The Impact of Health Literacy and Socioeconomic Status on Asthma Disparities

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Abstract

Objective—Racial/ethnic disparities have been well documented in asthma. While socioeconomic status (SES) has been repeatedly implicated as a root cause, the role of limited health literacy has not been extensively studied. The purpose of this study was to examine the independent contributions of SES and health literacy in explaining asthma disparities.

Methods—A cohort study was conducted in a Chicago-based sample of 353 adults aged 18–40 years with persistent asthma from 2004 to 2007. Health literacy, SES, and asthma outcomes including disease control, quality of life, emergency department visits, and hospitalizations were assessed in person at baseline, and asthma outcomes were measured every 3 months for 2 years by phone. Multivariate models were used to assess racial/ethnic disparities in asthma outcomes and the effect of health literacy and SES on these estimates.

Results—Compared with White participants, African American adults fared significantly worse in all asthma outcomes ($p < .05$) and Latino participants had lower quality of life ($\beta = -0.47$; 95% confidence interval [CI]= −0.79, −0.14; $p = .01$) and worse asthma control (risk ratio [RR] = 0.63; 95% CI = 0.41, 0.98; $p = .04$). Differences in SES partially explained these disparities. Health literacy explained an additional 20.2% of differences in quality of life between Latinos and Whites, but differences in hospitalization rates between African American and White adults remained (RR = 2.97; 95% CI = 1.09, 8.12, $p = .03$).

Conclusions—Health literacy appears to be an overlooked factor explaining racial and ethnic disparities in asthma. Evidence-based low literacy strategies for patient education and counseling should be included in comprehensive interventions.

Keywords

control; hospitalization; quality of life; race/ethnicity

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Introduction

Racial/ethnic disparities have been well documented in asthma. Specifically, African American and Latino adults have been found to have a higher prevalence of asthma, poorer knowledge of the disease and their treatment, greater emergency department use and risk of hospitalization, poorer quality of life, and ultimately worse disease control than their White counterparts (1–3).

Socioeconomic status (SES) has long been implicated as an explanatory factor for disparities in asthma outcomes (4–7). More recently, health literacy, defined as "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions" (8) has been viewed as a potentially modifiable factor driving healthcare inequities (9). A number of studies have shown that accounting for differences in health literacy significantly reduces disparities between African Americans and Whites in a variety of health-related outcomes (10–15). These results suggest that improving health literacy may be an effective way of reducing health disparities, while recognizing the continued need to address more challenging barriers indicative of socioeconomic differences.

While low health literacy has been linked to poorer asthma outcomes, no study to our knowledge has investigated in detail whether it mediates long-standing racial differences in a variety of asthma outcomes (16–19). Recognizing the role SES plays in racial and ethnic disparities, the purpose of this research was to examine the independent contribution of health literacy in explaining racial differences in asthma outcomes.

Methods

Study Sample

The sample was recruited as part of the Chicago Initiative to Raise Asthma Health Equity (CHIRAH) study, a longitudinal cohort study representing one of the National Heart, Lung, and Blood Institute Centers of Excellence in Reducing Asthma Disparities (20). Chicago public and archdiocese schools were selected by a combination of population proportionate and cluster sampling methods from four school sampling groups defined based on their racial makeup (schools ±50% African American) and SES (schools ±70% of students receiving subsidized school lunch). To screen and assess household eligibility in the 105 schools who agreed to participate, surveys were distributed to each child and sent home to be filled out by his/her parent or guardian, of which 78.9% (48,917/62,005) were returned. These surveys, designed for low literacy populations, assessed the child's asthma status and identified any other children or adults in the household with asthma. Potentially eligible households with asthmatic children or adults between the ages of 8–14 years or 18–40 years ($n = 3676$) were then contacted to verify ages and determine whether individuals satisfied further eligibility criteria including being fluent in spoken English and having a history of physician- or nurse-diagnosed asthma requiring at least 8 weeks of asthma medication in the last 12 months. This resulted in 519 adults who were verified eligible and agreed to participate in the study and 166 (32.0%) either could not be scheduled or were scheduled and did not show. More detailed methods have been reported elsewhere (21).

The 353 eligible adults who completed an in-person baseline interview were then followed up longitudinally by phone every 3 months for 2 years, with 71% completing all six follow-up interviews. Adults with complete variables of interest at baseline were included in this analysis ($n = 345$, 97.7%). The research protocol was approved by the institutional review boards of all participating research institutions, and the Chicago public and archdiocese schools and participants provided informed consent prior to participation.

