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Prevalence and Costs of Five Chronic Conditions in Children

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Abstract

The objective is to examine the prevalence and health-care costs associated with asthma, epilepsy, hypertension, food allergies, and diabetes in children aged 0–18 years. Prevalence was calculated using 2005–2012 Medical Expenditure Panel Survey (MEPS) data, a population-based, nationally representative sample. Using MEPS, two-part models estimated the cost of each condition for all children while controlling for sociodemographic categories. Prevalence rates varied by race and ethnicity across conditions. Females had higher prevalence of all chronic conditions, except epilepsy. An additional US$1,377.60–US$9,059.49 annually were spent on medical expenses for children aged 0–18 years, with asthma, diabetes, or epilepsy compared to children without these conditions. This is the first study to examine the costs and prevalence of chronic health conditions in children and adolescents using a single data set. Understanding the odds of having a condition by sociodemographic categories highlights disparities that can potentially inform school nurses on the best allocation of resources to serve students.

Keywords

chronic diseases; diabetes; epilepsy; hypertension; food allergies; asthma

Introduction

Although chronic health conditions are generally associated with adults, roughly 25% of children and adolescents in the United States are also affected (Van Cleave, Gortmaker, & Perrin, 2010). Additionally, it has been estimated that 7.5% of children in the United States

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Authors' Note

The findings and conclusions in this report are those of the authors and do not necessarily reflect the official position of the Centers for Disease Control and Prevention.

Declaration of Conflicting Interests

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have unmet health needs (Newacheck, Hughes, Hung, Wong, & Stoddard, 2000) and that 5% of children have multiple chronic conditions (Anderson, 2010; Gerteis et al., 2014). Chronic health conditions can influence both health and academic outcomes, such as absenteeism, concentration, and grades; when conditions develop during childhood, they may persist into adulthood (Danese et al., 2009; Forrest, Bevans, Riley, Crespo, & Louis, 2011; Perrin, Bloom, & Gortmaker, 2007). Chronic illness in children can also be disruptive to families and may result in negative effects on daily functioning and quality of life for multiple family members. Rising rates and undertreatment of chronic conditions during childhood may lead to poorer life outcomes and increased dependency on public support systems in adulthood (Perrin et al., 2007).

The prevalence of all chronic diseases in children increased from 1988 to 2006 (Van Cleave et al., 2010). This finding coupled with the influence chronic conditions may have during development and into adulthood illustrates the need to better understand prevalence rates among children and adolescents. Potential disparities in prevalence rates by gender, race, or ethnicity during childhood and adolescence might be addressed by policies and practices that can change the trajectory of chronic health conditions for these groups in the future. Multiple societal sectors, including homes, communities, health care, and schools, play a critical role in helping children and adolescents manage their chronic conditions. Schools and school nurses, in particular, have a unique role and are an ideal setting to support, address, and manage some of these complex health needs. One study estimated that for every dollar invested in a school nursing program, society gains US$2.20 (Wang et al., 2014).

Previous studies have examined the prevalence rates for chronic conditions in childhood and adolescence. For example, asthma was estimated to affect 7.3–9.5% of all children and as many as 18% of children living in poverty. Asthma is often complicated by socioeconomic status (SES) and environmental factors that limit the ability to control symptoms and exacerbations (Akinbami, 2012; Barnett & Nurmagambetov, 2011; Bloom, Cohen, & Freeman, 2010), thus illustrating the need to estimate prevalence rates by SES characteristics.

The prevalence of food allergies among children increased 18% from 1997 to 2007, and allergic reactions to foods have become the most common cause of anaphylaxis in community health settings (Decker et al., 2008). Although difficult to measure, recent research suggests that approximately 4% of children and adolescents are affected by food allergies (Liu et al., 2010).

Among the most common neurological disorders affecting children, epilepsy increases the risk for a number of psychosocial problems, including learning disabilities, academic underachievement, emotional problems, and difficulties with social interactions (Hirtz et al., 2007; Mott, Shellhaas, & Joshi, 2013). Two recent surveys found a prevalence rate of approximately 0.7% for epilepsy among children and adolescents (Boyle et al., 2011; Russ, Larson, & Halfon, 2012).

