Asthma and Food Allergy Management in Chicago Public Schools

AUTHORS: Ruchi S. Gupta, MD, MPH,[a] Victoria Rivkina, MPH,[a,b] Lilliana DeSantiago-Cardenas, MSW,[b] Bridget Smith, PhD,[a,c] Blair Harvey-Gintoft, MSW,[b] and Stephanie A. Whyte, MD, MBA[b]

[a]Center for Community Health, Northwestern University, Chicago, Illinois; [b]Office of Student Health and Wellness, Chicago Public Schools, Chicago, Illinois; and [c]Spinal Cord Injury (SCI) QUERI and Center for Management of Complex Chronic Care, Edward J. Hines Jr. Veterans Affairs Hospital, Chicago, Illinois

KEY WORDS
asthma, food allergy, chronic disease management, schools

ABBREVIATIONS
CI—confidence interval
CPS—Chicago Public Schools
IMPACT—Instructional Management Program and Academic Communications Tool
OR—odds ratio
SIM—Student Information Management

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Address correspondence to Ruchi S. Gupta, MD, MPH, Center for Community Health, Feinberg School of Medicine, Northwestern University, 750 N. Lake Shore Drive, Suite 670, Chicago, IL 60611. E-mail: r-gupta@northwestern.edu

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WHAT'S KNOWN ON THIS SUBJECT: Asthma and food allergy are common chronic conditions impacting 14% and 8% of US school-aged children, respectively. School districts must be prepared to track students who have these conditions to ensure proper daily management and emergency response.

WHAT THIS STUDY ADDS: This study examines the demographic distribution of asthma and food allergy and the existence of school health management plans in a large, urban school district. The findings show that school health management plans are underused for both conditions.

abstract

FREE

OBJECTIVES: This study aimed to characterize asthma and food allergy reporting and management in Chicago Public Schools.

METHODS: Demographic and health data for students who have asthma and food allergy were extracted from the Chicago Public Schools database. Demographic and geographic variability and the existence of school health management plans were analyzed, and multiple logistic regression models were computed. Home addresses were geocoded to create maps of case counts per community area.

RESULTS: Approximately 18 000 asthmatic and 4000 food allergic students were identified. Of asthmatic students, 9.3% had a food allergy; of food allergic students, 40.1% had asthma. Asthma odds were significantly higher among black and Hispanic students (odds ratio [OR] = 2.3 and 1.3, respectively), whereas food allergy odds were significantly higher among black students (OR = 1.1; 95% confidence interval [CI], 1.0–1.3) and significantly lower among Hispanic students (OR = 0.8; 95% CI, 0.7–0.9). Only 24.3% of students who had asthma and 50.9% of students who had food allergy had a school health management plan on file. Odds of having a school health management plan were significantly higher among students with both conditions, but the likelihood of having a plan on file was significantly lower among racial/ethnic minority and low-income students, regardless of medical condition.

CONCLUSIONS: Only 1 in 4 students who have asthma and half of food allergic students have health management plans in schools, with lower numbers among minority and low-income students. Improving chronic disease reporting and access to school health management plans is critical. *Pediatrics* 2014;134:729–736

Chronic disease among school-aged children is a critical public health concern in the United States. Approximately 15% to 20% of US children between the ages of 0 and 17 years currently have a chronic disease,[1] with asthma and food allergy among the most common conditions. An estimated 14% of US children have at some point in their lives been diagnosed with asthma,[2] while food allergy is reported to affect 8% of children in the United States.[3] Although similar rates exist in Chicago, significant variability in rates of disease has been shown by race and between communities.[3–5]

Families and children are not only challenged with appropriately managing asthma and/or food allergy, they also face many disease-related academic and social obstacles.[1] Because of the amount of time children spend in school or participating in school-related activities, school districts play a critical role in managing both the medical and social aspects of asthma and/or food allergy.[1] To adequately care for the increasing population of school-aged children who have asthma and food allergy, school districts must be prepared to accurately identify, track, and respond to affected students in a timely manner, which can be a daunting task.