Study Variables

Demographic and Socioeconomic—Participants self-reported race/ethnicity and were allowed to choose more than one category. They were then classified into Latino, African American/non-Latino, and White/Other categories. SES was assessed by self-reported household income (<$15,000, $15,000–$30,000, $30,000–$50,000, >$50,000), highest level of education completed (less than high school diploma, high school/general educational development (GED) graduate, some college, college graduate, and professional/graduate degree), insurance status (private, Medicaid, and self-pay), and work status (full time, part time, and not at all). Participants were also asked the number of years since his/her asthma diagnosis.

Literacy—Literacy was measured using the Rapid Estimate of Adult Literacy in Medicine (REALM), a reading recognition test comprising 66 health-related words. The total number of words pronounced correctly was categorized into low (0–44), marginal (45–60), and adequate (61–66) literacy groups. The low and marginal groups were combined to form the limited literacy group due to low number of participants with low literacy ($n = 29$, 8.3%). The REALM is the most commonly used test of literacy in medical settings (22) and is highly correlated with standardized reading tests and the Test of Functional Health Literacy in Adults (23, 24).

Asthma Outcomes—At each time point, the asthma quality of life (AQOL) in the past 2 weeks was measured using the Mini Asthma Quality of Life Questionnaire (MiniAQLQ), a scale developed to measure the functional impairments that are most problematic to adult patients with asthma (25). The 15 items, with responses ranging from 1 to 7, were read aloud to the participants. The measure spans four domains: symptoms, activity limitations, emotional function, and environmental stimuli. Overall mean scores were calculated at each time point, with higher scores representing better quality of life.

Participants were asked to report the number of asthma-related emergency department visits and hospitalizations in the past 3 months at each follow-up interview. Variables indicating whether any visits or hospitalizations occurred were then created for each time point. Since responses collected at the baseline interview were based on the prior year, they were not comparable to those based on the last 3 months and therefore were not included in this analysis.

Asthma control was determined at each time point based on National Asthma Education Prevention Program Expert Panel Report (NAEPP/EPR) 3 guidelines (26) using self-reported daytime symptoms, nighttime awakenings due to symptoms, activity limitations, use of short-acting β-agonists, and urgent care visits. Subjects were classified into one of three levels of asthma control (well controlled, not well controlled, and poorly controlled) and ultimately "not well" and "poorly" controlled participants were combined and referred to as "uncontrolled."

Statistical Analysis

χ^2-test and one-way analysis of variance (ANOVA) tests were used to compare age, gender, health literacy, and socioeconomic characteristics across the three racial groups. The explanatory nature of health literacy and SES on racial/ethnic differences in asthma-related outcomes was examined using regression-based mediational methods (27, 28).

Generalized linear regression models specifying a Gaussian distribution and identity link were used for continuous outcomes. For dichotomous outcomes, a Poisson distribution with a log link was specified in order to estimate risk ratio (RR) estimates rather than odds ratios

for ease of data interpretation and to avoid overestimating risk (29–31). For analyses involving repeated asthma outcomes, generalized estimating equation (GEE) methodology was used to include all available data over the seven possible time points while accounting for dependence among participants using an unstructured working correlation matrix (32, 33). Robust variance estimators were computed in all models to account for potential within-school clustering of study participants and possible overestimation of variance resulting from using the Poisson distribution for binomial outcomes (30, 31).

Mediational Analysis—Once relationships between race/ethnicity and the potential mediators of literacy and SES variables were established as outlined above, separate unadjusted GEE models of the asthma-related outcomes were conducted with health literacy and each socioeconomic variable as independent variables. Next, multivariate GEE models adjusting for age, gender, and duration of asthma were fit for each asthma outcome in order to identify any racial/ethnic disparities in asthma outcomes. Finally, health literacy and socioeconomic variables were first entered alone, then together, to examine independent contributions of each and then to isolate the added benefit of health literacy in reducing differences in asthma outcomes. Literacy and SES were considered mediators if they either eliminated or decreased the strength of the relationship between the race/ethnicity and the outcome (27, 28). All analyses were done using STATA version 10.1 (StataCorp, College Station, TX, USA).

