conditions are increasing in prevalence over time,[14–16] but there is also evidence for growing disparities.[8,17] Youth with CCs and FLs are subject to high health care-related financial burden,[18–20] poor quality of life,[21,22] poor educational attainment,[23] and low social and community participation[24] – as such, growing disparities in the prevalence of these conditions have the potential to impact future adult social and economic disparities with major implications for public and private health expenditures, workforce participation, and quality-adjusted life years. Understanding the scope of this problem is a critical first step for designing supportive programs and policies that can mitigate the negative effects of growing up with a chronic illness.

We sought to provide an update on the prevalence of youth and young adults (ages 5–25) in the US who are currently living with a CC or FL (and thus need access to medical care and/or supportive services) while also assessing for socioeconomic differences in prevalence, determine how the prevalence of such conditions has changed over the past two decades (prior to the COVID-19 pandemic), and estimate the number of youth who enter adulthood (ie, turn 18) with a CC or FL each year.

METHODS

DATA SOURCE AND POPULATION

Data are from the National Health Interview Survey (NHIS), which collects health information annually for a nationally representative, cross-sectional sample of the civilian, non-institutionalized population in the United States; we obtained NHIS data from the Integrated Public Use Microdata Series (IPUMS) database.[25] We included the 20 most recent years of NHIS data prior to the major redesign in 2019,[26] at which point the survey dramatically reduced the number of chronic conditions that it assessed. Since NHIS is repeated cross-sectional survey, our sample included 236,412 unique youth/young adults, ages 5–25 years, whose families were interviewed in one of 20 NHIS years, from 1999 to 2018, and were selected as the "sample adult" (ages 18–25) or "sample child" (ages 5–17) respondent in the survey. Youth younger than 5 years were not included as the many of the conditions assessed are not typically diagnosed in pre-school aged-children; youth over age 18 were included as very few prior estimates report the prevalence of pediatric-onset conditions among young adults. Survey information for the "sample child" is obtained from a knowledgeable adult residing in the household, usually the child's parent (91.3% of included sample children had a biological, adoptive or stepparent as their respondent). The individual selected as the "sample adult" responds for him/herself to relevant survey questions unless he/she is physically or mentally unable to do so, in which case a knowledgeable proxy provides survey information. Overall response rates for NHIS households varied from 64.2% to 89.6% for the included years. As data are already collected and de-identified, this study was deemed exempt by the Boston Children's Hospital and UCLA Institutional Review Boards.

MEASURES

Chronic Conditions (CC) and Functional Limitations (FL). We identified CC if individuals reported having ever or recently been diagnosed with a condition that is typically pediatric-onset and expected to be persistent or severe (Appendix A). Specifically, NHIS sample adult/child respondents were asked to report if they had ever received a diagnosis for a pre-specified list of chronic conditions, which differed based on the age of the respondent (≤17 vs ≥18). For a subset of conditions (eg, asthma), respondents were asked to report if they had experienced that condition in the past year. Certain conditions (eg, chronic liver condition) were newly assessed by the NHIS at some point during the study period and thus prevalence estimates are reported for applicable years only.

We identified FL if individuals reported any functional/activity limitation related to a condition that is typically pediatric-onset and expected to be persistent or severe (Appendix A). Specifically, respondents were asked a series of questions to determine if they had any limitations (eg, activities of daily living) and then asked to specify the underlying condition causing said limitations from a pre-specified list of conditions that differed based on the age of the respondent.

For both CC and FL, we evaluated all conditions assessed in the NHIS for possible inclusion in our definition but decided on the final list of included conditions based on alignment between sample child and sample adult questionnaires and clinical expertise. We dichotomized CC/FL status by those who reported either a CC or FL (17.1% reported a CC only, 3.1% reported a FL only, 6.8% reported both) compared to those who reported neither a CC nor a FL (73.0%, data not shown).

Sociodemographics. We compiled data on several sociodemographic characteristics of respondents, including: survey year, age, sex, race and ethnicity (white non-Hispanic [nH]; Black nH; Asian nH; other nH; Mexican-American; other Hispanic), citizenship status (born in the US; legal/naturalized citizens; non-citizens; unreported), interview language (English only; any other language; unreported), educational attainment (for young adults, their own educational attainment was used; for children, their parent's/parents' highest educations attainment was used), total combined income of all family members as a percentage of the federal poverty level (FPL), insurance coverage during the past 12 months (private only; public only; public and private; partial; uninsured), employment status (for young adults, their own employment status was used; for children, their parent's/parents' employment status was used), and US region of residence (Northeast; Midwest; South; West). Sociodemographic characteristics were included if consistently assessed across survey years, concordant between child and adult samples, and conceptually related to condition prevalence (eg, Autism is known to vary by sex). Reference categories were chosen because they were either the most prevalent group (eg, White, non-Hispanic) or because of relevance for comparison (eg, highest income group as referent).

ANALYTIC APPROACH

All analyses were performed with SAS 9.4 (SAS Institute Inc., Cary, NC) and accounted for the complex, multistage probability sampling design of the NHIS, incorporating stratification, clustering, and unequal household selection probabilities. Data were first analyzed descriptively; differences in the prevalence of CC/FL by sociodemographics were assessed with Chi-square tests. We employed multivariate linear probability models to estimate annual average increase in prevalence of CC/FL

and differences in average CC/FL prevalence across sociodemographic predictors; regression models adjusted for aforementioned sociodemographic characteristics in order to estimate the adjusted annual trend in prevalence accounting for demographic changes over time. As the large sample increases likelihood of statistically significant findings of a small effect size, we focus interpretation of sociodemographic differences in prevalence on those findings with a more stringent alpha criterion ($P < 0.01$) and with an effect size of ≥3% points. Prevalence in individual CC/FL (eg, asthma) were calculated in five-year increments over the study period (for parsimony in the tables) while annual average increase in prevalence of each condition was estimated with bivariate linear probability models. As a sensitivity analysis, we restricted analyses of trends to include only those conditions that were consistently assessed across all study years and to include only years 2004 on (after a change in the NHIS methodology regarding the questions that were assessed and the target sample size). We used weighted estimates from the most recent three years of data (2016–2018) to estimate the 'current' total number of youth (ages 5–25) with any CC or FL and divided this number by 21 (number of years of age included from 5 to 25 years) to determine the number with a CC or FL who turn 18 each year.

RESULTS

Across all years, 28.1% of children (age 5–17) had a reported CC/FL (Table 1A) with an unadjusted annual increase in prevalence of 0.32% points (pp) per year ($P < 0.0001$; Appendix B1). After adjustment for sociodemographic characteristics, the annual increase in prevalence was 0.24 pp per year ($P < 0.0001$; Table 1A, Fig. A). Socioeconomic disparities were identified by income (youth living below the federal poverty level had 3.39 pp higher adjusted prevalence than the highest income families), by insurance (compared to privately insured youth, those with public insurance or combination public and private had 8.63 pp and 21.54 pp higher prevalence, respectively while those with partial coverage had 5.75 pp higher prevalence and uninsured youth had 2.17 pp lower prevalence), and by employment (7.65 pp higher for children with unemployed parents compared to those who parents were employed; Table 1A). Hispanic children and youth who were born outside of the US had lower prevalence of CC/FL compared to non-Hispanic white youth and those born in the US, respectively.

Across all years, 25.1% of young adults (age 18–25) reported a CC/FL (Table 1B) with an unadjusted annual increase in prevalence of 0.35% points (pp) per year ($P < 0.0001$; Appendix B2). After adjustment for sociodemographic characteristics, the annual increase in prevalence was 0.33 pp per year ($P < 0.0001$; Table 1B, Fig. B). Socioeconomic disparities were identified by income (those living below the federal poverty level had 3.11 pp higher adjusted prevalence than those with the highest income), by insurance (compared to privately insured youth, those with public insurance or combination public and private had 10.58 pp and 27.24 pp higher prevalence, respectively while those with partial coverage had 6.09 pp higher prevalence), by employment (unemployed youth had 3.93 pp higher prevalence than employed youth), and by education (adjusted prevalence decreased with increasing levels of education; Table 1B). Hispanic youth and those who were born outside of the US had lower prevalence of CC/FL compared to non-Hispanic white youth and those born in the US, respectively.

