Importance of Adult Literacy in Understanding Health Disparities

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BACKGROUND: In several recent studies, the importance of education and race in explaining health-related disparities has diminished when literacy was considered. This relationship has not been tested in a nationally representative sample of U.S. adults.

OBJECTIVE: To understand the effect of adult literacy on the explanatory power of education and race in predicting health status among U.S. adults.

DESIGN: Using the 1992 National Adult Literacy Survey, logistic regression models predicting health status were estimated with and without literacy to test the effect of literacy inclusion on race and education.

SUBJECTS: A nationally representative sample of 23,889 noninstitutionalized U.S. adults.

MEASURES: Poor health status was measured by having a work-impairing condition or a long-term illness. Literacy was measured by an extensive functional skills test.

RESULTS: When literacy was not considered, African Americans were 1.54 (95% confidence interval, 1.29 to 1.84) times more likely to have a work-impairing condition than whites, and completion of an additional level of education made one 0.75 (0.69 to 0.82) times as likely to have a work-impairing condition. When literacy was considered, the effect estimates of both African-American race and education diminished 32% to the point that they were no longer significantly associated with having a work-impairing condition. Similar results were seen with long-term illness.

CONCLUSIONS: The inclusion of adult literacy reduces the explanatory power of crucial variables in health disparities research. Literacy inequity may be an important factor in health disparities, and a powerful avenue for alleviation efforts, which has been mistakenly attributed to other factors.

KEY WORDS: disparities; education; race/ethnicity; literacy.
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The elimination of pervasive health disparities across race and ethnicity is a major goal of current U.S. health research, practice, and policy.[1,2] Adult literacy may be a crucial, yet overlooked factor in understanding health disparities. In a number of recent studies, literacy has been a more powerful predictor of health status, health-related behaviors, and health-related knowledge than education or race.[3–8] If the addition of literacy to health status models changes the predictive power of education and/or race, this may provide new insight into the pathways that lead to health disparities, providing potentially effective avenues to eliminate them.

This issue has not yet been investigated in a nationally representative sample. Existing studies used samples from specific populations, most of which were expected to have lower literacy than the general public, such as the elderly[5] or public health patients.[3–7] The study goal was to determine the specific effect on education and race variables when literacy was included in predictive health status models using a nationally representative sample.

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METHODS

Data Set

The 1992 National Adult Literacy Survey (NALS) was administered in person to a nationally representative sample of 24,944 noninstitutionalized people aged 16 or over. African-American and Hispanic individuals were oversampled. The response rate was 81%.[9] Nonresponders were more likely to be older and male; race had only a moderate effect on nonresponse. African-American and Hispanic adults were slightly more likely to complete the demographic survey and whites were slightly more likely to complete the literacy testing.[9]

The NALS defined literacy as a person's ability to perform everyday tasks of various levels of difficulty in 3 skill domains: prose, document, and quantitative. Each literacy domain was measured on a continuous scale from 0 to 500, which was then broken down into 5 literacy levels. Post hoc analyses found that domain scores were highly correlated within individuals and the 3 literacy scales could be meaningfully combined into 1.[10]

Rather than grade-equivalent skills, NALS literacy scores measure the ability to respond to practical literacy demands, a more meaningful metric and context for measuring adult literacy. Point increases along the 0 to 500 NALS scale represent increasing refinement of information processing skills, with major breakthroughs at literacy-level cut points (e.g., the ability to make low-level inferences from relatively long texts marks the shift from level 2 to level 3). More detail about this issue and information about the precise skills represented across the 0 to 500 continuum are available elsewhere.[9,11]

Sample

This study excluded individuals who were below 18 years of age (n=776), blind (n=243), or mentally retarded (n=54), as their literacy may be influenced by factors different from the general population, leaving a study sample of 23,889. Table 1 provides contextual information about the sample characteristics for the dependent, independent, and control variables. Data were analyzed with STATA 6[12] using the appropriate complex sample design corrections to provide unbiased estimates of variance. National Adult Literacy Survey sampling weights were used to account for unequal selection probabilities and nonresponse.

Dependent Variables

Two NALS health questions pertaining directly to physical health measured health status: (1) Do you have a physical, mental, or other health condition that stops your participation

Table 1. Frequency Counts of Dependent and Independent Study Variables

Variables	Coding	Frequency	% of Sample
Dependent variables			
Condition keeps from work	No	22,374	93
	Yes	1,490	7
Long-term illness	No	22,182	93
	Yes	1,646	7
Independent			
Literacy (0 to 500 scale)	Level 1 (<224)	4,537	20
	Level 2 (225 to 274)	6,249	27
	Level 3 (275 to 324)	8,283	34
	Level 4 (326 to 374)	4,417	18
	Level 5 (375+)	403	2
Race	White	16,875	68
	Black	4,483	18
	Hispanic	1,668	7
	Other	1,636	7
Education	None	130	1
	Elementary	317	1
	Middle school	1,370	7
	Some HS	3,130	15
	GED/HS diploma	14,100	58
	BA/BS	3,220	13
	Postgraduate	1,509	6
Control			
How well understand English	Very well	19,376	81
	Well	3,605	15
	Not well	702	3
	Not at all	194	1
Born in U.S.A.	Yes	21,208	89
	No	2,681	11
Unemployed	No	22,047	93
	Yes	1832	7
Family income	<$5,000	4,035	19
	$5,000 to 9,999	3,259	16
	$10,000 to 14,999	2,817	14
	$15,000 to 19,999	2,304	11
	$20,000 to 29,999	3,530	16
	$30,000 to 39,999	2,145	10
	$40,000 to 49,999	1,190	6
	$50,000 to 74,999	1,044	5
	$75,000 to 99,999	273	1
	$100,000+	279	1
Income missing	Yes	5,483	23
Female	Yes	13,673	52
Age (y)	<25	3,538	15
	25 to 34	6,207	23
	35 to 44	5,626	22
	45 to 54	3,616	14
	55 to 64	2,860	11
	65+	2,042	15
Marital status	Married living with spouse	11,825	49
	Other	12,064	51
Food stamps	Yes	2,830	9
Live in MSA	Yes	19,368	77
Census region	1=Northeast	5,034	21
	2=Midwest	6,910	24
	3=South	7,118	34
	4=West	4,827	21