Results

Participant characteristics stratified by race/ethnicity are reported in Table 1. On average, participants were 30.9 years old (SD = 6.1), mostly female (77.6%), and predominately African American (56.3%). One-third (32.4%) were determined to have limited literacy skills, nearly half had a high school education or less, and a household income less than $30,000 a year. Rates of limited literacy differed significantly across the three racial groups (31.3% for Latinos vs. 38.3% for African Americans vs. 13.2% for Whites; $p = .002$). Racial/ethnic groups also differed with respect to SES, with Whites having more education, higher income, and being more likely to have private insurance (all $p < .002$). Latinos and Whites were more likely to have full time jobs than African Americans ($p = .02$), and no differences were found by age, gender, duration of asthma, or β-agonist use.

Accounting for repeated measurements in unadjusted models, participants with limited health literacy had lower AQOL (β= −0.56; 95% confidence interval [CI]= −0.79, −0.33; $p < .001$), reported more emergency department visits (RR = 1.67; 95% CI = 1.27, 2.18; $p < .001$) and hospitalizations (RR = 2.10; 95% CI = 1.16, 3.82; $p=.01$), and were less controlled (RR = 0.49; 95% CI = 0.34, 0.71; $p < .001$) than those with adequate health literacy. Similarly, those with lower education, income, and less insurance coverage also had worse asthma outcomes (see Table 2).

Controlling for age, gender, and duration of asthma, African American adults performed significantly worse than White adults in all asthma outcomes (see Table 3, model 1). Similarly, Latino participants had lower quality of life (β = −0.47; 95% CI = −0.79, −0.14; $p = .01$) and worse asthma control (RR = 0.63; 95% CI = 0.41, 0.98; $p = .04$) than White participants. Entered separately, health literacy and SES partially accounted for these differences; however, significant differences in quality of life between Latino and White participants and hospitalizations for African Americans versus Whites persisted (Table 3, models 2 and 3).

Limited literacy was a significant independent predictor in all models, both with and without the inclusion of SES, in some cases accounting for any remaining disparities to a point of

non-significance. After controlling for SES, limited literacy significantly reduced differences by an additional 21.2% in AQOL between Latinos and Whites ($\beta = -0.33$; 95% CI = $-0.62, -0.05$; $p = .02$ to $\beta = -0.26$; 95% CI = $-0.53, -0.00$; $p = .05$). However, the increased risk of an asthma-related hospitalization for African Americans remained (RR = 2.97; 95% CI = 1.09, 8.12, $p = .03$).

Discussion

African American and Latino adults had poorer quality of life, greater risk of an emergency department visit or hospitalization, and worse disease control. Limited literacy skills were also related to poorer outcomes and partially explained some of these racial/ethnic disparities. Specifically, literacy skills alone attenuated asthma disparities between African American and White adults by approximately 13–17%, a finding which is approximately consistent with prior studies examining health literacy as a mediator of African American race and other health-related outcomes (10–15).

Similar to previous studies, we found increased asthma-related emergency department use and hospitalizations in African Americans (3, 4, 7). Health literacy alone was able to account for differences in emergency department use, but differences in hospitalization rates between African Americans and Whites remained in our models. Rather than this being an indication of differing disease severity, one explanation for why racial differences persisted could relate to cultural beliefs about the disease and its treatment and/or perceptions of trust in patterns of accessing and using the healthcare system (2, 34, 35). African American adults have expressed an increased fear of adverse effects and doubts in benefits of corticosteroids and mistake asthma to be an acute condition rather than a chronic disease, seeking treatment only when symptoms occur (36, 37). These beliefs may lead to more severe asthma due to suboptimal disease management, therefore increasing the risk of hospitalization due to asthma. Our findings highlight the importance of assessing patients' attitudes and beliefs about their illness in order to provide the education and tools needed to help them to better manage their disease.

In a study performed in a similar population using the same quality of life measure, non-Hispanic Whites reported a higher quality of life than Hispanics with adequate English proficiency, suggesting there is something beyond language causing differences in this outcome (38). Our research found similar inequities between Latinos and Whites, but the addition of health literacy as a covariate attenuated the disparity by 20% to a point of non-significance.