Prevalence of both CC and FL increased significantly over time for children and young adults (all $P < 0.0001$). Increasing prevalence of CC was primarily driven by attention deficit hyperactivity disorder/attention deficit disorder (ADHD/ADD) (0.24 pp per year), autism/asperger's/autism spectrum disorder (ASD) (0.13 pp per year), and asthma (0.12 pp per year) for children (Table 2A), and by asthma (0.14 pp per year), seizures/epilepsy (0.13 pp per year), and prediabetes/borderline diabetes (0.12 pp per year) for young adults (Table 2B). Increasing prevalence of FL was primarily driven by speech conditions (0.07 pp per year), ''other'' mental health conditions (eg, ADHD/ADD, 0.06 pp per year), and depression/anxiety/emotional problems (0.05 pp per year) for children (Table 2A), and by musculoskeletal problems (0.11 pp per year), depression/anxiety/emotional problems (0.09 pp per year), and ''other'' mental health conditions (eg, ADHD/ADD, 0.05 pp per year) for young adults (Table 2B).

Trend results were not substantively different across sensitivity analyses, except that the increase in CC among children was no longer statistically significant when restricted to later years (Table 3). We estimate that there are currently 87.4 million youth ages 5–25 in the US, of which 25.7 million reported any CC or FL (22.5 million with a CC only and 10.2 million with a FL only); this amounts to 1.2 million youth with a CC or FL who currently turn 18 each year.

DISCUSSION

We identify that the prevalence of US youth living with a chronic condition or functional limitation has risen over the past two decades from around 1-in-5 youth to nearly 1-in-3 youth – amounting to over 25 million US youth ages 5–25 at present population levels. Socioeconomic disparities in prevalence were noted, consistent with prior reports. Increasing trends appear to be driven by increasing prevalence of conditions that may be prevented or managed in primary care (eg, prediabetes, asthma, hypertension), emphasizing the importance of primary prevention for youth. Given the unprecedented number of youth with these pediatric-onset conditions, it is incumbent for the overall health care system to not only treat these youth in the pediatric setting but also seek ways to matriculate them into adult care so that their conditions

Table 1A. Sociodemographic Characteristics of *Children* (Ages 5–17 y) with and without Chronic Conditions/Functional Limitations from 1999 to 2018

	Total	No CC/FL	Any CC/FL	*P*-value	Adj. Diff.	SE	*P*-value
Total N (unweighted)	166,629	120,087	46,542				
Total % (weighted)		71.9%	28.1%				
Age (y), mean	11.02	10.92	11.28	< .0001	0.64%	0.04%	< .0001
Standard deviation	3.98	4.01	3.88				
Sex				< .0001			
Male	51.1%	66.8%	33.2%		*Reference*		
Female	48.9%	77.2%	22.8%		−10.43%	0.28%	< .0001
Race and Ethnicity				< .0001			
White, non-Hispanic	58.5%	71.0%	29.0%		*Reference*		
Black, non-Hispanic	14.9%	66.8%	33.2%		−0.81%	0.43%	0.0589
Asian, non-Hispanic	4.2%	85.4%	14.6%		−11.08%	0.59%	< .0001
Other, non-Hispanic	1.8%	66.4%	33.6%		1.74%	1.25%	0.1659
Hispanic							
Mexican-American	13.9%	77.8%	22.2%		−5.22%	0.48%	< .0001
Other Hispanic	6.6%	72.4%	27.6%		−1.94%	0.56%	0.0005
Citizenship Status				< .0001			
Born in US (or territories)	94.8%	71.2%	28.8%		*Reference*		
Legal citizen	1.6%	78.1%	21.9%		−3.97%	0.97%	< .0001
Not a citizen	3.5%	88.7%	11.3%		−10.59%	0.57%	< .0001
Unknown	0.2%	87.7%	12.3%		−8.00%	2.23%	0.0004
Interview Language				< .0001			
English only	89.9%	70.9%	29.1%		*Reference*		
Any other	8.4%	81.6%	18.4%		−7.48%	0.54%	< .0001
Unknown	1.6%	77.9%	22.1%		−3.30%	1.03%	0.0014
Education Attainment				< .0001			
No high school diploma	12.9%	72.9%	27.1%		−0.67%	0.50%	0.1869
HS grad or GED	21.4%	70.1%	29.9%		*Reference*		
Some college, no degree	17.8%	68.3%	31.7%		2.41%	0.46%	< .0001
Associates/vocational deg.	13.1%	69.0%	31.0%		2.47%	0.48%	< .0001
Bachelor's degree	20.1%	75.4%	24.6%		−1.54%	0.47%	0.0011
Graduate degree	14.4%	75.6%	24.4%		−0.85%	0.53%	0.1135
Unknown	0.4%	89.8%	10.2%		−15.16%	1.58%	< .0001
Family Income				< .0001			
Less than 100% FPL	18.7%	66.5%	33.5%		3.39%	0.63%	< .0001
100–199% FPL	22.4%	70.3%	29.7%		1.82%	0.57%	0.0013
200–299% FPL	17.6%	73.1%	26.9%		0.42%	0.49%	0.3892
300–399% FPL	13.1%	73.4%	26.6%		0.70%	0.48%	0.1474
400–499% FPL	9.0%	75.2%	24.8%		−0.44%	0.54%	0.4184
500% + FPL	19.3%	75.4%	24.6%		*Reference*		
Insurance Status				< .0001			
Private only	57.1%	75.2%	24.8%		*Reference*		
Public only	28.7%	64.8%	35.2%		8.63%	0.42%	< .0001
Private & Public	1.3%	50.8%	49.2%		21.54%	1.54%	< .0001
Partial coverage	6.3%	69.1%	30.9%		5.75%	0.61%	< .0001
Uninsured	6.2%	80.9%	19.1%		−2.17%	0.56%	0.0001
Unknown	0.4%	80.2%	19.8%		−4.85%	1.79%	0.0067
Parental Employment				< .0001			
Currently employed	89.9%	73.3%	26.7%		*Reference*		
Not currently employed	10.1%	59.9%	40.1%		7.65%	0.55%	< .0001
Region				< .0001			
Northeast	17.3%	70.7%	29.3%		0.89%	0.43%	0.0398
Midwest	23.3%	70.7%	29.3%		−0.12%	0.40%	0.7683
South	36.4%	70.8%	29.2%		*Reference*		
West	23.0%	75.8%	24.2%		−2.46%	0.35%	< .0001
Annual Trend					0.24%	0.03%	< .0001

Adj. Diff. indicates adjusted difference (from multivariable linear probability model adjusting for all covariates included in the table, these should be interpreted as an absolute percentage point change in probability); CC, chronic conditions; FL, functional limitations; FPL, federal poverty level; GED, general educational development; and SE, standard error.

are successfully managed across their life course. These findings have important implications for medical education and workforce development, and health and social policy.

Our data suggest that the current prevalence of US youth with a FL or CC is higher than previously reported in older studies.[5,7–9,11] Prevalence of pediatric-onset conditions was hypothesized to be higher given

