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Direct medical costs of constipation in children over 15 years: a population-based birth cohort

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Abstract

Background—Although direct medical costs for constipation-related medical visits are thought to be high, to date there have been no studies examining if longitudinal resource utilization is persistently elevated in children with constipation. Our aim was to estimate the incremental direct medical costs and types of health care utilization associated with constipation from childhood to early adulthood.

Methods—A nested case-control study was conducted to evaluate the incremental costs associated with constipation. The original sample consisted of 5,718 children in a population-based birth cohort who were born during 1976–1982 in Rochester, MN. The cases included individuals who presented to medical facilities with constipation. The controls were matched and randomly selected among all non-cases in the sample. Direct medical costs for cases and controls were collected from the time subjects were between 5–18 years of age or until the subject emigrated from the community.

Results—We identified 250 cases with a diagnosis of constipation in the birth cohort. While the mean inpatient costs for cases were \$9994 (95% CI=2538, 37201) compared to \$2391 (95% CI=923, 7452) for controls (p=0.22) over the time period, the mean outpatient costs for cases were \$13927 (95% CI=11325, 16525) compared to \$3448 (95% CI=3771, 4621) for controls (p<0.001) over the same time period. The mean annual number emergency department visits for cases were 0.66 (95% CI=0.62, 0.70) compared to 0.34 (95% CI=0.32, 0.35) for controls (p<0.0001).

Conclusion—Individuals with constipation have higher medical care utilization. Outpatient costs and ER utilization were significantly greater for individuals with constipation from childhood to early adulthood.

Keywords

Childhood constipation; Direct medical costs; Case-control study

INTRODUCTION

Chronic constipation is a common and heterogeneous disorder, which is often characterized by difficult, infrequent stool passage, or incomplete evacuation.^{1–3} Population-based studies have estimated the prevalence of chronic constipation in North America varies between 2% and 27% of children and adults, leading to at least 2.5 million physician visits annually in the United States.^{1–7} In a recent database analysis by Everhart et al.⁸ on the burden of digestive diseases in the United States, constipation was the second most common ambulatory care diagnosis, after gastroesophageal reflux disease (GERD).

Chronic constipation is one of the most common reasons for ambulatory care visits by children.^{9–12} In young children (birth to 5 years), incident medical visits (first time visits) for constipation were among the highest for all the gastrointestinal disorders including GERD and abdominal pain of unknown origin.¹³ The incidence of medical presentation for children with constipation has also been observed to be substantially higher than other chronic episodic pediatric conditions (for example, 7 times higher than asthma in children 7–8 years of age and 3 times higher than migraine headaches in children 10–14 years of age)^{10, 11}

No studies have examined longitudinal resource utilization in children and adults with constipation in the community.¹⁴ Utilizing a national disease and therapeutic index database, Sonnenberg et al.⁹ estimated that ambulatory visits for constipation resulted in annual costs of \$29 million (1985 value). In recent review,⁸ 5.4 million prescriptions were filled for constipation according to the Verispan database of retail pharmacy, but the data did not capture the very large number of nonprescription medications purchased for constipation.

Childhood constipation is often a relapsing chronic condition; children may present repeatedly for constipation over a prolonged period of time. In a longitudinal follow-up study of childhood constipation, van Ginkel et al.¹⁵ showed that constipation was still present in 30% of children after puberty despite medical therapy. Disease chronicity may contribute to an increased number of outpatient visits, diagnostic evaluations, and inpatient admissions in these people. However, none of the previous studies have been able to evaluate the long-term costs and utilization associated with a diagnosis of constipation. A better understanding of long-term resource utilization may help practitioners and health systems develop strategies to optimally manage these patients. The aim of the present study was to estimate the incremental direct medical costs and type of health care associated with constipation from childhood through early adulthood.