Although prevalence estimates vary, hypertension and diabetes are also relevant conditions to examine among children and adolescents (Morrison, Sprecher, Barton, Waclawiw, & Daniels, 1999; Sorof, Poffenbarger, Franco, Bernard, & Portman, 2002). Type 1 diabetes is an autoimmune disorder usually diagnosed in early childhood, while type 2 diabetes is typically diagnosed later in life and associated with metabolic syndrome and being overweight. Although diabetes is not the most prevalent chronic condition among children and adolescents, the possible complications of diabetes make it vitally important to address once diagnosed (Hamman et al., 2014). According to the National Survey of Children's Health, the rate of diabetes (type 1 and type 2) in persons aged 18 years was 0.3% in 2011–2012 (Data Resource Center for Child and Adolescent Health, 2012). Hypertension has also been impacted by the rising rates of obesity (Sorof, Lai, Turner, Poffenbarger, & Portman, 2004). For example, one school-based screening study in Houston public schools estimated a prevalence of hypertension of 4.5% using a sample of 5,102 school students aged 8–18 years, which increased to 11% for those in the obese category (body mass in sex ≥ 95% percentile; McNiece et al., 2007).

The purpose of this study was to examine the prevalence and cost of a select number of chronic conditions: asthma, food allergies, epilepsy, diabetes, and hypertension. These conditions may adversely affect students' academic achievement or may require significant resources from school health services to manage at school. Knowledge of the costs of these conditions can help determine potential resource allocation or the possible role of school health services in reducing overall medical expenditures. These five conditions were selected for their potential to impact factors such as school attendance, activity participation, or cognition, which may lead to poor overall health and academic outcomes (Institute of Medicine, 2012; McDougall et al., 2004).

Method

Data

This analysis used pooled data from the 2005–2012 Medical Expenditure Panel Surveys (MEPS). MEPS is a publicly available nationally representative sample of the noninstitutionalized U.S. population, in which individuals self-report answers to questions ranging from their health conditions and health-care expenditures to SES and demographic characteristics (Ezzati-Rice, Rhode, & Greenblatt, 2008). This analysis used data from the fully consolidated and medical condition MEPS files. Variables regarding individuals' SES characteristics, demographics, and medical care expenditures were extracted from the fully consolidated files. The International Classification of Diseases, Ninth Revision (ICD-9) codes and Clinical Classification Codes (CCC) included in the medical condition files allowed the identification of individuals who had any of the five selected chronic conditions. The fully consolidated and medical condition files were linked by personal identifiers constructed from the MEPS' data: survey year, household ID, and person ID. The linked data set consisted of 67,733 children (observations) aged 0–18 years; among these, 8,034 had at least one of the five selected chronic conditions.

Both ICD-9 codes and CCC were used to determine whether each observation had one of the examined conditions. CCC were used to identify asthma (CCC: 128), diabetes (CCC: 49 and

50), epilepsy (CCC: 83), and hypertension (CCC: 98). Hypertension, as defined here, does not include secondary hypertension or one time elevated blood pressure readings, as this would likely identify underlying conditions that cause hypertension or sporadic elevations of blood pressure. The CCC for allergic reactions (253) includes all allergic reactions, and the focus for this analysis was food allergies. Accordingly, both the CCC for allergic reactions and the ICD-9 code of 995 were used concurrently to identify children with food allergies. Children could have multiple entries in the medical conditions files; during the linkage process, we ensured that those with more than one of the five chronic conditions had each condition accounted for. Each condition was run separately with the observation entering the model for each relevant condition.

Variables extracted from the fully consolidated files included total medical expenditures; age; sex (female and male); race (White, African American, American Indian, Asian, and multiple races); ethnicity (Hispanic and non-Hispanic); geographic region (Northeast, Midwest, South, and West); poverty level (poor, near poor, low middle income, middle income, and high income); health insurance status (private insurance, public insurance, or no insurance); and mother's smoking status, mother's age, mother's marital status, and mother's education level (defined as 1 if mother has a General Education Development (GED) or high school education). Children who did not have a parental linkage in the data set were not included. Groupings for geographic region and poverty level were defined within the MEPS data file. Age was grouped into three distinct categories: 0–5, 6–11, and 12–18 years. Total medical expenditures for each child were obtained from MEPS and were adjusted to 2014 dollars using the Center for Medicare Studies' Health Care Expenditure Price Index.