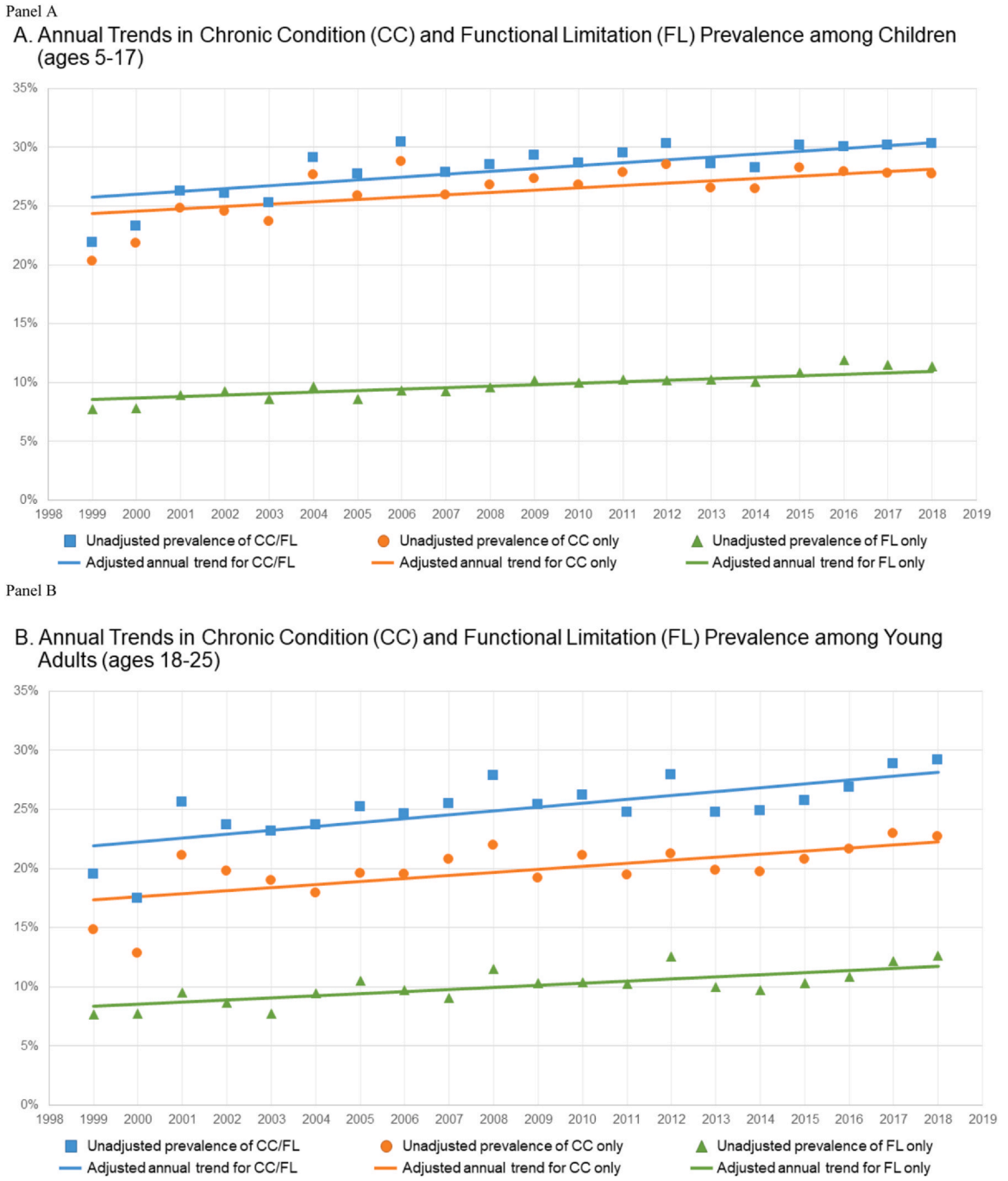

Figure. *Annual trends in chronic condition (CC) and functional limitation (FL) prevalence. Figures show the unadjusted prevalence of having either a chronic condition or functional limitation (blue squares), chronic condition only (orange circles), and functional limitation only (green triangles) for children ages 5–17 y (panel A) and young adults ages 18–25 y (panel B). Figures additionally show the corresponding adjusted annual trend for these groups, based on predicted population margins from the multivariate adjusted model; the adjusted model controls for age, sex, race and ethnicity, citizenship status, interview language, educational attainment, family income, insurance status, employment status, region of residence, and year.*

improvement in treatment and survivorship, as well as increasing incidence.[16,27] We find evidence that a substantial driver behind identified increases in conditions among youth stems from preventable conditions that show a similar increase in incidence in adult populations (eg, prediabetes) and conditions for which identification and treatment may be increasing (eg, autism spectrum disorder). Causative drivers behind the increase in these conditions are myriad and include a complex interaction of individual biology, community context and environment, and health care systems. Still, the increase in preventable/treatable conditions highlights the critical importance of public health and primary prevention efforts in the pediatric care setting to reduce current burden on youth and the future burden on the adult health system.

It is critically important that we can consistently track the prevalence and status of chronic conditions among Americans, and we must rely on robust population-based

Table 1B. Sociodemographic Characteristics of *Young Adults* (Ages 18–25 y) with and without Chronic Conditions/Functional Limitations from 1999 to 2018

	Total	No CC/FL	Any CC/FL	*P*-value	Adj. Diff.	SE	*P*-value
Total N (unweighted)	69,783	52,541	17,242				
Total % (weighted)		74.9%	25.1%				
Age (y), mean	21.51	21.47	21.60	< .0001	1.30%	0.11%	< .0001
Standard deviation	2.02	2.02	2.00				
Sex				< .0001			
Male	50.2%	77.3%	22.7%		*Reference*		
Female	49.8%	72.4%	27.6%		3.85%	0.43%	< .0001
Race and Ethnicity				< .0001			
White, non-Hispanic	60.9%	72.8%	27.2%		*Reference*		
Black, non-Hispanic	14.2%	73.1%	26.9%		–2.81%	0.68%	< .0001
Asian, non-Hispanic	4.6%	85.4%	14.6%		–7.66%	0.95%	< .0001
Other, non-Hispanic	1.4%	66.7%	33.3%		3.03%	2.02%	0.1353
Hispanic							
Mexican-American	12.7%	82.0%	18.0%		–7.54%	0.77%	< .0001
Other Hispanic	6.2%	78.3%	21.7%		–3.29%	0.86%	0.0001
Citizenship Status				< .0001			
Born in US (or territories)	87.0%	73.1%	26.9%		*Reference*		
Legal citizen	3.7%	82.7%	17.3%		–7.21%	1.05%	< .0001
Not a citizen	9.1%	88.4%	11.6%		–11.39%	0.73%	< .0001
Unknown	0.3%	88.5%	11.5%		–11.40%	2.79%	< .0001
Interview Language				< .0001			
English only	92.8%	74.1%	25.9%		*Reference*		
Any other	6.7%	85.6%	14.4%		–3.40%	0.94%	0.0003
Unknown	0.5%	77.8%	22.2%		0.64%	2.54%	0.8006
Education Attainment				< .0001			
No high school diploma	16.5%	72.9%	27.1%		2.50%	0.73%	0.0006
HS grad or GED	28.9%	73.4%	26.6%		*Reference*		
Some college, no degree	34.4%	75.4%	24.6%		–1.75%	0.55%	0.0013
Associates/vocational deg.	6.9%	75.1%	24.9%		–2.86%	0.93%	0.0021
Bachelor's degree	11.7%	79.0%	21.0%		–7.07%	0.77%	< .0001
Graduate degree	1.2%	80.6%	19.4%		–6.89%	1.75%	< .0001
Unknown	0.5%	72.0%	28.0%		7.27%	3.40%	0.0325
Family Income				< .0001			
Less than 100% FPL	23.4%	72.0%	28.0%		3.11%	0.75%	< .0001
100–199% FPL	22.4%	73.9%	26.1%		1.99%	0.77%	0.0096
200–299% FPL	17.8%	75.9%	24.1%		0.77%	0.79%	0.3295
300–399% FPL	12.2%	76.6%	23.4%		0.27%	0.85%	0.7465
400–499% FPL	8.1%	75.8%	24.2%		1.45%	1.03%	0.1571
500% + FPL	16.1%	77.6%	22.4%		*Reference*		
Insurance Status				< .0001			
Private only	53.2%	77.6%	22.4%		*Reference*		
Public only	13.3%	64.1%	35.9%		10.58%	0.82%	< .0001
Private & Public	0.8%	47.4%	52.6%		27.24%	2.88%	< .0001
Partial coverage	13.7%	70.7%	29.3%		6.09%	0.66%	< .0001
Uninsured	18.0%	78.8%	21.2%		0.86%	0.64%	0.1749
Unknown	1.0%	78.6%	21.4%		–0.52%	2.25%	0.8179
Employment Status				< .0001			
Currently employed	64.6%	76.7%	23.3%		*Reference*		
Not currently employed	35.4%	71.6%	28.4%		3.93%	0.49%	< .0001
Region				< .0001			
Northeast	16.3%	76.2%	23.8%		–0.38%	0.70%	0.5921
Midwest	24.8%	72.3%	27.7%		2.36%	0.60%	< .0001
South	36.3%	75.4%	24.6%		*Reference*		
West	22.6%	75.8%	24.2%		1.47%	0.63%	0.0194
Annual Trend					0.33%	0.04%	< .0001

Adj. Diff. indicates adjusted difference (from multivariable linear probability model adjusting for all covariates included in the table, these should be interpreted as an absolute percentage point change in probability); CC, chronic conditions; FL, functional limitations; FPL, federal poverty level; and SE, standard error.

national surveys to track these conditions. Yet there are limitations to existing surveys. First, in the most recent redesign of the NHIS (beginning in 2019), most of the detailed questions about chronic conditions were dramatically pared down, making future monitoring of the impact of primary prevention effects on these trends difficult. Second, given the design of the NHIS, different conditions were queried for sample adult (ages ≥18) versus sample child (ages ≤17) participants, making estimates only moderately comparable across our two

Table 2A. Prevalence of Chronic Conditions/Functional Limitations over Time among *Children* (Ages 5–17 y)