Chicago is home to the third largest public school district in the United States, serving ~400 000 racially and socioeconomically diverse K–12 students in >650 public and charter schools.[6] The Chicago Public School (CPS) district requires parents to follow a specific process for reporting chronic conditions such as asthma and food allergy. Only after a child's condition is verified by a physician can it be entered into the district's database. Once entered, the caretaker is invited to develop a school health management plan, or 504 Plan, tailored to the child's needs. Because both asthma and food allergy may cause potentially life-threatening reactions without warning, the development of appropriate school health management plans is recognized as a critical task for all school districts.[7–10]

Although previous literature describes the impact of asthma and food allergies in schools,[1,2] little research discusses the existence of school health management plans for students who have confirmed asthma and/or food allergy in a large, diverse school district. The goal of this study was, therefore, to characterize asthma and food allergy reporting and management in Chicago Public Schools.

METHODS

This study was conducted during the 2012/2013 academic year as part of the *Improving Chronic Disease Verification and Medication Access in the Chicago Public Schools* research initiative, a collaborative effort between the Northwestern University Center for Healthcare Studies and the CPS Office of Student Health and Wellness. This initiative was designed to examine the effectiveness of the school district's chronic disease management policies and processes to improve reporting and verification. The study was approved by the Northwestern University Institutional Review Board as well as the CPS Research and Review Board.

CPS Database

District-wide student demographic data and health information were collected from the CPS Instructional Management Program and Academic Communications Tool (IMPACT) Student Information Management (SIM) system in April 2013. The SIM system collects information on school enrollment, attendance, demographics, behavior, and health for every student in the CPS district. According to CPS chronic disease management policies, all students who have chronic conditions are asked to provide medical confirmation of their condition to the school. Only then are these physician-verified chronic disease cases entered into the IMPACT SIM reporting system by a school nurse. Each chronic disease is identified in the SIM system by a unique health condition code. Students whose chronic conditions are verified by a physician and recorded in the CPS database are then offered a school health management plan, the 504 Plan. However, students whose chronic conditions are reported to the school by parents but not supported by the appropriate physician verification paperwork can neither be entered into the database nor offered a school health management plan.

Statistical Analysis

To characterize physician-verified asthma and food allergy in CPS, the number of children who had each condition as reported in the SIM database for the 2012/2013 academic year was calculated. Frequencies for age, gender, race/ethnicity, free/reduced lunch eligibility, immunization status, 504 Plan existence, school's geographic region, and school type were calculated for all CPS students as well as for students who had asthma and food allergy. To explore the association between demographic characteristics and report of asthma or food allergy, a multiple logistic regression model for each outcome that included dichotomous indicator variables to measure students' age, gender, race/ethnicity, free/reduced lunch eligibility, and geographic region was estimated. To describe the association between demographic characteristics and existence of 504 Plans, a separate multiple logistic regression model was estimated. All statistical analysis was done using Stata statistical software (Stata Corp, College Station, TX).

GIS Mapping

To evaluate community-level reporting of asthma and food allergy, home addresses of school recorded cases were geocoded using ArcGIS US StreetMap (Environmental Systems Research Institute,

Inc, Redlands, CA) and were linked with respective neighborhoods. Neighborhoods were defined by community area; Chicago is comprised of 77 community areas, which are aggregates of census tracts within the city and were designed to be homogenous on key census indicators, including population characteristics, economic status, and living conditions. Maps were created with case counts of school reported asthma and food allergy per Chicago community area represented by a qualitative graduated color ramp.

RESULTS

Demographic and Geographic Characteristics

Data were analyzed for 402 788 CPS students. Demographic and geographic data are presented in Table 1.

CPS Students Who Had Asthma

Of all CPS students, 18 287 had physician-diagnosed asthma. More than half of students who had asthma were male (58.3%), black (52.3%), and qualified for free or reduced lunch (80.3% and 6.3%, respectively). Most CPS students who had asthma attended a school on the city's North-Northwest Side (30.2%) or West Side (25.0%), as presented in Fig 1. Of all CPS students who had reported asthma, 9.3% also had documented food allergy.