METHODS

Setting

Olmsted County, Minnesota, is a metropolitan and rural area 90 miles southeast of Minneapolis, Minnesota. Census data from the 1990 population, representing the years the children from this birth cohort were in school, indicated the population was 70,745 (75% were age < 45 years), and was estimated to be 96% Caucasian; sociodemographically, the community is very similar to the United States Caucasian population.^{16, 17} Over 95% of County residents receive their medical care from one of the two group practices in the community (Mayo Medical Center and Olmsted Medical Center). Mayo Clinic has maintained a common medical record system with its two affiliated hospitals (Saint Marys and Rochester Methodist) for over 90 years.^{16, 17} Recorded diagnoses and surgical procedures are indexed, including the diagnoses made for outpatients seen in office or clinic consultations, emergency room visits or nursing home care, as well as the diagnoses recorded for hospital inpatient, at autopsy examination or on death certificates. This system

was further developed by the Rochester Epidemiology Project (REP), which created similar indices for the records of other providers of medical care to local residents, most notably the Olmsted Medical Center and its affiliated Olmsted Community Hospital. Thus, details of the medical care provided to the residents of the County are available for study. Annually, over 80% of the entire population is attended by one or both of these two practices, and nearly everyone is seen at least once during any given 3-year period.¹⁶ Therefore, the Rochester Project medical records linkage system also provides what is essentially an enumeration of the population from which samples can be drawn.

Identification of the 1976–1982 Rochester Birth Cohort

As approved by the Institutional Review Boards of the Mayo Clinic and Olmsted Medical Center, we used this system previously to draw a birth cohort consisting of all children born between January 1, 1976, and December 31, 1982, to mothers residing in Olmsted County, Minnesota, comprising the Minnesota Independent School district 535 (N = 8548) in the city of Rochester.¹⁸ Subjects were identified through computerized birth certificate information from the Minnesota Department of Health, Division of Vital Statistics. The vital status of each member of the birth cohort during the 1995–1996 school year were established using resources from the Rochester Epidemiology Project, Independent School District 535, and the Minnesota Department of Health. The target population of this study consisted of 5718 children, who at or after the age of 5 years all still lived in Rochester and whose family did not deny research authorization. A review of hospital and school records indicated that 80% of the target population continued to reside in the area until at least age 18 years.

Identification of cases with constipation from age 5 to younger than 21 years in the 1976–1982 birth cohort

Through the Rochester Epidemiology Project, all diagnoses and surgical procedures recorded at Rochester medical facilities are indexed continuously for automated retrieval. This diagnostic index expedites retrieval of the unit (or dossier) medical record, which includes the history of all encounters in the hospital, community and ambulatory medical and social services, emergency department, outpatient clinics, and home visits, as well as laboratory and psychologic test results from birth until patients no longer reside within the community.

Case ascertainment—All birth cohort members diagnosed with constipation from 5 to younger than 21 years were identified by the following. Potential cases of constipation were identified using the diagnostic index developed by the Rochester Epidemiologic Projects (REP). The potential cases from 5 to younger than 21 years were identified as having one or more of the following diagnostic or surgical codes, out of all birth cohort members: constipation, H-ICDA-8 05640112 or ICD-9 564; obstipation, H-ICDA-8 05640111; encopresis, H-ICDA-8 03167110 or ICD-9 307.7; unspecified functional disorder of intestine, ICD-0 564.9. The diagnostic index was designed to be sensitive and thus this broad search should capture all clinically diagnosed cases. However, a detailed chart review was undertaken to improve specificity and ensure these cases actually had constipation.

Individuals were designated as cases with a diagnosis of constipation if they met the following criteria from the chart abstraction: (1) HICDA or ICD-9 diagnosis, and (2) chart review confirmed the medical visit was primarily for constipation, even if other gastrointestinal symptoms were reported.

All children with a recognized or underlying disorder that would contribute to their gastrointestinal symptoms at the time of the visit from the chart review such as cerebral

palsy, developmental delay, a metabolic disorder, intestinal malformation or obstruction, Hirschsprung's disease, intestinal allergy, or inflammation were excluded from this study.