This study has limitations. While schools were systematically sampled, non-English-speaking households and households without children of school age were not assessed. In addition, adults with limited English proficiency were not included and there is some potential selection bias given the voluntary nature of the study. As such, this is not a representative sample of adults in Chicago with asthma and results comparing Latinos and Whites may be skewed. Perhaps more noteworthy is that the study population came from a large metropolitan area with known high rates of asthma morbidity and mortality and it is unclear whether these results would be similar in smaller communities with less of an asthma burden. It is also important to keep in mind that self-reported outcomes were used, although this method of outcome assessment is common within the asthma literature. Despite similarly reported β-agonist use across groups, differences by race/ethnicity could be attributed to differences in asthma severity.

Our analysis of the potential role of health literacy and SES as mediating variables that can in part explain racial/ethnic asthma disparities is also subject to certain limitations. First, our

assessment of mediation assumes that all variables that confound the relationship between race/ethnicity and a specified outcome and also those that confound the relationships between health literacy or SES and asthma outcomes have been accounted for in the models (39). It is very possible there are other contributing factors we have not adequately measured, including healthcare system factors, health status, social networks and support, attitudes and beliefs, and behavioral factors (e.g., smoking) (2, 40). Second, despite the longitudinal nature of the data, with the statistical methods employed, we are unable to confirm that SES or health literacy independently caused noted reductions in disparities. However, the associations found provide a basis for future intervention studies using health literacy as a means to reduce disparities in asthma.

Conclusions

Interventions are urgently needed to further reduce racial and ethnic disparities in asthma. While differences in both SES and health literacy were shown to reduce racial/ethnic differences in outcomes, health literacy could be a more easily modified target to address in the short term compared with long-standing economic barriers. Clearly, both should be addressed in comprehensive strategies designed to promote asthma self-management and access to health services. Low literacy approaches to health education and behavior change are becoming more widely available and offer guidance for the development of specific strategies for use in the context of asthma health promotion (41, 42).

Acknowledgments

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Table 1

Sample characteristics stratified by race/ethnicity.

Variable	All participants (*n* = 348)	African American (*n* = 196)	Latino (*n* = 99)	White/Other (*n* = 53)	*p*-Value
		Race/ethnicity			
Age, mean (SD)	30.9 (6.1)	30.4 (6.1)	31.2 (5.6)	32.2 (6.8)	.13
Female (%)	77.6	80.1	73.4	75.5	.43
Years with asthma, mean (SD)	17.9 (10.3)	18.2 (10.2)	18.4 (9.7)	16.2 (11.8)	.41
β-Agonist use (%)	79.4	81.4	80.6	69.8	.17
Limited literacy (%)	32.5	38.3	31.3	13.2	.002
Education (%)					.003
<High school	16.7	17.9	18.2	9.4	
High school graduate	32.8	34.7	27.3	35.9	
Some college	35.0	37.8	36.3	22.6	
College graduate	15.5	9.7	18.2	32.1	
Income (%)					<.001
<$15,000	28.2	36.2	18.2	17.0	
$15,000–$30,000	25.6	28.1	28.3	11.3	
$30,000–$50,000	18.1	17.9	20.2	15.1	
>$50,000	28.1	17.9	33.3	56.6	
Work (%)					.02
None	38.2	45.4	26.3	34.0	
Part time	19.8	16.3	24.2	24.5	
Full time	42.0	38.3	49.5	41.5	
Insurance status (%)					<.001
Self-pay	13.2	14.8	14.1	5.8	
Medicaid	41.8	51.3	33.3	21.1	
Private insurance	45.0	33.7	52.5	73.1	

Table 2

Unadjusted GEE models for asthma outcomes by health literacy and SES.