CPS Students Who Had Food Allergy

Of all CPS students, 4250 had a physician-diagnosed food allergy. Food allergic students most often identified as black (36.8%) or Hispanic (33.5%), and fewer students who had food allergy qualified for free lunch than in the general student population (57.1% vs 78.1%). Most CPS students who had food allergy attended a school on the city's North-Northwest Side (47.3%) or West Side (17.7%), as presented in Fig 2. Of all CPS students who had reported food allergy, 40.1% also had documented asthma.

Existence of 504 Plans

Only a quarter (24.3%) of asthmatic students and half (50.9%) of food allergic students had a 504 Plan on file. Among CPS students diagnosed with both asthma and food allergy, 56.7% had a 504 Plan on file at school.

Associations

Odds of having a recorded diagnosis of asthma or food allergy on file were evaluated by age, gender, race/ethnicity, free/reduced lunch eligibility, and geographic region. Data are presented in Table 2.

Asthma

Odds of asthma were significantly higher among black (odds ratio [OR] = 2.3; 95% CI, 2.2–2.4; $P < .001$) and Hispanic students (OR = 1.3; 95% CI, 1.2–1.4; $P < .001$) versus white students. Odds were significantly lower among all other geographic regions when compared with the city's North-Northwest Side ($P < .001$). No statistically significant variation was observed by free/reduced lunch status.

Food Allergy

Odds of food allergy were slightly higher among black (OR = 1.1; 95% CI, 1.0–1.3; $P < .05$) and Asian students (OR = 1.4; 95% CI, 1.2–1.6; $P < .001$) versus white students. Food allergy odds were significantly lower among students who received free (OR = 0.3; 95% CI, 0.3–0.4; $P < .001$) or reduced (OR = 0.5; 95% CI, 0.4–0.5; $P < .001$) lunch when compared with those who did not apply. Odds were also significantly lower among all other geographic regions when compared with the city's North-Northwest Side ($P < .001$).

504 Plan

In addition, the odds of having a 504 Plan on file with the school were evaluated by age, gender, race/ethnicity, free/reduced lunch eligibility, immunization status, and geographic region, stratified by asthma and food allergy diagnosis. Data are presented in Table 3. Among students who had asthma, odds of having a 504 Plan decreased as age increased, 504 Plan odds were lower for boys versus girls, for black and Hispanic students versus white students, for students who qualified for free or reduced lunch versus those who did not apply, and among students from all other areas of Chicago when compared with the North-Northwest Side. Odds of having a 504 Plan on file were greater for asthmatic students who were immunization compliant. Similar odds of having a 504 Plan were found among students who had food allergy. Interestingly, students who had asthma who also had a food allergy were significantly more likely to have a 504 Plan on file versus students who had asthma alone (OR = 4.1; 95% CI, 3.7–4.6; $P < .001$); an increase in management plan odds was also found for food allergic students who had asthma (OR = 1.9; 95% CI, 1.7–2.2; $P < .001$).

DISCUSSION

To our knowledge, this study is the first to examine asthma and food allergy reporting and management in a large, urban school district. During the 2012/2013 academic year, physician-verified asthma was documented for 18 287 CPS students, whereas food allergy was documented for 4250 students. Although 40.1% of food allergic students had documented asthma, only 9.3% of asthmatic students also had a documented food allergy on file. Furthermore, it was determined that only 24% of asthmatic and 51% of food allergic students had a school health management plan on file. Although students who had both conditions were more likely to have 504 Plans than students who had either condition alone, minority and low-income students remained less likely to have a plan on file as compared to white students from households with higher income.

Our finding of comorbid atopic disease among children who had documented

TABLE 1 Characteristics of CPS Student Population, Total and by Asthma and Food Allergy Diagnosis