Data collection—Detailed information about the data collection has been previously described.^{12, 13} The medical records of all potential incident cases with a medical visit for constipation from 5 to younger than 21 years of age were reviewed using a standardized chart review instrument.^{12, 13} Information regarding the date of the initial visit and the presence of a medical visit for constipation in the chart was used to confirm the data from the search of the administrative diagnostic index. Data concerning the demographic characteristics, presenting complaints, and specific medical complaints and accompanying gastrointestinal symptoms leading to the diagnosis were abstracted from the medical record. In addition, detailed sociodemographic factors were collected at birth in the 1976–1982 birth cohort. To determine factors that may influence medical presentation for a condition, birth certificate information, including parental demographic characteristics, was evaluated. This information was available from the computerized birth certificate information obtained from the Minnesota Department of Health, Division of Vital Statistics. The specific information evaluated included whether or not the child was born to a single parent, maternal age, and maternal level of education. The selected comorbidities in cases and controls were defined as the occurrence of at least one diagnosis within the time frame of the study (table 1); the comorbidities were selected based on our *a priori* expectation that they could have an impact on constipation status and medical costs, as well as being prevalent in children, including the common cold, chronic sinusitis, otitis media, and influenza. Among the selected comorbid conditions, we excluded conditions which did not have measurable counts for calculating the medical costs.

Age- and Sex-Matched Controls

For each identified and reviewed case, we randomly selected 2 sex- and age-matched controls from the pool of subjects in the birth cohort who did not have one of the relevant HICDA or ICD-9 diagnoses for constipation. The controls were matched on gender and date of birth (± 6 month) using an optimal matching algorithm applied to the values of each matching factor.

Cost and Utilization Data

Beginning in January 1987, resource use and associated charges data from Mayo Clinic and Olmsted Medical Center were collected. This claims-based database contains information on medical resource utilization, associated charges, and estimated economic costs for patients receiving care at either the Olmsted Medical Center or the Mayo Clinic and their associated inpatient facilities. The Olmsted County Healthcare Expenditure and Utilization Database (OCHEUD) provides a standardized inflation-adjusted estimate of costs for each service or procedure provided locally in constant dollars. Specifically, using a “bottom-up” (also referred to as micro-costing) costing approach, OCHEUD groups resource utilization into the Medicare Part A and B classification system. Part A billed charges are adjusted by using hospital cost-to-charge ratios and Part B physician services are valued by using Medicare reimbursement rates.

Although the services provided represent the clinical practice patterns of Mayo Clinic and Olmsted Medical Center providers, the value of each unit of service has been adjusted to national norms by use of widely accepted valuation techniques.¹⁹ OCHEUD provides an estimated economic cost for each line item in the billing record and allows the aggregation of costs into categories deemed relevant to a particular study.¹⁹

Statistical Analyses

We present descriptive statistics on baseline factors (e.g. age, gender, proportion of cesarian births, etc) as well as sociodemographic factors (e.g. mother's education level, age of mother at birth of child, etc.) for both the mothers and children. All categorical descriptive variables are presented with both a count and percentage for both the controls and cases and were compared using the Chi-Square test statistic. Continuous variables are described using the mean and the standard deviation; comparison between the controls and cases was done using the Wilcoxon Rank Sum test.

The incremental costs associated with constipation were assessed during the year that all children were age 10, 13, and 16. We used 2-part models to estimate these costs so that we accounted for the \$0 cost in the population.²⁰ For the 2-part model specifications, logistic regression was used in part 1 to estimate the probability of costs conditional on patient characteristics; Part 2 employed an inverse Gaussian distribution function with log link in cost models. The specifications for the second part were determined using the modified Park test as recommended by Manning and Mullahy.²⁰ For the given ages none of the comorbidities that were diagnosed during the given year of the specified age were significant in predicting costs.

The Tian & Huang²¹ method was used to assess the overall mean estimated cost. It is a two part model for censored medical costs due to loss to follow-up which also will account for zero costs over the time frame. The first part assumes a parametric model, in this case logistic regression to examine the association between positive medical costs from age 5 to 21 or loss to follow up adjusting for constipation or not. The second part uses a generalized linear model with a gamma distribution and a log link for the positive costs. The censoring caused by incomplete follow up is addressed by applying the inverse probability weighting method to the two part model. This method allows for testing to see if a covariate has any effect on the total medical costs as well an estimation of the mean medical costs for individuals.

