Socioeconomic Status and the Likelihood of Antibiotic Treatment for Signs and Symptoms of Pulmonary Exacerbation in Children with Cystic Fibrosis

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Objective To determine whether socioeconomic status (SES) influences the likelihood of antibiotic treatment of pulmonary exacerbations in patients with cystic fibrosis (CF).

Study design We used data on 9895 patients ≤18 years old from the Epidemiologic Study of CF. After establishing an individual baseline of clinical signs and symptoms, we ascertained whether antibiotics were prescribed when new signs/symptoms suggested a pulmonary exacerbation, adjusting for sex, presence of *Pseudomonas aeruginosa*, the number of new signs/symptoms, and baseline disease severity.

Results In a 12-month period, 20.0% of patients <6 years of age, 33.8% of patients 6 to 12 years of age, and 41.4% of patients 13 to 18 years of age were treated with any (oral, intravenous (IV), or inhaled) antibiotics; the percentage receiving IV antibiotics was 7.3%, 15.2%, and 20.9%, respectively. SES had little effect on treatment for pulmonary exacerbation with any antibiotics, but IV antibiotics were prescribed more frequently for patients with lower SES.

Conclusions SES-related disparities in CF health outcomes do not appear to be explained by differential treatment of pulmonary exacerbations. *(J Pediatr 2011;159:819-24)*.

Socioeconomic status (SES) is a strong predictor of outcomes in patients with cystic fibrosis (CF).[1,2] Although barriers in access to quality care is an important cause of SES-related disparities in many patient populations,[3] earlier analyses have failed to show any apparent SES-related difference in clinic visits or the prescription of chronic therapies at CF care centers.[1,4] Pulmonary exacerbations are an important contributor to the deterioration in lung function seen in patients with CF.[5] Substantial inconsistencies in the prescription of antibiotics in response to signs and symptoms of a pulmonary exacerbation have been documented,[6] and, as might be expected, treatment has a clear effect on short-term clinical status, although the effect on long-term outcomes is more difficult to demonstrate.[7] However, an analysis of site-specific variations in practice patterns found that CF care sites with patients who have the best lung function prescribe intravenous (IV) antibiotics more frequently than sites with patients who have lower average forced expiratory volume in 1 second (FEV_1).[8] This analysis sought to determine whether variability in antibiotic treatment of the clinical characteristics of acute pulmonary exacerbations might be related to SES and thus provide an explanation for SES-related disparities in outcomes. We were also interested in determining whether practice patterns might be associated in different ways with several alternative markers of SES.[9-14]

Methods

This study was a longitudinal analysis that included patients ≤18 years of age who were enrolled in the Epidemiologic Study of Cystic Fibrosis (ESCF) between 2000 and 2005. The design and implementation of the ESCF have been described.[15] The ESCF was a multicenter longitudinal cohort study initiated in 1994 to collect data on care practices and outcomes of patients with CF in the United States and Canada. Several additional variables (including those relevant

CF	Cystic fibrosis
ESCF	Epidemiologic Study of Cystic Fibrosis
FEV_1	Forced expiratory volume in 1 second
IV	Intravenous
MA	Medicaid or state insurance
MEA	Maternal educational attainment
MIZ	Median household income by zip code
SES	Socioeconomic status

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Table I. Demographic, socioeconomic status, and baseline clinical measures by age group