	Total	1999–2003	2004–2008	2009–2013	2014–2018	Annual Trend
Chronic Conditions						
Ever diagnosed with…						
ADHD/ADD	9.02%	7.25%	8.25%	9.86%	10.71%	0.24%*
Learning Disability	8.49%	8.56%	8.52%	8.62%	8.26%	–0.01%
Other Developmental Delay	3.96%	3.21%	4.03%	4.77%	3.82%	0.05%*
Autism/Asperger's/ASD	1.20%	0.36%	0.72%	1.21%	2.49%	0.13%*
Heart Disease – other	1.01%	1.15%	1.11%	0.91%	0.86%	–0.02%*
Intellectual Disability	0.99%	0.78%	0.78%	1.15%	1.24%	0.03%*
Cerebral Palsy†	0.33%	0.39%	2.15%	0.33%	0.30%	–0.01%**
Diabetes	0.25%	0.22%	0.26%	0.27%	0.24%	0.00%
Heart Disease – congenital	0.23%	0.23%	0.24%	0.22%	0.20%	0.00%
Sickle Cell Anemia	0.15%	0.19%	0.15%	0.15%	0.10%	–0.01%**
Arthritis	0.14%	0.14%	0.17%	0.12%	0.12%	0.00%
Down Syndrome	0.13%	0.13%	0.13%	0.12%	0.14%	0.00%
Had in past year…						
Asthma	9.85%	8.19%	10.36%	10.81%	10.02%	0.12%*
Stutter/Stammer	1.67%	1.28%	1.60%	1.88%	1.91%	0.04%*
Frequent diarrhea/colitis	1.26%	1.11%	1.19%	1.26%	1.46%	0.02%*
Anemia	0.97%	0.85%	1.02%	1.00%	0.99%	0.01%
Seizures/epilepsy	0.68%	0.59%	0.67%	0.75%	0.72%	0.01%**
Deaf/Uses hearing aid	0.32%	0.49%	0.33%	0.26%	0.21%	–0.02%*
Blind	0.15%	0.15%	0.13%	0.18%	0.16%	0.00%
Functional Limitations						
Learning disability‡	2.68%	3.01%	2.61%	2.58%	2.64%	–0.02%
Other mental health condition(eg, ADHD/ADD)‡	2.41%	2.02%	2.10%	2.49%	2.85%	0.06%*
Depression/anxiety/emotional problem	1.95%	1.76%	1.47%	2.03%	2.51%	0.05%*
Speech condition	1.84%	1.27%	1.67%	2.16%	2.27%	0.07%*
Any health problem that requires special equipment or assistive devices	1.12%	0.89%	1.06%	1.17%	1.36%	0.03%*
Developmental problem (eg, cerebral palsy)	1.02%	1.24%	0.90%	0.93%	1.01%	–0.02%*
Lung/breathing problem (eg, asthma and emphysema)	0.67%	0.86%	0.63%	0.63%	0.56%	–0.02%*
Other unclassified problem	0.47%	0.46%	0.50%	0.50%	0.42%	0.00%
Birth defect	0.39%	0.31%	0.36%	0.46%	0.43%	0.01%**
Intellectual disability	0.37%	0.29%	0.28%	0.41%	0.49%	0.01%*
Vision problem/Blindness	0.36%	0.33%	0.34%	0.40%	0.37%	0.00%
Hearing problem	0.30%	0.30%	0.28%	0.35%	0.28%	0.00%
Musculoskeletal problem	0.28%	0.26%	0.29%	0.29%	0.27%	0.00%
Seizures	0.24%	0.23%	0.21%	0.28%	0.23%	0.00%

ADHD/ADD indicates attention deficit hyperactivity disorder/attention deficit disorder; ASD, autism spectrum disorder; and NHIS, National Health Interview Survey.

Conditions with total prevalence of < 0.1% were excluded for parsimony; data for these conditions is presented in Appendix B1 and B2.

* Statistical significance of unadjusted annual trend: $P < 0.01$.

† Subject to an NHIS interviewer error from 2004 to 2007 Quarter 2 so estimates may not be accurate during this period; total and trend assessment excluded these quarters.

** Statistical significance of unadjusted annual trend: $P < 0.05$.

‡ Asked from 2001 on; total and trend assessed using available years.

subgroups of youth and potentially resulting in misclassification. Importantly, CC estimates generated in the young adult sample were noticeably lower than those in the child sample, which may be due to the fact that many prevalent pediatric-onset conditions are not assessed among legal adults in the NHIS, that there may be a loss to follow-up or lack of follow-up by the adult provider for these conditions (making young adults less likely to report these conditions or receive a new diagnosis), or simply that young adults who are self-reporting their conditions do so with different accuracy than parents responding for their children.

In addition to addressing prevention in pediatric care to address chronic disease, adult health, educational, and vocational systems must be prepared for the increasing burden of chronic conditions of childhood origin that our study demonstrates. A previous review of undergraduate, graduate, and continuing medical education has shown that medical providers are ill prepared for this growing population.[28] Additional studies have also shown that internal medicine trainees do not feel comfortable caring for conditions of childhood origin.[29] Our study suggests that given the number of patients with chronic conditions who are becoming adults, a priority should be made by accrediting bodies (such as the Accreditation Council for Graduate Medical Education) to ensure that adult providers receive adequate training to care for this population.[30] Further, policy leaders will want to consider a range of responses that span primary and secondary prevention as the larger context for transition to adulthood is not solely situated in the health care sector – it requires a multidisciplinary approach that address different sectors

Table 2B. Prevalence of Chronic Conditions/Functional Limitations over Time among *Young Adults* (Ages 18–25 y)

	Total	1999–2003	2004–2008	2009–2013	2014–2018	Annual Trend
Chronic Conditions						
Ever diagnosed with…						
Hypertension (Chronic)	2.92%	2.47%	2.85%	3.13%	3.17%	0.05%*
Heart Disease – other	2.91%	2.89%	2.96%	2.71%	3.06%	0.00%
Arthritis†	2.80%	3.70%	3.10%	2.53%	2.28%	–0.10%*
Seizures/epilepsy‡	1.88%	1.64%	1.99%	1.38%	2.37%	0.04%
Prediabetes/borderline diabetes§	1.17%	0.17%	0.95%	1.46%	2.01%	0.12%*
Diabetes	0.93%	0.81%	0.94%	0.92%	1.03%	0.01%
Type 1/Pediatric-onset (dx < 20 years)	0.74%	0.62%	0.69%	0.75%	0.88%	0.02%**
Cancer or malignancy	0.84%	1.06%	0.93%	0.83%	0.56%	–0.03%*
Pediatric-onset (dx < 20 years) cancer	0.52%	0.62%	0.62%	0.50%	0.33%	–0.02%*
Chronic liver condition††	0.31%		0.38%	0.33%	0.27%	–0.01%
COPD‡‡	0.25%			0.27%	0.24%	–0.01%
Heart Disease – coronary	0.22%	0.12%	0.25%	0.28%	0.22%	0.01%
Angina	0.16%	0.13%	0.15%	0.14%	0.20%	0.00%
Stroke	0.15%	0.13%	0.13%	0.20%	0.14%	0.00%
Heart Attack	0.10%	0.06%	0.08%	0.11%	0.15%	0.01%***
Had in past year…						
Asthma	8.17%	6.77%	8.21%	8.74%	8.82%	0.14%*
Chronic bronchitis	2.52%	3.43%	2.49%	2.42%	1.84%	–0.10%*
Hypertension§§	2.19%	1.97%	2.97%	2.29%	2.04%	–0.02%
High cholesterol§§	1.66%	1.09%	1.81%	1.93%	1.63%	0.03%***
Seizures/epilepsy†††	1.13%			0.71%	1.54%	0.13%*
Weak/failing kidneys	0.46%	0.55%	0.48%	0.52%	0.30%	–0.02%*
Liver condition	0.40%	0.31%	0.36%	0.42%	0.49%	0.01%***
Deaf/Uses hearing aid	0.38%	0.45%	0.48%	0.27%	0.33%	–0.01%**
Blind	0.15%	0.14%	0.18%	0.15%	0.14%	0.00%
Functional Limitations						
Depression/anxiety/emotional problem	2.68%	2.09%	2.43%	2.83%	3.30%	0.09%*
Musculoskeletal problem	2.43%	1.49%	2.29%	2.77%	3.06%	0.11%*
Any health problem that requires special equipment or assistive devices	0.98%	0.80%	0.94%	1.17%	1.00%	0.01%
Lung/breathing problem (eg, asthma and emphysema)	0.94%	1.22%	1.03%	0.86%	0.68%	–0.03%*
Nervous system condition	0.92%	0.55%	1.05%	1.00%	1.07%	0.03%*
Arthritis/rheumatism	0.87%	0.95%	0.92%	0.80%	0.80%	–0.01%
Intellectual disability	0.68%	0.49%	0.54%	0.71%	0.95%	0.03%*
Other unclassified problem	0.68%	0.59%	0.76%	0.73%	0.66%	0.00%
Other mental health condition (eg, ADHD/ADD)	0.63%	0.22%	0.50%	0.84%	0.90%	0.05%*
Developmental problem (eg, cerebral palsy)	0.54%	0.43%	0.53%	0.64%	0.56%	0.01%***
Birth defect	0.37%	0.27%	0.42%	0.37%	0.43%	0.01%***
Vision problem/Blindness	0.37%	0.26%	0.36%	0.42%	0.43%	0.01%**
Hearing problem	0.24%	0.13%	0.21%	0.27%	0.32%	0.01%**
Heart problem	0.24%	0.21%	0.23%	0.18%	0.35%	0.01%
Digestive problem	0.21%	0.16%	0.13%	0.31%	0.23%	0.01%***
Circulation problems (eg, blood clots)	0.17%	0.19%	0.16%	0.19%	0.14%	0.00%
Genitourinary problem	0.14%	0.12%	0.22%	0.16%	0.08%	0.00%
Diabetes	0.13%	0.11%	0.10%	0.15%	0.17%	0.00%
Hypertension/high blood pressure	0.12%	0.09%	0.12%	0.13%	0.14%	0.00%
Endocrine problem	0.11%	0.08%	0.08%	0.10%	0.18%	0.01%***

ADHD/ADD indicates attention deficit hyperactivity disorder/attention deficit disorder; and COPD, chronic obstructive pulmonary disease.