Variable	All CPS Students $N = 402\,788$	CPS Students with Asthma $N = 18\,287$ (4.5%)	CPS Students with Food Allergy $N = 4250$ (1.1%)
Age			
3–5 y	15.3 (61 617)	8.2 (1490)	15.3 (648)
6–10 y	36.2 (145 923)	36.2 (6615)	46.4 (1971)
11–13 y	20.9 (84 346)	26.0 (3749)	19.6 (834)
≥14 y	27.5 (110 902)	29.7 (5433)	18.8 (797)
Gender			
Male	50.2 (202 337)	58.3 (10 662)	57.0 (2421)
Female	49.8 (200 451)	41.7 (7625)	43.0 (1829)
Race/ethnicity			
White	9.0 (36 423)	6.2 (1136)	18.7 (796)
Black	40.4 (162 834)	52.3 (9563)	36.8 (1567)
Hispanic	45.0 (181 057)	37.8 (6908)	33.5 (1424)
Asian	3.5 (13986)	1.9 (340)	6.9 (291)
Multiracial	1.1 (4320)	1.2 (223)	2.8 (120)
All other	1.0 (4116)	0.6 (117)	1.2 (52)
Free/reduced lunch program			
Free	78.1 (314 509)	80.3 (14 685)	57.1 (2428)
Reduced	6.8 (27 426)	6.3 (1152)	7.1 (303)
45-day temporary free	0.5 (1894)	0.5 (96)	0.6 (24)
Denied	6.2 (25 278)	6.5 (1186)	13.0 (553)
Did not apply	8.4 (33 681)	6.3 (1152)	22.2 (942)
Immunization status			
Compliant	93.2 (375 396)	95.9 (17 548)	97.2 (4140)
Not compliant	5.3 (21 595)	4.0 (740)	4.0 (740)
Section 504 Plan			
Yes	2.7 (10 725)	24.3 (4448)	51.0 (2169)
No	97.3 (392 063)	75.7 (13 839)	49.0 (2081)
Geographic region			
Far South Side	8.6 (34 411)	9.1 (1668)	8.2 (353)
North-Northwest	31.3 (125 860)	30.2 (5519)	47.3 (2009)
South Side	13.4 (54 127)	15.3 (2790)	12.1 (513)
Southwest Side	23.0 (92 517)	19.7 (3598)	13.9 (592)
West Side	21.9 (88 105)	25.0 (4576)	17.7 (751)
School category			
Elementary	71.1 (286 175)	68.9 (12 595)	78.9 (3352)
High school	27.7 (111 368)	29.6 (5418)	19.8 (841)
K–12	0.1 (579)	0.2 (30)	0.2 (10)
Middle	1.3 (4652)	1.3 (243)	1.1 (46)

Data are presented as Frequency, % (n).

asthma or food allergy is consistent with the literature. It is well known that if 1 atopic condition exists, the likelihood of the other condition increases.[11–16] What is less clear, however, is why students who had documented food allergy in this study had much higher rates of asthma than students with asthma had food allergy. Of note, it has been demonstrated that children who have food allergy tend to develop asthma at a younger age[17] and also have more severe asthma symptoms.[18] To this end, our finding may represent true variability in comorbid atopic disease, or may represent disparities intrinsic to the chronic disease reporting and verification process within the school district.

Our data indicate that school health management plans were severely underutilized among CPS students; only 24% of students who had asthma and 51% of students who had food allergy had a plan on file. Unfortunately, the underutilization of school health management plans is not uncommon. Previous studies determined that only 25% to 28% of students who have asthma have a written plan on file with their school.[19,20] In addition, although food allergy management plans are widely recommended as a best practice for schools,[8,21–23] their use in US school districts has been inconsistent. For example, a Mississippi study found that statewide variation in the use of school health management plans ranged from 0% to 37% among food allergic students.[24] A study examining food allergy management plans in a South Carolina school district determined 44% of schools had plans on file for all their food allergic students, whereas 42% of schools had plans on file for less than half of such students.[25] The use of recommended school health management plans in CPS is similar to what has previously been reported in the literature. It is clear that opportunities for improvement remain in the use of school health management plans among school districts nationwide.

During the 2012/2013 academic year, 91% of CPS students identified as a racial/ethnic minority and almost 85% were low-income. Although CPS school health management plans were underutilized on the whole, racial/ethnic minority and low-income students were particularly less likely to have a plan on file with the school. Although black and Hispanic students were disproportionately affected by asthma and food allergy, they were significantly less likely to have a school health management plan on file when compared with white CPS students. Furthermore, low-income students, or those who participated in the free/reduced lunch program, were also significantly less likely to have such a plan on file as compared with the district's more affluent students who did not apply for the program. Unfortunately, racial and economic disparities in asthma and food allergy diagnosis and management are not unusual. In Chicago, racial and socioeconomic disparities in pediatric asthma are well documented, with Hispanic and black children from disadvantaged households disproportionately