	Age group			Group statistical difference ($P < .05$)
	<6 years	6-12 years	13-18 years	
n, total	4806	2600	2489	
Demographic characteristics				
Age, mean ± SD	2.43 ± 1.86	9.48 ± 2.04	15.70 ± 1.70	all
Sex, n (%)				NS
Male	2435 (50.7%)	1334 (51.3%)	1309 (52.6%)	
Female	2371 (49.3%)	1266 (48.7%)	1180 (47.4%)	
Ethnicity/race, n (%)				all
Non-Hispanic white	4021 (83.7%)	2315 (89.0%)	2294 (92.2%)	
Non-Hispanic black	161 (3.3%)	88 (3.4%)	73 (2.9%)	
Hispanic	403 (8.4%)	131 (5.0%)	100 (4.0%)	
Other	198 (4.1%)	64 (2.5%)	21 (0.8%)	
Unknown	23 (0.5%)	2 (0.1%)	1 (<0.1%)	
SES measures				
MEA, n (%)				Age <6 years vs others
Less than high school graduate	185 (3.8%)	71 (2.7%)	59 (2.4%)	
High school graduate or higher	1606 (33.4%)	949 (36.5%)	701 (28.2%)	
Unknown*	3015 (62.7%)	1580 (60.8%)	1729 (69.5%)	
MIZ, n (%)				NS
<$40K	985 (20.5%)	486 (18.7%)	497 (20.0%)	
$40K to <$50K	1250 (26.0%)	749 (28.8%)	628 (25.2%)	
$50k to <$60K	842 (17.5%)	446 (17.2%)	464 (18.6%)	
≥$60K	1323 (27.5%)	750 (28.8%)	714 (28.7%)	
Unknown*	406 (8.4%)	169 (6.5%)	186 (7.5%)	
MA, n (%)				
Medicaid	2259 (47.0%)	1048 (40.3%)	942 (37.8%)	Age <6 years vs others
Other	2393 (49.8%)	1450 (55.8%)	1437 (57.7%)	
Unknown*	154 (3.2%)	102 (3.9%)	110 (4.4%)	
Baseline clinical measures				
FEV_1 % predicted, mean ± SD	NA	94.4 ± 19.5	82.9 ± 21.8	All
Weight-for-age percentile, mean ± SD	44.0 ± 29.5	38.7 ± 28.2	38.3 ± 28.2	Age <6 years vs others
Cough, n (%)				All
None	3289 (68.5%)	971 (37.4%)	599 (24.1%)	
Occasionally	1277 (26.6%)	1197 (46.1%)	1099 (44.2%)	
Daily	236 (4.9%)	431 (16.6%)	788 (31.7%)	
Sputum, n (%)				All
None	4514 (94.1)	1836 (70.7%)	1264 (50.8%)	
Occasionally	244 (5.1%)	590 (22.7%)	784 (31.5%)	
Daily	40 (0.8%)	171 (6.6%)	438 (17.6%)	
Wheezing, n (%)	12 (0.2%)	5 (0.2%)	22 (0.9%)	Age 13-18 years vs others
Crackles, n (%)	26 (0.5%)	63 (2.4%)	153 (6.1%)	All
Hemoptysis, n (%)	0 (0.0%)	1 (<0.1%)	11 (0.4%)	Age 13-18 years vs others
P aeruginosa positive, n (%)	1428 (33.5%)	1336 (51.4%)	1560 (70.1%)	All

NA, not applicable.
*Unknown is not included in *P* value comparisons.

to SES and the treatment of pulmonary exacerbations with non-quinolone oral antibiotics) were added in 2003. Data on patient demographics, pulmonary function, morphometric characteristics, and therapies were collected at each clinic encounter. Pulmonary function test results were reported as measured values and converted to percent predicted with reference equations from Wang et al[16] for female patients through age 15 years and male patients through age 17 years and Hankinson et al[17] for patients at older ages. Therapies monitored in ESCF include IV, inhaled, and oral antibiotics and a variety of chronic medications.[4] Therapies are recorded as those prescribed by the provider; there is no mechanism for documenting patient adherence to prescribed therapies. The study was approved by the Copernicus Group institutional review board (tracking number OVA1-03-008) or local institutional review boards, and participants or their guardians provided informed consent.

Diagnosis and Treatment of Pulmonary Exacerbations

The treatment of pulmonary exacerbation is a cornerstone of therapy for CF, but the definition of these exacerbations is controversial,[18] which contributes to the lack of standardization of treatment. Rabin et al[6] used ESCF data to characterize signs and symptoms most likely to lead to treatment of a pulmonary exacerbation, and we adopted that approach for this analysis. In the ESCF case report forms, clinicians recorded cough and sputum (none, occasional, or daily), crackles and hemoptysis (present or absent), weight, and FEV_1 (in patients old enough to perform acceptable measurements).[15] Using the approach of Rabin et al, we characterized patients in a 12-month baseline period on the basis of their best reported findings of signs and symptoms and then evaluated the data from each patient during the next 6 months (the study period) for reports of changes from this baseline. The