	Quality of life β (95% CI)	ED visits RR (95% CI)	Hospitalizations RR (95% CI)	Controlled RR (95% CI)
Health literacy				
Limited	−0.56 (−0.79, −0.33)***	1.67 (1.27, 2.18)***	2.10 (1.16, 3.82)*	0.49 (0.34, 0.71)***
Adequate	–	–	–	–
SES				
Education				
<High school	−0.99 (−1.32, −0.66)***	3.23 (1.74, 5.98)***	10.1 (3.31, 30.7)***	0.38 (0.23, 0.64)***
High school	−0.58 (−0.87, −0.29)***	3.04 (1.75, 5.27)***	4.58 (1.54, 13.6)**	0.52 (0.35, 0.77)**
Some college	−0.60 (−0.89, −0.32)***	3.04 (1.75, 5.28)***	4.62 (1.59, 13.4)**	0.47 (0.32, 0.68)***
College graduate	–	–	–	–
Income				
<$15,000	−0.99 (−1.27, −0.71)***	2.16 (1.48, 3.14)***	4.10 (1.73, 9.72)**	0.26 (0.17, 0.41)***
$15,000–$30,000	−0.53 (−0.78, −0.28)***	1.43 (0.98, 2.09)	2.14 (0.75, 6.08)	0.43 (0.29, 0.63)***
$30,000–$50,000	−0.55 (−0.84, −0.26)***	1.00 (0.65, 1.56)	3.84 (1.47, 10.0)**	0.58 (0.39, 0.85)**
>$50,000	–	–	–	–
Work				
None	−0.60 (−0.84, −0.37)***	1.26 (0.94, 1.70)	1.63 (0.87, 3.07)	0.45 (0.31, 0.65)***
Part time	−0.11 (−0.37, −0.16)	0.95 (0.65, 1.41)	0.58 (0.26, 1.30)	0.87 (0.60, 1.26)
Full time	–	–	–	–
Insurance status				
Self-pay	−0.48 (−0.80, −0.16)**	2.01 (1.34, 3.03)**	4.36 (1.92, 9.88)***	0.53 (0.33, 0.84)**
Medicaid	−0.77 (−0.98, −0.55)***	2.09 (1.56, 2.80)***	3.20 (1.69, 6.06)***	0.32 (0.23, 0.45)***
Private insurance	–	–	–	–

Notes: CI, confidence interval; ED, emergency department; GEE, generalized estimating equation; RR, risk ratio; SES, socioeconomic status.

*
$p < .05$,

**
$p < .01$,

***
$p < .001$.

Table 3

Multivariate GEE model estimates for race/ethnicity and literacy on longitudinal asthma outcomes.

Asthma outcome	Model I[a] Baseline	Model II[a] +Literacy	Model III[a] +SES	Model IV[a] +Literacy and SES
Quality of life (β)				
Race/ethnicity				
African American	−0.44 (−0.75, −0.13)**	−0.29 (−0.58, −0.00)*	−0.11 (−0.37, 0.16)	−0.03 (−0.28, 0.22)
Latino	−0.47 (−0.79, −0.14)**	−0.35 (−0.66, −0.05)*	−0.33 (−0.62, −0.05)*	−0.26 (−0.53, −0.00)
White/Other	–	–	–	–
Health literacy				
Limited	N/A	−0.58 (−0.81, −0.35)***	N/A	−0.41 (−0.65, −0.18)***
Adequate	N/A	–	N/A	–
ED visits (RR)				
Race/ethnicity				
African American	2.07 (1.11, 3.85)*	1.80 (0.98, 3.31)	1.51 (0.79, 2.86)	1.44 (0.76, 2.73)
Latino	1.13 (0.55, 2.34)	1.01 (0.49, 2.04)	0.98 (0.47, 2.04)	0.96 (0.46, 2.00)
White/Other	–	–	–	–
Health literacy				
Limited	N/A	1.90 (1.27, 2.86)**	N/A	1.70 (1.13, 2.54)*
Adequate	N/A	–	N/A	–
Hospitalizations (RR)				
Race/ethnicity				
African American	4.06 (1.27, 12.9)*	3.51 (1.09, 11.3)*	2.93 (1.11, 7.79)*	2.97 (1.09, 8.12)*
Latino	2.70 (0.80, 9.14)	2.42 (0.74, 7.93)	2.57 (0.83, 7.99)	2.49 (0.82, 7.59)
White/Other	–	–	–	–
Health literacy				
Limited	N/A	2.25 (1.23, 4.12)**	N/A	1.62 (0.83, 3.17)
Adequate	N/A	–	N/A	–
Control (RR)				
Race/ethnicity				
African American	0.64 (0.42, 0.97)*	0.74 (0.49, 1.12)	1.03 (0.68, 1.57)	1.19 (0.79, 1.78)
Latino	0.63 (0.41, 0.98)*	0.72 (0.47, 1.10)	0.80 (0.53, 1.23)	0.92 (0.61, 1.40)
White/Other	–	–	–	–
Health literacy				
Limited	N/A	0.49 (0.34, 0.71)***	N/A	0.51 (0.34, 0.75)**
Adequate	N/A	–	N/A	–

Notes: ED, emergency department; GEE, generalized estimating equation; RR, risk ratio; SES, socioeconomic status; N/A, not applicable.

[a]All models were adjusted for age, gender, and duration of asthma.

*p < .05,

**p < .01,

***
$p < .001$.