Data Analysis

The prevalence of each chronic condition was calculated and reported by age, race, gender, and ethnicity. The study consisted of two analyses. The first analysis used logistic regression to calculate odds ratios (*OR*s) of children and adolescents in each strata having the identified chronic condition.

The second analysis estimated the medical expenditures associated with each chronic condition while controlling for age; sex; race; geographic region; poverty level; health insurance status; and mother's smoking status, age, marital status, and education level. Two-part models were used to account for distributional issues that arise when a large number of observations have zero medical expenditures (i.e., zero-mass issue). Using the entire sample, the first part of the two-part model estimated the probability of having a positive medical expenditure with a logistic regression. The second part of the model used only those observations with positive medical expenditures and estimated the association between medical expenditures and the chronic condition being examined. Estimates in the second part were generated through a generalized linear model (GLM) with a log link and gamma distribution. Lastly, using predictions from the logit and GLM models, the total predicted additional annual medical cost per child associated with each chronic condition was estimated. Separate two-part models were estimated for each of the conditions. Additionally, separate two-part models were estimated for each identified age-group.

Each chronic condition entered its two-part model as a binary variable (0,1). Covariates were the same in both the logit model and GLM model. Stata Version 13 (Stata Corp LP, College Station, TX) was used to conduct all statistical analyses. The complex survey design of MEPS and sampling weights were accounted for in all analyses.

Results

Table 1 reports the summary statistics for the sample. The sample is fairly evenly distributed over the age ranges. Over 60% of the sample had private insurance and 31.82% identified their income as middle income. The period of prevalence of the five chronic conditions from 2005 to 2012 can be found in Table 2. This table also illustrates the prevalence rates by age, race, sex, and ethnicity. Table 3 presents the *OR*s for the individual characteristics for each chronic condition. Table 4 presents the additional annual medical cost per child for each chronic condition by age-group.

The prevalence of asthma across the entire sample was 8.50%. The highest prevalence of asthma was in children aged 6–11 years. Females had a prevalence of approximately 10%, whereas males had a prevalence of almost 7%. The odds of having asthma increased by 23% among children with public insurance when compared to those with private insurance. Children and adolescents in the older age-groups had higher odds of having asthma than children aged 0–5 years; African Americans had a 50% higher odds of having asthma relative to Whites. The yearly medical costs associated with asthma for children aged 6–11 years were US$1,549.88 ($p \leq .001$) higher relative to the medical costs of children without asthma (Table 4).

The prevalence of diabetes (types 1 and 2 combined) across the entire sample was 0.35%. The prevalence of diabetes was 0.72% for adolescents aged 12–18 years. Males had a higher prevalence of diabetes versus females (0.46% vs. 0.25%). The odds of having diabetes was 85% lower for Asian children than for Whites. Additionally, the odds of Hispanic children and adolescents having diabetes was 60% lower than non-Hispanic children and adolescents. The additional yearly medical expenditures associated with diabetes (type 1 or 2) were US $6,702.30 ($p \leq .05$) higher for children and adolescents with diabetes relative to those without this condition.

The prevalence of epilepsy in the sample was 0.69%, with higher rates in Hispanic than in non-Hispanic children and adolescents (0.75% vs. 0.46%). Adolescents aged 12–18 years had 29% lower odds of having epilepsy than children aged 0–5 years. A child or adolescent with epilepsy had an additional US$9,103.25 ($p \leq .001$) per year in associated medical costs relative to children and adolescents who did not have epilepsy. Children aged 0–5 years had an additional US$12,763.42 ($p \leq .05$) per year in associated medical costs relative to children aged 0–5 years who did not have epilepsy.

The prevalence of food allergies across the sample was 0.44%. The prevalence of food allergies in Asian and American Indian children and adolescents was 0.35% and 0.50%, respectively. Additionally, food allergies were not associated with significantly higher total medical expenditures.