Similarly, this two-part model was employed to evaluate the predictors of costs within a multivariate model for those patients with constipation. Each comorbidity that contained measurable counts was entered into the model predicting outpatient, inpatient and total costs. For each variable entered into the model, an estimate of the percentage change in costs associated with each clinical characteristic is generated, contingent upon whether patients have positive costs. However, one patient (0.4%) did not have a positive value for total costs and outpatient costs in the cohort, and 120 (48%) had no inpatient costs.

All calculated p-values were two-sided and p-values less than 0.05 were considered statistically significant. Statistical analyses was performed using SAS (SAS Institute, Cary, NC) and R - General (R Development core Team (2008)) software packages.²²

RESULTS

By 5 years of age, 5718 children were still living in the community. Of these, 5506 subjects had not denied research authorization at the time of the study and were eligible for this study. Among 5506 subjects at risk, a total of 250 incident subjects with a medical diagnosis of constipation were identified. The mean age at the time of the initial visits was 11 years ($\pm$ 4.2). The overall incidence rate for presenting with a diagnosis of constipation in children from 5 to 21 years was 45 (95% CI, 40 – 51) per 1000 persons-years.

Sociodemographic features

Table 2 summarizes the sociodemographic characteristics in subjects with and without constipation including parental demographics. Compared with age- and sex- matched controls from the same birth cohort, there were no significant differences for the presence of parental sociodemographic factors (single parent, maternal age, education level, the proportion of constipation, and existing psychologic conditions), aside from a higher rate of maternal somatization in children who later presented with constipation.

Prevalence of selected comorbidities

Table 3 summarized the distribution of the selected comorbidities in subjects with constipation and without constipation. Of subjects with constipation, 19.2% received no medical care for 1 of the selected comorbidities compared with 42.2% of the matched control sample ($p < .0001$). Similarly, subjects with constipation were more likely to have been treated for 2 or more of the selected comorbidities than the matched controls (60.8%, vs. 31.4%; $p < .0001$). Specifically, children with constipation were more likely to present with gastrointestinal, somatic and psychological, or respiratory conditions compared to controls (table 3).

Medical visits and costs

The number of annual medical visits and annual costs of subjects with constipation from 5 to 21 years of age versus controls is summarized in table 4. On average, subjects with constipation used more of all types of medical services than their matched controls. Emergency department visits were the most frequently used type of services by subjects with constipation, followed by outpatient care and inpatient care. More subjects with constipation utilized hospital outpatient and inpatient as well as emergency department care compared with matched controls. Notably, the mean annual number of emergency department visits for subjects with constipation were 0.66 compared to 0.34 for controls ($p < 0.0001$) (table 4).

The mean direct medical costs for cases were four times those of controls over the time period (\$25100 vs. \$5913; $p = 0.055$). The mean inpatient costs for cases over the time period were \$9994 compared to \$2391 for controls ($p = 0.22$), while the mean outpatient costs over the same time period for cases were \$13927 compared to \$3448 for controls ($p < 0.001$) (table 4).

Figure 1 shows the total annual observed costs of subjects with constipation and without constipation according to age. Overall, subjects with constipation consistently had higher health care costs from childhood to early adulthood. Figure 2 shows the annual observed outpatients medical costs for subjects with constipation versus controls. Total annual medical costs for children to young adults with constipation were approximately twice that of controls (primarily outpatient).

Interactions between constipation status and each comorbidity condition were examined for total, inpatient medical costs and outpatient medical costs. There were no significant interactions between constipation status and comorbid conditions for estimating medical costs.

Influence of comorbid conditions on medical costs for patients with constipation

After adjusting for other factors, depression and otitis media were significantly associated with both total and outpatient medical costs for patients with constipation (Table 5). Anxiety was found to be significantly associated with all cost categories, generating a 348% increase

in inpatient costs for patients with constipation (table 5). Patients with headaches had increased inpatient costs but this did not significantly impact total costs.

Abdominal pain, influenza, and asthma, while not associated with total medical costs, were significantly associated with lower inpatient medical costs for patients with constipation.