Conditions with total prevalence of < 0.1% were excluded for parsimony; data for these conditions is presented in Appendix B1 and B2.

* Statistical significance of unadjusted annual trend: $P < 0.01$.

† Includes rheumatoid arthritis, gout, lupus, or fibromyalgia; asked from 2001 on; total and trend assessed using available years.

‡ Asked in 2002, 2007, 2008, 2010, 2013, 2015, 2017; total and trend assessed using available years.

§ Assessment question wording changed in 2006.

** Statistical significance of unadjusted annual trend: $P < 0.05$.

†† Asked from 2008 on; total and trend assessed using available years.

‡‡ Asked from 2012 on; total and trend assessed using available years.

*** Statistical significance of unadjusted annual trend: $P < 0.1$.

§§ Asked in 2002, 2007, and 2012 on; total and trend assessed using available years.

††† Asked in 2010, 2013, 2015, 2017; total and trend assessed using available years.

Table 3. Estimating Annual Trends of Chronic Conditions (CC) and Functional Limitations (FL)

	Main Analyses			Restricted Conditions			Restricted Time		
	Beta	SE	*P*-value	Beta	SE	*P*-value	Beta	SE	*P*-value
Modeling Any CC or FL									
Unadjusted annual trend among children (5–17)	0.323%	0.025%	< .0001	0.363%	0.025%	< .0001	0.106%	0.042%	0.0110
Adjusted annual trend among children (5–17)	0.244%	0.025%	< .0001	0.283%	0.025%	< .0001	0.053%	0.041%	0.1914
Unadjusted annual trend among young adults (18–25)	0.346%	0.041%	< .0001	0.277%	0.040%	< .0001	0.228%	0.067%	0.0006
Adjusted annual trend among young adults (18–25)	0.328%	0.040%	< .0001	0.258%	0.040%	< .0001	0.235%	0.066%	0.0004
Modeling Any CC (only)									
Unadjusted annual trend among children (5–17)	0.281%	0.025%	< .0001	0.324%	0.025%	< .0001	0.059%	0.041%	0.1494
Adjusted annual trend among children (5–17)	0.200%	0.025%	< .0001	0.244%	0.025%	< .0001	0.004%	0.040%	0.9301
Unadjusted annual trend among young adults (18–25)	0.277%	0.036%	< .0001	0.163%	0.033%	< .0001	0.208%	0.059%	0.0005
Adjusted annual trend among young adults (18–25)	0.256%	0.036%	< .0001	0.146%	0.034%	< .0001	0.198%	0.059%	0.0008
Modeling Any FL (only)									
Unadjusted annual trend among children (5–17)	0.178%	0.016%	< .0001	0.091%	0.014%	< .0001	0.179%	0.027%	< .0001
Adjusted annual trend among children (5–17)	0.126%	0.017%	< .0001	0.042%	0.015%	0.0036	0.144%	0.028%	< .0001
Unadjusted annual trend among young adults (18–25)	0.192%	0.030%	< .0001	0.192%	0.030%	< .0001	0.138%	0.049%	0.0053
Adjusted annual trend among young adults (18–25)	0.180%	0.030%	< .0001	0.180%	0.030%	< .0001	0.155%	0.048%	0.0012

SE indicates standard error; NHIS, National Health Interview Survey.

Modeling was performed using linear probability models so beta coefficients should be interpreted as an absolute percentage point change in probability. In addition to annual trend, adjust analyses control for: age, sex, race and ethnicity, citizenship status, interview language, educational attainment, family income, insurance status, employment status, and region of residence.

Restricted conditions refers to the inclusion of only conditions that were consistently assessed in all available survey years (1999–2018) when constructing the summary measures.

Restricted time refers to restricting analyses to 2004 and beyond, after a redesign of the NHIS.

such as school/employment, housing/independent living, and frequently transition in community/social spheres. For instance, we identified that young adults with more education have lower prevalence of CC/FL (while such a gradient was not observed for parental education), likely reflecting the fact that current higher educational systems may not fully accommodate youth with CC/FL, which in turn makes them less likely to persist in these spaces and exposes them to future education-related disparities.[23,31] Disparities were also observed whereby unemployment was associated with higher prevalence of CC/FL, again likely related to the lack of accommodations in vocational settings that may prevent some youth with CC/FL from gaining/maintaining employment. Conversely, some employed youth may experience job-lock[32] whereby their condition (and related need for insurance) causes them to stay in an imperfect employment setting.

New policy incentives are clearly needed to ensure that youth are able to maintain continuous access to care and other supportive services as they age. Currently, the Centers for Medicare and Medicaid Services (CMS) allows medical providers to bill when patients transition from the inpatient to the outpatient setting; this is a foundation that can be built upon to pay for patient transition and transfer from pediatric to adult care, as this is likely to require specialized supports to ensure care continuity.[33–35] This can include new Current Procedural Terminology Codes to allow providers to bill for transition services, care coordination, and dual appointments with pediatricians and internists, as well as coordination between health care providers and other social services. Innovation in provision of high-quality services to Medicare enrollees suggests that optimal incentive structures are capable of driving change;[36,37] comparable programs that focus on younger populations may be leveraged to similar effects.[38] Many young adults face additional barriers during transition, such as changing health care systems or moving to different states, which in turn increases their susceptibility to disengagement from care,[39] disease exacerbations, and medical complications.[28,40] CMS should allow providers to temporarily bill when patients move to a new system or across state lines during the transition and transition process to address this problem. Despite expanded access to insurance for young adults stemming from the national dependent coverage expansion provision of the Affordable Care Act,[41,42] young adults remain the most uninsured age group and have the lowest health care utilization of any age group.[43,44] Additional health policy that focuses on the specific challenges associated with maintaining insurance coverage during this age range may be warranted.

Finally, these findings show that not only is the prevalence of chronic disease increasing among youth, but there are also substantial disparities. Our study shows that individuals with chronic illness are more likely to be poor, unemployed, and have public insurance. Given the lower socioeconomic status that many of these individuals face, policy decisions must be implemented to ensure that this growing population continues to be supported in the future. These can include continued and expanded funding for Medicaid to support this population.[45] The level of poverty and parental unemployment further suggests the importance of ongoing social services for these individuals, such as those that target income, food, and housing insecurity.[46–49] As an example, improving educational and employment opportunities can ensure better access to health insurance and medical care while improving food and housing insecurity can ameliorate chronic conditions such as asthma. Ultimately given that several disparities were observed for both parent- and child-derived factors (eg, parent and young adult employment) suggests that a vicious cycle may exist for pediatric-onset conditions whereby socioeconomic disadvantage is perpetuated throughout the life-course. Breaking this cycle will rely on targeted health and social policies that both ameliorate family disadvantage during childhood as well as ensure equal opportunity for social, educational, and vocational participation for youth as they age into adulthood.