The prevalence of hypertension was 0.17% overall, with higher rates in older children; 0.36% in adolescents of 12–18 years compared to 0.04% in children aged 6–11 years. The prevalence of hypertension in females and males was 0.25% and 0.09%, respectively, with females having a 65% higher odds of this condition. There was no statistically significant difference between total medical expenditures for children and adolescents with or without hypertension.

Discussion

Management and prevention of chronic conditions in children and adolescents can maximize health outcomes and reduce unnecessary health-care utilization and costs (Modi et al., 2012). Additionally, managing these chronic health conditions in the school setting may help improve academic outcomes and lower absenteeism (Moricca et al., 2013; Rodriguez et al., 2013). Understanding the cost burden of chronic conditions allows for comparisons of required resources to implement interventions against possible cost savings, especially for programs that must compete for limited resources.

This is the first study that uses a single data set to simultaneously determine the prevalence and costs of five chronic conditions among a nationally representative sample of children and adolescents. Prevalence estimates indicate the highest burden for asthma, followed by epilepsy, diabetes, food allergies, and hypertension. The prevalence of diabetes is higher in adolescents relative to younger children and may be due to an increase in type 2 diabetes associated with obesity. Epilepsy prevalence was consistent with previous studies (Boyle et al., 2011; Russ et al., 2012). This study illustrates that youth with asthma, diabetes, and epilepsy have higher medical care expenditures relative to youth without these conditions; epilepsy being highest at an additional cost per child of US$9,103.25 annually. We estimated direct medical expenditures for each condition, making it difficult to compare estimates from previously published literature which varied in methodologies and types of health-care costs examined such as outpatient visits, emergency department utilization, hospitalizations, and indirect costs (Allareddy et al., 2014; Cramer et al., 2014; Gupta et al., 2013; Jerrell & Sakarcan, 2009; Kamble & Bharmal, 2009; Patel, Holdford, Edwards, & Carroll, 2011; Shrestha, Zhang, Albright, & Imperatore, 2011; Tran et al., 2012). We show similar disparities seen in other studies, such as disproportionately higher rates of diabetes and asthmas in American Indian and African American children, respectively (Akinbami, 2006; Gold & Wright, 2005; Perrin et al., 2007). Stakeholders should consider this variation among ethnic groups when shaping prevention policies and practices, understanding its potential impact on long-term health outcomes into adulthood.

There are several limitations to our study. First, MEPS data are subject to common biases such as recall, underreporting by parents, and coding techniques of individual surveyors; this may have led to our low estimate of food allergy prevalence in children and adolescents. Additionally, there was inadequate specificity in identification of certain conditions using publicly available MEPS data, as it only contains three-digit ICD-9 codes. For example, diabetes could not be separated by type, making it impossible to investigate the change in financial burden due to a particular type and its comorbidities. Also, the CCC used for epilepsy contains the ICD-9 code for “seizures not otherwise specified,” which may include

febrile seizures; however, this is not seen as commonly in children aged greater than 5 years. Children with other health conditions that were not one of the five specified in our study were still included in the sample; consequently, they may have had additional expenditures unrelated to our specified conditions. Children with one of the five conditions in our study may have also had additional health conditions that were not accounted for. This study was unable to determine costs of chronic conditions at the local level, such as schools or districts, a possible area for future research with a different data source.

Preventing and treating chronic conditions require comprehensive interventions across multiple sectors; for children and adolescents, school-based interventions such as those led by school nurses and within school–based health-care clinics are instrumental (Akinbami, 2006; Institute of Medicine, 2012). School nurses can provide care coordination between schools, parents, and health-care providers to ensure that students with chronic health conditions receive necessary care to optimize health and learning. Several studies of school nurse case management for students with asthma found that school nurses effectively improved the health of students and increased knowledge and appropriate medical treatments at school (Engelke, Guttu, Warren, & Swanson, 2008; McClanahan & Weismuller, 2015). At the community level, health-care providers can engage families in prevention and treatment strategies, while promoting coordination of services across providers and in school settings.