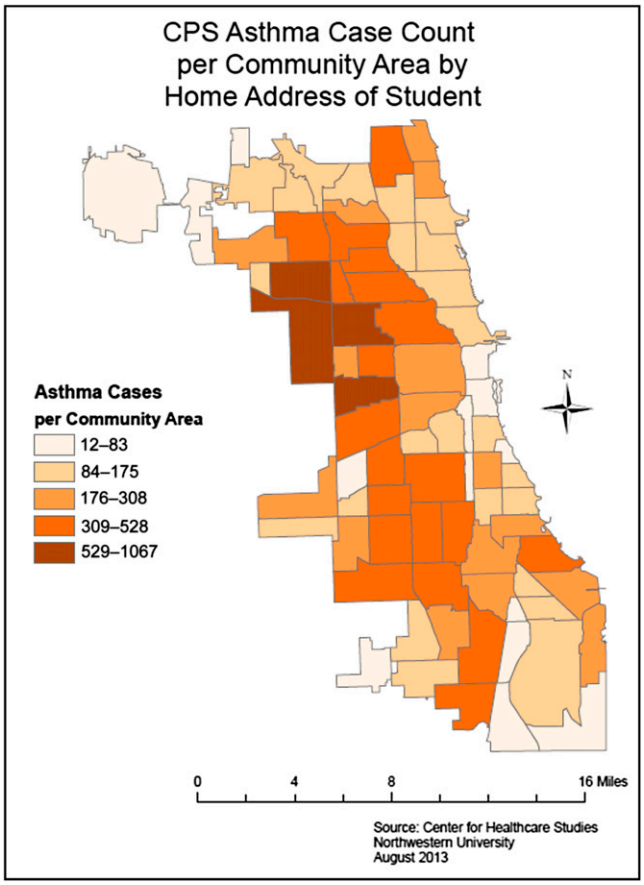

FIGURE 1
Asthma case count by student's home address.

affected.[5,26–32] Additionally, it is unclear whether socioeconomic and racial variability in food allergy is intrinsic to the disease verification process; however, many have speculated that it is attributable, in least at part, to barriers to care among racial/ethnic minorities and disadvantaged households.[33–37]

Additionally, this study determined that students attending school on the city's North-Northwest Side were significantly more likely to have a school health management plan on file than students from any other region of Chicago. These findings speak to the general racial/ethnic and socioeconomic segregation of the city, as well as limitations in access to care, which likely impact documentation of chronic disease and access to school health management plans in CPS. Although Chicago's North-Northwest Side has a predominately white population and a large proportion of residents whose annual household income is >$50 000, the rest of the city has a predominance of black and Hispanic students from households with an annual income far below $50 000.[38–41] Furthermore, health care providers are more densely clustered within the downtown and North-Northwest areas of the city.[42] Chicago residents who live on the West, South, and Far South sides of the city have fewer health care options and must travel longer distances, often through unsafe areas, to access a provider.[42] CPS students from lower income households and/or who live in the latter neighborhoods may have difficulty visiting a health care provider, particularly for specialty care, to obtain the necessary physician verification of asthma or food allergy required by the school. Without this physician verification, a school health management plan cannot be offered. Ironically, these students, who often rely heavily on school-based services for care, may be most vulnerable for adverse events secondary to undocumented chronic disease.

Immunization compliance in CPS was 93% for the study period and improved further among asthmatic (96%) and food allergic students (97%). One reason for high overall compliance likely has to do with the district's policy on the issue. According to the CPS Minimum Health Requirements, all kindergarten, sixth, and ninth grade students must submit proof of immunization by a predetermined date ~2 months into the school year.[43] Students who fail to comply are dismissed from school until proof of immunization is provided.[43] Interestingly, our study found that immunized students were almost twice as likely as students who were not immunized to have a school health management plan on file. Although this is not surprising in terms of access to medical care, it would be expected that all immunized students who have asthma and food allergy would also have a school health management plan. One possibility is that asthma and food allergy physician verification and plan development be made mandatory, similar to immunization. Although this may increase compliance, it is more challenging to implement as compared with the immunization policy. Immunizations are only required 3 times during students' tenure with the district, whereas asthma and food allergy school health management plans are intended to be updated each year. Additionally, parents who report their child's condition without obtaining physician verification should have this documented in the system and assisted in accessing care for verification.