LIMITATIONS

Several limitations should be considered when interpreting our findings. First, we rely on self or caregiver report of CC and FL rather than verifiable medical diagnoses, which is subject to recall bias, which may be differential across the age threshold (as parent report is primary used for ages ≤17 whereas ages ≥18 is primarily self-report). Moreover, our data limit ascertainment of CC to those who have been diagnosed, potentially biasing against identification in those with poor access to care. Second, the low prevalence of specific conditions limits our ability to explore disparities and trends for each individual condition, as does NHIS design limitations that result in inconsistent assessment of some conditions across years. This could be addressed by the NHIS, or other national surveys, utilizing the same medical conditions across the age spectrum. Importantly, the list of included conditions is not inclusive of all potential pediatric-onset conditions and therefore likely represents an underestimation of the true prevalence; however, the NHIS (prior to 2019) represents one of the largest and most comprehensive survey with which to longitudinally assess national prevalence and trends of CC/FL. Finally, although we adjusted for several detailed sociodemographic characteristics in estimating annual trends in prevalence, we could not fully explore the mechanisms that might explain these trends, such as improved screening/detection. Despite these limitations, this investigation represents an important update on the prevalence of chronic conditions of pediatric onset in adulthood, thereby identifying opportunities for improvement in medical education and health policy to support youth living with CC/FL.

CONCLUSION

We find evidence that the prevalence of individuals who enter adulthood at 18 years of age with a chronic condition of pediatric onset has increased over the past two decades. In addition, inequities in prevalence remain regarding income, employment, and insurance status. Continued monitoring of annual trends in the prevalence

of CC/FL will be important for future planning in medical education and health policy to address this increasing population and their medical and social needs.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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APPENDIX A. LIST OF CHRONIC CONDITIONS/FUNCTIONAL LIMITATIONS ASSESSED IN THE NHIS

	Children (Ages 5–17)	Young Adults (Ages 18–25)	Notes
Chronic Condition			
Ever diagnosed with…	*14*	*14*	
ADHD/ADD	Yes	No	
Angina	No	Yes	
Arthritis	Yes	*Yes*	Adults asked from 2001 on (includes gout, lupus, etc)
Autism/Asperger's/ASD	Yes	No	
Cancer or malignancy	No	Yes	
Cerebral Palsy	*Yes*	No	Subject to an NHIS interviewer error from 2004 to 2007 Quarter 2
Chronic liver condition	No	*Yes*	Adults asked from 2008 on
Chronic Obstructive Pulmonary Disease	No	*Yes*	Adults asked from 2012 on
Cystic Fibrosis	Yes	No	
Diabetes	Yes	Yes	
Down Syndrome	Yes	No	
Emphysema	No	Yes	
Heart Attack	No	Yes	
Heart Disease – congenital	Yes	Yes	Labeled as "Congenital" for children, "non-coronary" for adults
Heart Disease – coronary	Yes	Yes	Labeled as "Non-congenital" for children, "Coronary" for adults
Hypertension (Chronic)	No	Yes	Defined as diagnosed in 2+ visits
Intellectual Disability	Yes	No	
Learning Disability	Yes	No	
Muscular Dystrophy	Yes	No	
Other Developmental Delay	Yes	No	
Prediabetes/borderline diabetes	No	*Yes*	Question change in 2006
Seizures/epilepsy	No	*Yes*	Adults asked in '02,'07,'08,'10,'13,'15,'17
Sickle Cell Anemia	Yes	No	
Stroke	No	Yes	
Had in past year…	*7*	*9*	
Anemia	Yes	No	
Asthma	Yes	Yes	
Blind (now)	Yes	Yes	
Chronic bronchitis	No	Yes	
Deaf/Uses hearing aid (now)	Yes	Yes	
Frequent diarrhea/colitis	Yes	No	
High Cholesterol	No	*Yes*	Adults asked in 2002, 2007, and 2012 on
Hypertension	No	*Yes*	Adults asked in 2002, 2007, and 2012 on
Liver condition	No	Yes	
Seizures/epilepsy	Yes	*Yes*	Adults asked in 2010, 2013, 2015, 2017
Stutter/Stammer	Yes	No	
Weak/failing kidneys	No	Yes	
Assessed but not included in definition			
Ever diagnosed with…	*1*	*5*	
Asthma	Yes	Yes	
Deaf/Uses hearing aid	No	Yes	
Hepatitis	No	Yes	Asked in adults in 2000 on
High Cholesterol	No	*Yes*	Adults asked in '02,'03,'07,'08,'12,'14-'18
Ulcer	No	Yes	

	Children (Ages 5–17)	Young Adults (Ages 18–25)	Notes
Had in past year…	*6*	*4*	
Eczema/skin allergy	Yes	No	
Food/digestive allergy	Yes	No	
Frequent (3+) ear infections	Yes	No	
Hay fever	Yes	Yes	
Respiratory allergy	Yes	No	
Severe headaches/migraines	Yes	Yes	Adults: past 3 mo; Children: past 12 mo
Sinusitis	No	Yes	
Ulcer	No	Yes	
Functional Limitation	*14*	*27*	
Alcohol/drug/substance abuse problem	No	Yes	
Arthritis/rheumatism	No	Yes	
Benign tumors, cysts	No	Yes	
Birth defect	Yes	Yes	
Blood problem	No	Yes	
Cancer	No	Yes	
Circulation problems (eg, blood clots)	No	Yes	
Depression/anxiety/emotional problem	Yes	Yes	Labeled as "Emotional/behavioral condition" for children
Developmental problem (eg, cerebral palsy)	Yes	Yes	
Diabetes	No	Yes	
Digestive problem	No	Yes	
Endocrine problem	No	Yes	
Genitourinary problem	No	Yes	
Hearing problem	Yes	Yes	
Heart problem	No	Yes	
Hypertension/high blood pressure	No	Yes	
Intellectual disability	Yes	Yes	
Learning disability	*Yes*	No	Asked in children in 2001 on
Lung/breathing problem (eg, asthma and emphysema)	Yes	Yes	Labeled as "Asthma" for children
Missing limbs (fingers, toes or digits), amputee	No	Yes	
Musculoskeletal problem	Yes	Yes	Labeled as "Bone/muscle condition" for children
Nervous system condition	No	Yes	
Other mental health condition (eg, ADHD/ADD)	*Yes*	Yes	Labeled as "ADHD/ADD" for children (asked in 2001 on)
Other unclassified problem	Yes	Yes	
Seizures	Yes	No	
Skin problem	No	Yes	
Speech condition	Yes	No	
Stroke problem	No	Yes	
Vision problem/Blindness	Yes	Yes	
Any health problem that requires special equipment or assistive devices	Yes	Yes	Asked as a separate question, not in the functional limitation battery
Assessed but not included in definition	*1*	*9*	
Back or neck problem	No	Yes	
Fatigue	No	Yes	
Fracture, bone/joint injury	No	Yes	
Old age	No	Yes	
Other injury	Yes	Yes	Labeled as "Injury" for children
Pregnancy	No	Yes	
Senility	No	Yes	
Surgical after-effects	No	Yes	
Weight problem	No	Yes	

ADHD/ADD indicates attention deficit hyperactivity disorder/attention deficit disorder; ASD, autism spectrum disorder; and NHIS, National Health Interview Survey.

List of conditions includes all those conditions assessed in the NHIS between 1999 and 2018, stratified by age of assessment.

APPENDIX B1. PREVALENCE OF CHRONIC CONDITIONS/FUNCTIONAL LIMITATIONS OVER TIME AMONG *CHILDREN* (AGES 5–17 Y)