Further research should examine medical care expenditures for children with multiple chronic conditions as well as specific populations, as the effectiveness of prevention policies and practices for programs may differ across demographic characteristics. Our research provides motivation to explore school-based strategies at the local level to reduce the burden of chronic conditions and their impact on student health and academic achievement. Additionally, investigating the costs for schools to address their health services and staffing needs is paramount. Understanding the prevalence of specific chronic conditions and their associated costs can help policy makers and local communities develop and support evidence-based programs and school health-care coordination models geared toward prevention and reduced long-term medical expenditures.

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Table 1

Characteristics of the MEPS Survey Data for Children Aged 0–18 Years, 2005–2012.

Characteristic	No. of Participants[a] (%)[b]
Age (years)	
0–5	20,007 (30.1)
6–11	22,929 (32.5)
12–18	24,797 (37.5)
Sex	
Female	34,479 (50.6)
Male	33,254 (49.4)
Insurance status	
Private	31,058 (61.8)
Public	32,019 (32.2)
None	4,656 (6.0)
Race	
White	47,337 (77.3)
African American	14,081 (14.2)
American Indian	722 (1.0)
Asian	3,159 (4.2)
Multiple races	2,434 (3.3)
Ethnicity	
Hispanic	25,329 (22.4)
Non-Hispanic	42,404 (77.6)
Poverty status[c]	
Poor	20,791 (19.2)
Near poor	5,530 (5.7)
Low middle	12,769 (15.7)
Middle	17,382 (31.8)
High middle	11,261 (27.6)

Note. MEPS = Medical Expenditure Panel Survey.

[a]No. of participants is based on sample and is unweighted.

[b]Percentages may not total 100 based on rounding and are weighted.

[c]Poor: income less than or equal to the poverty line, near poor: income < 125 of poverty line, low income: 125 < income < 200 of poverty line, middle income: 200 < income < 400 of poverty line, high income: income > 400% of the poverty line.

Table 2

Prevalence of Five Chronic Conditions in Adolescents Stratified by Age, Race, Sex, and Ethnicity.

Characteristic	Asthma, %	Epilepsy, %	Diabetes, %	Food Allergies, %	Hypertension, %
Overall	8.50	0.69	0.35	0.44	0.17
Age (years)					
0–5	7.11	0.81	0.13	0.44	0.07
6–11	9.87	0.82	0.13	0.46	0.04
12–18	8.42	0.48	0.72	0.42	0.36
5–18	9.06	0.63	0.43	0.43	0.20
Race					
Asian	5.75	0.54	0.06	0.35	0.00
Caucasian	7.89	0.66	0.37	0.45	0.18
African American	12.42	0.87	0.33	0.39	0.21
American Indian	8.15	1.26	0.53	0.50	0.28
Multiple races	9.32	0.67	0.31	0.53	0.05
Sex					
Female	10.04	0.71	0.25	0.48	0.25
Male	6.91	0.67	0.46	0.40	0.09
Ethnicity					
Non-Hispanic	8.81	0.75	0.40	0.50	0.18
Hispanic	7.41	0.46	0.18	0.22	0.15

Table 3

Odds Ratios (*OR*s) of Five Chronic Conditions Based on Demographics and Socioeconomic Characteristics.