An important strength of this study is the community-academic partnership that was instrumental in collecting, analyzing, and synthesizing the data

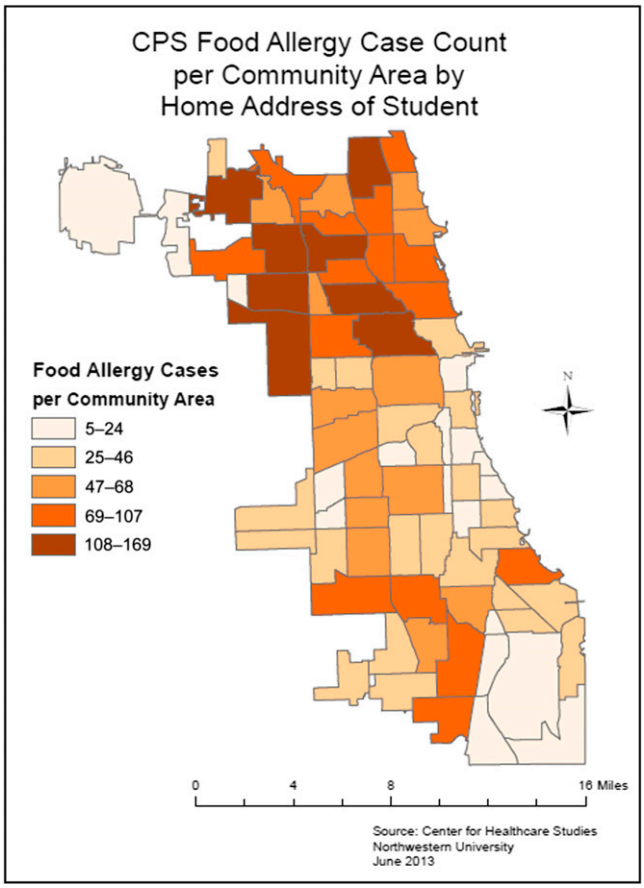

FIGURE 2
Food allergy case count by student's home address.

TABLE 2 Adjusted Odds Ratios of Asthma and Food Allergy in CPS

Variable	Asthma	Food Allergy
Age (vs 3–5 y)		
6–10	10.4 (5.7–19.2)**	1.3 (1.2–1.4)**
11–13	12.9 (7.0–23.8)**	1.0 (0.9–1.1)
≥14	11.0 (6.0–20.2)**	0.7 (0.6–0.8)**
Gender		
Male versus female	1.4 (1.4–1.5)**	1.3 (1.2–1.4)**
Race/ethnicity (vs white)		
Black	2.3 (2.2–2.4)**	1.1 (1.0–1.3)*
Hispanic	1.3 (1.2–1.4)**	0.8 (0.7–0.9)**
Asian	0.8 (0.7–0.9)**	1.4 (1.2–1.6)**
Multiracial	1.7 (1.5–2.0)**	1.5 (1.3–1.9)**
All other	1.1 (0.9–1.3)	1.0 (0.7–1.3)
Free/reduced lunch program (vs did not apply)		
Free	1.1 (0.9–1.1)	0.3 (0.3–0.4)**
Reduced	1.0 (0.9–1.0)	0.5 (0.4–0.5)**
45-day temporary free	1.0 (0.8–1.3)	0.5 (0.4–0.8)**
Denied	1.1 (1.0–1.2)*	0.8 (0.8–0.9)**
Geographic region (vs North-Northwest Side)		
Far South Side	0.7 (0.7–0.8)**	0.7 (0.6–0.7)**
South Side	0.7 (0.7–0.8)**	0.6 (0.6–0.7)**
Southwest Side	0.7 (0.7–0.8)**	0.5 (0.5–0.6)**
West Side	0.9 (0.9–0.9)**	0.6 (0.6–0.7)**