	Total	1999/00	2001/02	2003/04	2005/06	2007/08	2009/10	2011/12	2013/14	2015/16	2017/18	Annual Trend
Total N (unweighted)	166629	18675	18514	17568	15993	12932	16004	18521	18941	16946	12535	
Total % (weighted)		9.88%	9.96%	9.97%	9.97%	9.97%	9.96%	10.05%	10.06%	10.07%	10.11%	
Any CC or FL	28.08%	22.57%	26.14%	27.19%	29.05%	28.18%	28.97%	29.87%	28.42%	30.09%	30.21%	0.32%*
Any CC	26.27%	21.08%	24.68%	25.65%	27.32%	26.35%	27.05%	28.17%	26.48%	28.10%	27.77%	0.28%*
Ever diagnosed with...												
ADHD/ADD	9.02%	6.90%	7.63%	7.72%	7.95%	8.55%	9.59%	10.12%	9.97%	10.84%	10.90%	0.24%*
Arthritis	0.14%	0.16%	0.16%	0.14%	0.19%	0.14%	0.12%	0.14%	0.08%	0.14%	0.14%	0.00%
Autism/Asperger's/ASD	1.20%	0.29%	0.38%	0.59%	0.63%	0.80%	1.11%	1.30%	1.78%	2.64%	2.42%	0.13%*
Cerebral Palsy†	0.33%	0.53%	0.32%	1.49%	3.09%	0.92%	0.34%	0.30%	0.39%	0.29%	0.25%	−0.01%**
Cystic Fibrosis	0.03%	0.01%	0.08%	0.03%	0.02%	0.01%	0.03%	0.02%	0.05%	0.01%	0.04%	0.00%
Diabetes	0.25%	0.28%	0.19%	0.19%	0.31%	0.23%	0.29%	0.27%	0.19%	0.27%	0.26%	0.00%
Down Syndrome	0.13%	0.14%	0.10%	0.19%	0.10%	0.13%	0.11%	0.13%	0.15%	0.10%	0.15%	0.00%
Heart Disease – congenital	0.23%	0.20%	0.25%	0.30%	0.25%	0.19%	0.18%	0.27%	0.21%	0.18%	0.23%	0.00%
Heart Disease – other	1.01%	1.21%	1.14%	1.05%	1.11%	1.13%	0.99%	0.97%	0.65%	1.05%	0.76%	−0.02%*
Intellectual Disability	0.99%	0.85%	0.74%	0.83%	0.74%	0.73%	0.79%	1.36%	1.30%	1.31%	1.20%	0.03%*
Learning Disability	8.49%	8.38%	8.87%	8.54%	8.19%	8.71%	8.85%	8.58%	7.91%	8.47%	8.38%	−0.01%
Muscular Dystrophy	0.05%	0.05%	0.08%	0.03%	0.07%	0.02%	0.09%	0.02%	0.03%	0.07%	0.03%	0.00%
Other Developmental Delay	3.96%	3.28%	3.30%	3.53%	3.83%	4.16%	4.65%	4.90%	4.21%	3.93%	3.81%	0.05%*
Sickle Cell Anemia	0.15%	0.17%	0.20%	0.21%	0.13%	0.16%	0.15%	0.12%	0.16%	0.11%	0.09%	0.00%**
Had in past year...												
Anemia	0.97%	0.85%	0.93%	0.78%	1.07%	1.05%	1.03%	1.06%	0.86%	0.93%	1.11%	0.01%
Asthma	9.85%	5.82%	9.83%	9.73%	10.39%	10.59%	11.06%	10.95%	10.23%	10.15%	9.67%	0.12%*
Blind (now)	0.15%	0.12%	0.18%	0.12%	0.15%	0.12%	0.16%	0.17%	0.18%	0.18%	0.15%	0.00%
Deaf/Uses hearing aid (now)	0.32%	0.55%	0.47%	0.49%	0.29%	0.27%	0.24%	0.26%	0.24%	0.19%	0.24%	−0.02%*
Frequent diarrhea/colitis	1.26%	1.20%	1.09%	1.16%	1.11%	1.20%	1.10%	1.38%	1.38%	1.44%	1.51%	0.02%*
Seizures/epilepsy	0.68%	0.51%	0.70%	0.68%	0.59%	0.67%	0.82%	0.69%	0.62%	0.80%	0.74%	0.01%**
Stutter/Stammer	1.67%	1.29%	1.30%	1.56%	1.54%	1.53%	1.94%	1.88%	1.74%	1.95%	1.95%	0.04%*
Any FL	9.77%	7.76%	9.10%	9.12%	8.97%	9.43%	10.10%	10.23%	10.14%	11.38%	11.43%	0.18%*
Birth defect	0.39%	0.32%	0.31%	0.42%	0.29%	0.33%	0.47%	0.50%	0.42%	0.37%	0.46%	0.01%**
Depression/anxiety/emotional problem	1.95%	2.38%	1.28%	1.47%	1.26%	1.70%	2.14%	2.03%	1.99%	2.67%	2.52%	0.05%*
Developmental problem (eg, cerebral palsy)	1.02%	2.14%	0.62%	0.77%	0.89%	0.95%	0.96%	0.94%	0.92%	1.08%	0.96%	−0.02%*
Hearing problem	0.30%	0.36%	0.33%	0.26%	0.25%	0.25%	0.33%	0.34%	0.38%	0.27%	0.25%	0.00%
Intellectual disability	0.37%	0.34%	0.25%	0.32%	0.23%	0.28%	0.33%	0.49%	0.45%	0.43%	0.57%	0.01%*
Learning disability‡	2.68%		3.18%	2.62%	2.63%	2.61%	2.50%	2.54%	2.66%	2.71%	2.63%	−0.02%
Lung/breathing problem (eg, asthma and emphysema)	0.67%	0.84%	0.92%	0.70%	0.68%	0.58%	0.63%	0.65%	0.54%	0.62%	0.53%	−0.02%*
Musculoskeletal problem	0.28%	0.27%	0.28%	0.26%	0.25%	0.31%	0.25%	0.29%	0.29%	0.28%	0.31%	0.00%
Other mental health condition (eg, ADHD/ADD)‡	2.41%		2.03%	2.05%	2.02%	2.18%	2.44%	2.51%	2.64%	2.96%	2.79%	0.06%*
Other unclassified problem	0.47%	0.44%	0.58%	0.40%	0.60%	0.39%	0.61%	0.46%	0.41%	0.48%	0.34%	0.00%
Seizures	0.24%	0.18%	0.28%	0.19%	0.18%	0.26%	0.29%	0.25%	0.26%	0.24%	0.23%	0.00%
Speech condition	1.84%	1.23%	1.33%	1.33%	1.71%	1.74%	2.10%	2.12%	2.06%	2.43%	2.37%	0.07%*

	Total	1999/00	2001/02	2003/04	2005/06	2007/08	2009/10	2011/12	2013/14	2015/16	2017/18	Annual Trend
Vision problem/Blindness	0.36%	0.35%	0.36%	0.26%	0.30%	0.39%	0.36%	0.46%	0.33%	0.41%	0.39%	0.00%
Any health problem that requires special equipment or assistive devices	1.12%	0.95%	1.00%	0.89%	0.99%	1.05%	1.23%	1.13%	1.26%	1.36%	1.37%	0.03%*

ADHD/ADD indicates attention deficit hyperactivity disorder/attention deficit disorder; ASD, autism spectrum disorder; CC, chronic conditions; FL, functional limitations; and NHIS, National Health Interview Survey.

* Statistical significance of unadjusted annual trend: $P < 0.01$.

† Subject to an NHIS interviewer error from 2004 to 2007 Quarter 2 so estimates may not be accurate during this period; total and trend assessment excluded these quarters.

** Statistical significance of unadjusted annual trend: $P < 0.05$.

‡ Asked from 2001 on; total and trend assessed using available years.

APPENDIX B2. PREVALENCE OF CHRONIC CONDITIONS/FUNCTIONAL LIMITATIONS OVER TIME AMONG *YOUNG ADULTS* (AGES 18–25 Y)

	Total	1999/00	2001/02	2003/04	2005/06	2007/08	2009/10	2011/12	2013/14	2015/16	2017/18	Annual Trend
Total N (unweighted)	69783	7711	8038	7608	6840	5432	6555	7847	7845	6986	4921	
Total % (weighted)		8.99%	9.40%	9.71%	9.98%	10.10%	10.16%	10.42%	10.50%	10.49%	10.24%	
Any CC or FL	25.14%	18.49%	24.65%	23.43%	24.90%	26.65%	25.80%	26.35%	24.82%	26.31%	29.01%	0.35%*
Any CC	19.86%	13.79%	20.42%	18.44%	19.54%	21.38%	20.17%	20.32%	19.76%	21.20%	22.82%	0.28%*
Ever diagnosed with…												
Angina	0.16%	0.16%	0.09%	0.23%	0.08%	0.15%	0.23%	0.08%	0.09%	0.37%	0.09%	0.00%
Arthritis†	2.80%		3.71%	3.59%	3.26%	2.74%	2.42%	2.63%	2.39%	2.44%	2.12%	−0.10%*
Cancer or malignancy	0.84%	1.20%	0.95%	0.87%	0.95%	0.99%	0.86%	0.94%	0.68%	0.54%	0.45%	−0.03%*
Pediatric-onset (dx < 20 years) cancer	0.52%	0.61%	0.61%	0.57%	0.70%	0.61%	0.52%	0.54%	0.50%	0.26%	0.28%	−0.02%*
Chronic liver condition‡	0.31%					0.38%	0.32%	0.33%	0.29%	0.32%	0.26%	−0.01%
COPD§	0.25%							0.33%	0.27%	0.14%	0.29%	−0.01%
Diabetes	0.93%	0.80%	0.82%	0.89%	1.10%	0.78%	0.93%	0.78%	1.01%	0.97%	1.19%	0.01%
Type 1/Pediatric-onset (dx < 20 years)	0.74%	0.66%	0.54%	0.69%	0.84%	0.53%	0.72%	0.68%	0.85%	0.78%	1.04%	0.02%**
Emphysema	0.09%	0.04%	0.14%	0.08%	0.14%	0.09%	0.14%	0.14%	0.05%	0.05%	0.00%	0.00%**
Heart Attack	0.10%	0.06%	0.04%	0.10%	0.09%	0.07%	0.14%	0.08%	0.08%	0.17%	0.16%	0.01%***
Heart Disease – coronary	0.22%	0.05%	0.11%	0.24%	0.35%	0.17%	0.28%	0.24%	0.27%	0.34%	0.13%	0.01%
Heart Disease – other	2.91%	3.11%	2.98%	2.70%	2.99%	2.86%	3.18%	2.47%	2.68%	2.76%	3.36%	0.00%
Hypertension (Chronic, 2+ visits)	2.92%	2.08%	2.42%	2.93%	2.61%	3.24%	3.01%	3.14%	3.24%	3.36%	2.98%	0.05%*
Prediabetes/borderline diabetes††	1.17%	0.18%	0.12%	0.29%	1.10%	1.09%	1.49%	1.60%	1.14%	1.94%	2.52%	0.12%*
Seizures/epilepsy‡‡	1.88%		1.64%			1.99%	1.36%		1.41%	2.48%	2.25%	0.04%
Stroke	0.15%	0.06%	0.18%	0.19%	0.12%	0.10%	0.25%	0.19%	0.17%	0.14%	0.11%	0.00%
Had in past year…												
Asthma	8.17%	4.21%	8.88%	7.27%	8.00%	8.95%	9.04%	9.16%	7.79%	9.42%	8.49%	0.14%*
Blind (now)	0.15%	0.10%	0.18%	0.10%	0.25%	0.17%	0.04%	0.21%	0.19%	0.15%	0.11%	0.00%
Chronic bronchitis	2.52%	3.55%	3.47%	2.78%	2.71%	2.30%	2.50%	2.51%	2.13%	1.98%	1.52%	−0.10%*
Deaf/Uses hearing aid (now)	0.38%	0.52%	0.41%	0.43%	0.73%	0.25%	0.26%	0.30%	0.34%	0.24%	0.37%	−0.01%**
High cholesterol§§	1.66%		1.09%			1.81%		1.24%	1.94%	1.45%	2.01%	0.03%***
Hypertension§§	2.19%		1.97%			2.97%		2.15%	2.27%	2.05%	2.00%	−0.02%