Characteristic	Adjusted OR [95% CI] Asthma	Adjusted OR [95% CI] Epilepsy	Adjusted OR [95% CI] Diabetes	Adjusted OR [95% CI] Food Allergies	Adjusted OR [95% CI] Hypertension
Age (years)					
0–5	Referent	Referent	Referent	Referent	Referent
6–11	1.48 [1.31, 1.66]†	1.03 [0.71, 1.47]	1.06 [0.34, 3.33]	1.05 [0.64, 1.73]	0.61 [0.24, 1.59]
12–18	1.25 [1.13, 1.40]†	0.61 [0.41, 0.92]†	5.86 [2.02, 17.00]†	0.93 [0.60, 1.45]	5.31 [2.13, 13.24]†
Sex					
Female	Referent	Referent	Referent	Referent	Referent
Male	0.66 [0.60, 0.73]†	0.94 [0.71, 1.24]	1.90 [1.17, 3.07]	0.84 [0.59, 1.20]	0.35 [0.19, 0.61]†
Insurance status					
Private	Referent	Referent	Referent	Referent	Referent
Public	1.23 [1.08, 1.39]†	1.24 [0.80, 1.91]	1.66 [0.97, 2.83]	1.79 [1.05, 3.04]	2.81 [1.42, 5.56]
None	0.52 [0.39, 0.70]†	0.39 [0.16, 0.97]†	0.28 [0.06, 1.38]	0.95 [0.27, 3.39]	1.19 [0.27, 5.30]
Race					
White	Referent	Referent	Referent	Referent	Referent
African American	1.50 [1.34, 1.69]†	1.04 [0.77, 1.41]	0.68 [0.40, 1.17]	0.72 [0.43, 1.20	0.85 [0.43, 1.67)
American Indian	0.99 [0.56, 1.74]	1.93 [0.88, 4.20]	1.33 [0.46, 3.89]	1.17 [0.34, 4.01]	1.28 [0.31, 5.39)
Asian	0.69 [0.52, 0.92]†	0.73 [0.33, 1.60]	0.15 [0.04, 0.51]†	0.65 [0.27, 1.54]	Omitted
Multiple races	1.17 [0.95, 1.44]	0.87 [0.47, 1.59]	0.82 [0.21, 2.09]	1.04 [0.43, 2.54]	0.29 [0.04, 2.23)
Ethnicity					
Hispanic	0.85 [0.75, 0.97]†	0.52 [0.37, 0.74]†	0.40 [0.23, 0.68]†	0.39 [0.25, 0.62]†	0.62 [0.31, 1.27]
Non-Hispanic	Referent	Referent	Referent	Referent	Referent
Poverty status					
Poor	1.04 [0.88, 1.21]	1.27 [0.71, 2.29]	0.78 [0.41, 1.48]	0.57 [0.28, 1.15]	0.77 [0.31, 1.88]
Near poor	0.83 [0.68, 1.02]	1.08 [0.55, 2.14]	1.04 [0.50, 2.14]	0.60 [0.26, 1.39]	0.98 [0.31, 3.08]
Low middle	0.92 [0.78, 1.08]	1.40 [0.87, 2.26]	0.88 [0.45, 1.72]	0.90 [0.49, 1.67]	1.11 [0.45, 2.76]
Middle	0.93 [0.82, 1.07]	1.05 [0.66, 1.66]	0.74 [0.40, 1.37]	1.10 [0.64, 1.86]	0.75 [0.32, 1.76]
High middle	Referent	Referent	Referent	Referent	Referent

Note. CI = confidence interval.

†Statistical significance at the .05 level.

Table 4

Additional Annual Medical Costs Per Child for Five Chronic Conditions.

Chronic Condition by Age Group	Additional Cost Per Child (US$)	Range in US$ [95% CI]
Age 0–5 years		
Asthma***	1,169.72	[810.87, 1,528.57]
Epilepsy*	12,763.42	[487.42, 25,039.41]
Diabetes	Omitted	Omitted
Food allergies	−261.78	[−747.09, 223.53]
Hypertension	Omitted	Omitted
Age 6–11 years		
Asthma***	1,549.88	[927.81, 2,171.95]
Epilepsy***	7,801.15	[4,514.96, 11,087.34]
Diabetes	Omitted	Omitted
Food allergies	2,381.03	[−291.16,5,053.22]
Hypertension	Omitted	Omitted
Age 12–18 Years		
Asthma***	1,487.38	[1,118.15, 1,856.62]
Epilepsy***	6,460.05	[2,689.94, 10,230.17]
Diabetes***	4,130.90	[2,532.64, 5,729.16]
Food allergies	Omitted	Omitted
Hypertension	7,538.53	[−2,734.02, 17,81 1.07]
Age 0–18 years		
Asthma***	1,377.60	[1,064.81, 1,690.38]
Epilepsy***	9,103.25	[4,725.67, 13,480.84]
Diabetes*	6,702.30	[−81.73, 12,722.87]
Food allergies	1,044.46	[−34.42,2,123.34]
Hypertension	9,059.49	[−458.42, 18,577.39]

Note. CI = confidence interval.

** 1% significance levels.

* 5% significance levels.

*** .01% significance levels, respectively.