DISCUSSION

In this study, the overall incidence of a clinical diagnosis of constipation in children aged between 5 and 21 years of age in Olmsted County, MN was estimated to be 45 per 1000 person years. We observed that subjects with a diagnosis of constipation consistently have higher health care costs from childhood to early adulthood. Moreover, the overall annual medical costs for children with constipation are approximately twice that of controls. This is the first population based longitudinal study we know of to present US data on the costs related with constipation from childhood to young adulthood compared to controls. In particular, the costs for patients with constipation were higher compared with matched controls for ambulatory care.

Arguably, constipation has not received the public health attention it deserves, especially in children. von Ginkel et al.¹⁵ showed that one third of children with constipation still experience constipation in adolescence. In adults, symptoms of constipation persist over a prolonged period of time, and are likely a reason for repeated medical consultation²³; Talley et al. determined that in the general population, 89% of adults surveyed reported no change in their bowel symptoms during an intervening 12–20 month period²³. In addition, Chitkara et al.¹² showed that children with a diagnosis of constipation at younger than 5 years of age had about a 2 to 5 times higher incidence of subsequent medical visits for constipation through adolescence and early adulthood compared with the incidence rate among children without an early medical presentation. Therefore, children and adults may present repeatedly for constipation over a prolonged period of time, and this likely contributes to the incremental costs of health care utilization. In our study, children with constipation used more of all types of medical services from 5 years to adolescence. It is difficult to estimate the pure medical costs driven by chronic constipation, excluding the medical costs of any associated comorbid conditions. We did assess the influence of comorbidity on medical costs, and observed that otitis media, depression and anxiety had a significant impact on the total medical costs. More specifically, anxiety was associated with a 184 % increase in total medical costs, compared with depression that had a 97% increase and otitis media an 83% increase in total medical costs. Thus it is conceivable that comorbid conditions in children with constipation do increase health care utilization and induce higher total medical costs compared to those not so affected.

Liem et al.²⁴ studied the health utilization and cost impact of childhood constipation in the United States using the Medical Expenditure Panel Survey (MEPS) database. In this study, they showed that children with constipation used more health services than children without constipation, resulting in significantly higher costs: \$3430/year vs. \$1099/year. This amounts to an additional cost for children with constipation of \$ 3.9 billion/year. This study had some limitations; for example, the medical condition data in the MEPS were only derived from parental reports, and the study was cross-sectional. The present study has determined the incremental medical costs of childhood constipation with longitudinal observations over 15 years. In our study, total incremental costs per year for subjects with constipation were \$630 and incremental costs of outpatient care per year for subjects with constipation were \$359, both highly significant compared with matched controls. More interestingly, we found that subjects with a diagnosis of constipation consistently had higher health care costs from childhood to early adulthood. Although direct comparisons are not

possible due because no similar data exist, other studies have shown comparable high cost burdens of chronic disease. The incremental total expenditure associated with asthma in children versus without asthma was \$1,004.6 in 2004.²⁵ Another study²⁶ using 1996 Medical Expenditure Panel Survey data showed that the incremental total medical costs were \$479 for children with Attention-Deficit/Hyperactivity Disorders, and \$437 for children with asthma. Notably, because we could not look at indirect costs, such as missed school days due to illness or parents' workday absences due to their child's illnesses, much higher incremental costs associated with constipation may exist.

This study had some potential limitations. First, we did not include all subjects with constipation in the community, because subjects could have had mild symptoms not serious enough to present for medical attention. Thus, our study more likely underestimates the actual burden of childhood constipation. Furthermore, we cannot account for decreased quality of life, nontraditional therapeutic interventions, and over-the-counter drugs such laxatives, and the costs associated with undiagnosed patients with constipation were not included in this study. Second, these data may be generalized to only the white US population because the racial composition of this community is predominantly Caucasian.¹⁶ Moreover, the services and the utilization patterns in Olmsted County may not be completely generalizable to other settings due to a higher proportion of the working population employed in the health-care industry, and the correspondingly slightly higher education level. Because our study compared subjects with and without constipation in an attempt to demonstrate whether health-care utilization and the direct medical costs are equivalent in both groups, however, at least it is reasonable to conclude that childhood constipation induces significant incremental costs.