	Total	1999/00	2001/02	2003/04	2005/06	2007/08	2009/10	2011/12	2013/14	2015/16	2017/18	Annual Trend
Liver condition	0.40%	0.26%	0.42%	0.35%	0.34%	0.34%	0.58%	0.27%	0.35%	0.66%	0.42%	0.01%***
Seizures/epilepsy†††	1.13%						0.72%		0.71%	1.62%	1.46%	0.13%*
Weak/failing kidneys	0.46%	0.65%	0.56%	0.47%	0.59%	0.33%	0.48%	0.56%	0.47%	0.21%	0.32%	–0.02%*
Any FL	10.09%	7.68%	9.09%	8.61%	10.13%	10.29%	10.36%	11.42%	9.86%	10.59%	12.39%	0.19%*
Alcohol/drug/substance abuse problem	0.02%	0.01%	0.00%	0.01%	0.03%	0.04%	0.03%	0.00%	0.04%	0.04%	0.00%	0.00%
Arthritis/rheumatism	0.87%	0.60%	1.19%	1.11%	0.93%	0.82%	0.55%	0.88%	0.96%	0.86%	0.76%	–0.01%
Benign tumors, cysts	0.07%	0.06%	0.04%	0.11%	0.11%	0.08%	0.02%	0.04%	0.23%	0.03%	0.00%	0.00%
Birth defect	0.37%	0.26%	0.31%	0.24%	0.49%	0.43%	0.24%	0.52%	0.26%	0.52%	0.46%	0.01%***
Blood problem	0.06%	0.12%	0.09%	0.07%	0.05%	0.01%	0.04%	0.08%	0.05%	0.06%	0.02%	0.00%***
Cancer	0.08%	0.09%	0.08%	0.08%	0.14%	0.13%	0.08%	0.06%	0.07%	0.03%	0.09%	0.00%
Circulation problems (eg, blood clots)	0.17%	0.12%	0.26%	0.17%	0.17%	0.14%	0.14%	0.23%	0.18%	0.08%	0.20%	0.00%
Depression/anxiety/emotional problem	2.68%	2.01%	2.15%	2.16%	2.17%	2.81%	2.97%	2.99%	2.26%	3.24%	3.89%	0.09%*
Developmental problem (eg, cerebral palsy)	0.54%	0.46%	0.40%	0.40%	0.49%	0.64%	0.65%	0.76%	0.33%	0.55%	0.71%	0.01%***
Diabetes	0.13%	0.12%	0.10%	0.13%	0.10%	0.07%	0.16%	0.15%	0.14%	0.15%	0.20%	0.00%
Digestive problem	0.21%	0.20%	0.13%	0.14%	0.16%	0.12%	0.27%	0.34%	0.24%	0.21%	0.30%	0.01%***
Endocrine problem	0.11%	0.08%	0.04%	0.11%	0.11%	0.07%	0.18%	0.04%	0.10%	0.28%	0.09%	0.00%***
Genitourinary problem	0.14%	0.17%	0.09%	0.14%	0.30%	0.15%	0.10%	0.26%	0.11%	0.08%	0.04%	0.00%
Hearing problem	0.24%	0.16%	0.09%	0.13%	0.27%	0.20%	0.34%	0.23%	0.33%	0.14%	0.44%	0.01%**
Heart problem	0.24%	0.09%	0.40%	0.12%	0.15%	0.32%	0.18%	0.19%	0.28%	0.37%	0.31%	0.01%
Hypertension/high blood pressure	0.12%	0.08%	0.08%	0.07%	0.16%	0.13%	0.12%	0.15%	0.11%	0.18%	0.10%	0.00%
Intellectual disability	0.68%	0.33%	0.64%	0.53%	0.72%	0.34%	0.68%	0.76%	0.77%	1.02%	0.91%	0.03%*
Lung/breathing problem (eg, asthma and emphysema)	0.94%	1.34%	1.14%	1.01%	1.07%	1.08%	0.75%	1.01%	0.71%	0.67%	0.71%	–0.03%*
Missing limbs (fingers, toes or digits), amputee	0.05%	0.02%	0.02%	0.07%	0.07%	0.12%	0.04%	0.07%	0.06%	0.00%	0.04%	0.00%
Musculoskeletal problem	2.43%	1.11%	1.85%	1.81%	2.20%	2.44%	2.78%	2.83%	2.56%	2.95%	3.47%	0.11%*
Nervous system condition	0.92%	0.48%	0.53%	0.84%	1.19%	0.96%	1.03%	1.06%	0.86%	0.90%	1.31%	0.03%*
Other mental health condition (eg, ADHD/ADD)	0.63%	0.14%	0.28%	0.30%	0.50%	0.57%	0.59%	0.90%	0.89%	0.98%	1.00%	0.05%*
Other unclassified problem	0.68%	0.42%	0.77%	0.69%	0.93%	0.55%	0.78%	0.79%	0.63%	0.66%	0.61%	0.00%
Skin problem	0.01%	0.04%	0.01%	0.00%	0.02%	0.01%	0.00%	0.01%	0.03%	0.00%	0.00%	0.00%
Stroke problem	0.03%	0.03%	0.06%	0.02%	0.04%	0.01%	0.04%	0.06%	0.00%	0.03%	0.03%	0.00%
Vision problem/Blindness	0.37%	0.24%	0.35%	0.16%	0.37%	0.42%	0.40%	0.40%	0.40%	0.38%	0.52%	0.01%**
Any health problem that requires special equipment or assistive devices	0.98%	0.73%	0.88%	0.78%	1.26%	0.70%	1.04%	1.31%	1.14%	1.01%	0.91%	0.01%

ADHD/ADD indicates attention deficit hyperactivity disorder/attention deficit disorder; CC, chronic conditions; COPD, chronic obstructive pulmonary disease; and FL, functional limitations.

* Statistical significance of unadjusted annual trend: $P < 0.01$.

† Includes rheumatoid arthritis, gout, lupus, or fibromyalgia; asked from 2001 on; total and trend assessed using available years.

‡ Asked from 2008 on; total and trend assessed using available years.

§ Asked from 2012 on; total and trend assessed using available years.

** Statistical significance of unadjusted annual trend: $P < 0.05$.

*** Statistical significance of unadjusted annual trend: $P < 0.1$.

†† Assessment question wording changed in 2006.

‡‡ Asked in 2002, 2007, 2008, 2010, 2013, 2015, 2017; total and trend assessed using available years.

§§ Asked in 2002, 2007, and 2012 on; total and trend assessed using available years.

††† Asked in 2010, 2013, 2015, 2017; total and trend assessed using available years.

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