Data are presented as OR (95% CI). * $P < .05$. ** $P < .001$.

from a sample size of over 400 000 CPS students. However, this study is not without limitations. Causal inferences are limited by the cross-sectional design, which restricts analysis to descriptive statistics and associations. As discussed above, because this study only considers physician-verified chronic conditions on record with the school, it is likely that many CPS students who have parent-reported asthma and/or food allergy were not included in our analysis. It is the intention of the *Improving Chronic Disease Verification and Medication Access in the Chicago Public Schools* initiative to ultimately use these findings to improve the reporting and verification processes to ensure that all CPS students who have asthma and food allergy are identified and provided with an appropriate school health management plan.

Results of a separate part of the *Improving Chronic Disease Verification and Medication Access in the Chicago Public Schools* study indicate that parental education has the potential to improve school-based chronic disease management.[44] An intervention focusing on increasing parental knowledge of the district's chronic disease reporting and verification process has been developed. This evidence-based, multi-tiered intervention is comprised of 3 parts: (1) in-person parent education at Local School Council meetings; (2) the distribution of educational print material; and (3) an online toolkit for parents housed on the CPS Office of Student Health and Wellness Web site. Through this intervention, it is expected that asthma and food allergy reporting, verification, and school health management plan development will lead to improved chronic disease management for the CPS students impacted by these conditions.

CONCLUSIONS

This is the first known study to examine asthma and food allergy reporting and

TABLE 3 Adjusted Odds Ratios of School Health Management Plans in CPS, by Asthma and Food Allergy Diagnosis

Variable	Asthma	Food Allergy
Age (vs 3–5 y)		
6–10	1.2 (1.0–1.3)*	1.1 (0.9–1.3)
11–13	0.8 (0.7–0.8)**	0.7 (0.5–0.9)*
≥14	0.5 (0.4–0.6)**	0.5 (0.4–0.6)**
Gender		
Male versus female	0.8 (0.7–0.8)**	0.7 (0.7–0.9)*
Race/ethnicity (vs white)		
Black	0.5 (0.4–0.6)**	0.6 (0.5–0.7)**
Hispanic	0.8 (0.7–0.9)*	0.9 (0.7–1.2)
Asian	1.0 (0.8–1.3)	0.9 (0.6–1.2)
Multiracial	1.0 (0.8–1.4)	1.0 (0.7–1.6)
All other	0.9 (0.6–1.4)	0.8 (0.4–1.5)
Free/reduced lunch program (vs did not apply)		
Free	0.6 (0.5–0.7)**	0.5 (0.4–0.6)**
Reduced	0.8 (0.6–0.9)*	0.7 (0.5–0.9)*
45-day temporary free	0.7 (0.4–1.2)	0.4 (0.2–0.9)*
Denied	1.0 (0.8–1.2)	0.9 (0.7–1.1)
Immunization status		
Compliant versus not compliant	1.4 (1.1–1.8)*	1.7 (1.1–2.7)*
Geographic region (vs North-Northwest Side)		
Far South Side	0.6 (0.5–0.7)**	0.4 (0.3–0.6)**
South Side	0.6 (0.5–0.6)**	0.5 (0.4–0.7)**
Southwest Side	0.6 (0.5–0.6)**	0.5 (0.4–0.6)**
West Side	0.5 (0.5–0.6)**	0.6 (0.5–0.7)**
Chronic condition		
Asthma	—	1.9 (1.7–2.2)**
Food allergy	4.1 (3.7–4.6)**	—

Data are presented as OR (95% CI). * $P < .05$. ** $P < .001$.

management in a large, urban school district. More than 18 000 CPS students had documented asthma, whereas over 4000 students had documented food allergy. This study found that although 40.1% of food allergic students had documented asthma, only 9.3% of asthmatic students also had a documented food allergy on file. Furthermore, it was determined that only 24% of asthmatic and 51% of food allergic students had a school health management plan on file. Although students who had both asthma and food allergy were more likely to have a plan on file than students who had either condition alone, a disparity remained in access to school health management plans among minority and low-income students. It is imperative to work toward an accurate chronic disease reporting and management system, whereby students who have recorded asthma and food allergy have access to proper and timely in-school management of their condition.

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