Thus, we conclude that children with constipation consistently experience higher overall healthcare utilization, higher outpatient costs and more emergency department visits from childhood through early adulthood. Management strategies need to consider addressing these issues.

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Figure 1.
The mean observed annual total costs for constipation. Each bar represents the mean observed annual total medical costs for children with constipation versus controls according to age.

Figure 2.

The mean observed annual outpatient costs for constipation. Each bar represents the mean observed annual outpatient costs of children with constipation versus controls according to age.

Table 1

Medical indexes of the selected comorbid conditions (ICD-9 codes and HICDA codes)

Disease	H-ICDA codes	ICD-9 codes
GI disease		
GERD or heartburn	05300213, 07817110	530.1, 787.1
Dyspepsia	05369121	536.8
Abdominal pain	07800240	789.0
Peptic ulcer disease	05330110, 05331112	533. x
Irritable bowel syndrome	05641000, 05641110	564, 564.1
Non-GI disease		
Headache, tension or migraine	03460121, 03461310, 03168110, 06268120, 07920110, 07920114	784.0, 307.81, 346, 625.4, 784.0
Thyroid disorder	02450112, 02459130, 02400410, 02442111, 02451310, 02449120	245, 240.9, 244.2
Diabetes mellitus	02500110, 02500117, 02500118	250.0
Depression	03082210, 03089111, 03082111	296.2x, 296.89, 298.0, 300.4, 311
Anxiety	03100110, 03100120, 03100210	300.00, 300.02, 300.09, 309.21
Influenza	04700000, 047001xx, 047003xx, 04700510, 047009xx	487.xx
Otitis Media	03819000, 038191xx, 03819211	381.xx
Asthma	04939000, 049391xx	493.xx

GERD=gastroesophageal reflux disease

Table 2

A comparison of sociodemographic characteristics for subjects with constipation versus controls

	Case N=250	Control N=500	p-value
Follow up years, Mean ($\pm$ SD)	13.4 (2.1)	13. (2.4)	0.17
Age at diagnosis, mean age ($\pm$ SD)	11.6 ($\pm$ 4.2)	11.1 ($\pm$ 4.2)	0.99
Gender (matched)			
Boys	106 (42.4%)	212 (42.4%)	
Girls	144 (57.6%)	288 (57.6%)	
Proportion of Cesarean delivery	28 (11.2%)	54 (10.8%)	0.87
Maternal factor			
Non legitimate birth (out of wedlock)	25 (10.0%)	43 (8.6%)	0.53
Maternal age at child's birth, $\leq$ 18 y	12 (4.8%)	15 (3.0%)	0.21
Maternal age at birth, mean age ($\pm$ SD)	26.4 (5.0)	27.0 (4.8)	0.13
Maternal education level at child's birth			
< High school	91 (42.4%)	153 (35.4%)	0.09
Maternal medical presentation			
Diagnosis of functional GI	128 (51.2%)	202 (40.4%)	0.005
Constipation	0	2 (0.4%)	1.0
Other FGIDs	21 (9.0%)	27 (5.7%)	0.11
Somatization	33 (14.2%)	37 (7.9%)	0.009
Psychologic condition (anxiety, depression)	14 (6.0%)	19 (4.0%)	0.25

FGIDs = functional gastrointestinal disorders

Table 3

Prevalence of selected comorbidities for subjects with constipation versus controls

Type of comorbidity	Case N=250	Control N=500	p-value
2 or more comorbidities	152 (60.8%)	157 (31.4%)	<.0001
GI disease	128 (50.8%)	104 (20.8%)	<.0001
GERD or heartburn	15 (6.0%)	6 (1.2%)	0.0002
Dyspepsia	8 (3.2%)	5 (1.0%)	0.03
Abdominal pain	119 (47.6%)	96 (19.2%)	<.0001
Peptic ulcer disease	0	2 (0.4%)	0.56
IBS	12 (4.8%)	9 (1.8%)	0.0189
Non GI disease	181 (72.4%)	267 (53.4%)	<.0001
Headache, tension or migraine	74 (29.6%)	77 (15.4%)	<.0001
Depression	63 (25.2%)	73 (14.6%)	0.0004
Anxiety	29 (11.6%)	17 (3.4%)	<.0001
Thyroid disorder	3 (1.2%)	5 (1.0%)	~1
Diabetes mellitus	1 (0.4%)	5 (1.0%)	0.67
Influenza	26 (10.4%)	18 (3.6%)	0.0002
Otitis Media	129 (51.6%)	192 (38.4%)	0.0006
Asthma	53 (21.2%)	63 (12.6%)	0.0021

GERD=gastroesophageal reflux disease

IBS = irritable bowel syndrome

Table 4

Medical visits and costs of children with constipation versus controls

	Case N=250	Control N=500	p-value
Non-users (1987–2003 Mayo utilization), n (%)	1 (0.4%)	46 (9.2%)	<.0001
# of Patients with an Out Patient Visit(s)	163 (65.2%)	265 (53.0%)	0.0015
# of Patients with a Hospitalization(s)	130 (52.0%)	208 (41.6%)	0.007
# of Patients with a ER Visit(s)	241 (96.4%)	401 (80.2%)	<.0001
Hospital inpatient stays per year, mean ($\pm$ SD)	0.13 (0.59)	0.07 (0.41)	<.0001
Hospital outpatient visits per year, mean ($\pm$ SD)	0.16 (1.06)	0.11 (0.58)	<.0001
ER visits per year, mean ($\pm$ SD)	0.66 (1.25)	0.34 (0.85)	<.0001
Total Cost per Patient per Year ¹ : Mean (Q1–Q3)	1545.7 (409.1, 1613.2)	915.5 (170.1, 979.3)	N/A
Outpatient Cost per Patient per Year ¹ : Mean (Q1–Q3)	888.8 (370.6, 1097.1)	530 (145.4, 705.7)	N/A
Inpatient Cost per Patient per Year ¹ : Mean (Q1–Q3)	641.9 (0, 339)	372.72 (0, 234.8)	N/A
Estimated Total Costs (All Years) ² , Mean (95% CI)	\$25,100 (13,545, 39,707)	\$5913 (5040, 10166)	0.06
Estimated Inpatient Costs (All Years) ²	\$9994 (2538, 37201)	\$2391 (923, 7451)	0.22
Estimated Outpatient Costs (All Years) ²	\$13,927 (11,325, 16,525)	\$3448 (3770, 4620)	0.0001
Estimated Cost for Age 10, Mean (95% CI) ^{3, 4}	\$688.62 (648.53, 732.03)	\$460.84 (438.62, 483.97)	<.0001
Estimated Cost for Age 13, Mean (95% CI) ^{3, 4}	\$1592.70 (1476.10, 1709.35)	\$792.17 (746.85, 833.96)	<.0001
Estimated Cost for Age 16, Mean (95% CI) ^{3, 4}	\$1817.91 (1790.10, 1848.05)	\$1619.39 (1603.78, 1638.30)	<.0001

¹ Unadjusted Cost² Adjusted by Case vs. Control only.³ Adjusted by Case vs. Control & mother's diagnosis of functional GI⁴ CI calculating using bootstrap method

Table 5

Multivariable predictors of costs in cases

Predictor	Inpatient Costs		Outpatient Costs		Total Costs	
	Predicted Change in Costs (%)	P Value	Predicted Change in Costs (%)	P Value	Predicted Change in Costs (%)	P Value
Abdominal Pain	-113.5	<.0001	17.7	0.46	5.4	0.85
Depression	-69.0	0.08	89.2	0.0001	97.2	<.0001
Anxiety	348.3	<.0001	90.6	0.02	183.5	<.0001
Influenza	-186.1	<.0001	-9.6	0.68	-21.6	0.43
Asthma	-83.1	0.0001	10.3	0.738	8.8	0.81
Headache	60.9	0.005	-16.5	0.45	-8.7	0.75
Otitis Media	36.4	0.20	92.8	<.0001	82.8	0.001