MSA, metropolitan statistical area; HS, high school.

fully in work, school, housework, or other? and (2) Do you have a long-term illness (6 months or more)?

Independent Variables

Literacy was a continuous variable created by averaging individual literacy scores across each of the 3 domains (prose, document, and quantitative). In multivariate models, the original 0 to 500 literacy scale was transformed to a 0 to 50 scale (by dividing by 10) to allow for more meaningful interpretation of the odds ratios. In multivariate models, odds ratios represent the effect of a 10-point increase on the original NALS literacy scale compared with the level below it.

Race/ethnicity had 4 categories—white, African American, Hispanic, and Other race, constructed from 2 items in the original survey. The first included 7 race/ethnicity categories. The second ascertained Hispanic heritage.

Education was an ordinal variable with 7 levels corresponding to levels of educational attainment from no school to post graduate. In multivariate models, the ordinal education variable was specified as 1 continuous variable rather than a series of dichotomous variables to allow us to see the impact of the inclusion of literacy on the predictive power of 1 comprehensive education variable.

Control Variables

Sex, age, employment status, family income, income nonresponder, marital status, receipt of food stamps, living in a metropolitan statistical area (MSA), census region, English-language proficiency, and being born in the United States were controlled. Income nonresponder was included due to the large percentage of the sample that did not report income (5,483; 23%). Income nonresponders were coded as having income in the lowest income category (<$5,000). While this method provides an adequate control for the influence of income on health status, it does not allow us to draw any meaningful conclusions about the relationship of literacy, income, and health.

Analyses

For both health status variables, multivariate logistic regression models (with and without the literacy variable) were estimated to test the effect of including literacy in the explanatory power of education and race variables. Based on previous research that has found age-related differences in literacy proficiency and education by race,[11] we also tested to see whether the impact of literacy on the predictive power of the education and race variables differed by age by estimating all models separately for 2 age groups (<65 and 65+) in a separate analysis.

RESULTS

Bivariate Analyses

Table 2 shows average literacy by race and education in the study sample. Table 3 shows the odds ratios and confidence intervals for bivariate relationships between the independent and the control variables for both health status measures. Higher literacy and higher levels of education were associated with better health status, and African-American race with worse health status by both measures. Hispanic ethnicity did not have a significant relationship with either health status measure in bivariate or multivariate analyses.

Multivariate Analyses

Table 3 also shows the odds ratios (OR) and confidence intervals (CI) for the multivariate models with and without literacy

Table 2. Mean Literacy Scores by Race/Ethnicity and Educational Attainment

	Average Literacy (0 to 500 scale)
Race	
White	286
Black	232
Hispanic	212
Other	246
Education	
None	116
Elementary	126
Middle school	187
Some HS	233
GED/HS	281
BA/BS	322
Postgraduate degree	333

included. For both health status measures, the addition of literacy significantly ($P<.05$) increased the explanatory power of the model as measured by an adjusted Wald test.[13]

Having a Condition that Keeps One from Work

When literacy was not included in the predictive model, African Americans had 1.54 (95% CI, 1.29 to 1.84) times the odds of having a work-impairing condition compared with whites. Education also had a significant association with having a work-impairing condition. Each 1-point increase in education level (on the 7-point scale) was associated with lower odds (0.75; CI, 0.69 to 0.82) of having a work-limiting condition.

Literacy was significantly associated with having a condition that keeps one from work when other factors were controlled (OR, 0.90; CI, 0.88 to 0.92). Once literacy was included, African-American race no longer predicted having a condition that keeps one from work; the OR decreased 32% to 1.04 (CI, 0.85 to 1.26). The education variable also lost explanatory power, with the OR ratio changing 32% to a nonsignificant 0.99 (CI, 0.90 to 1.09).

Having a Long-Term Illness

Before literacy was included, African Americans had higher odds (OR, 1.24; CI, 1.03 to 1.49) of having a long-term illness compared with whites, and each 1-point increase in education was associated with 0.84 (CI, 0.79 to 0.91) the odds of having a long-term illness. Literacy was significantly associated with having a long-term illness when other factors were controlled (OR, 0.96; CI, 0.94 to 0.98), and literacy's inclusion reduced the OR of African-American race from 14% to 1.07 (CI, 0.89 to 1.30). Education also lost statistical significance, with the OR decreasing from 11% to 0.93 (CI, 0.85 to 1.02).

Age-Related Differences

When analyses were run stratified by age group (<65 vs 65+), the impact of literacy had similar associations with race and education with 2 exceptions. First, although the OR on

Table 3. Results for Logistic Regression Models Predicting Health Status Variables

	OR (95% CI)					
	Have a Condition That Keeps You from Work			Have a Long-Term Illness (6 Months or More)		
Variables	Bivariate Analyses	Multivariate Model Without Literacy	Multivariate Model With Literacy	Bivariate Analyses	Multivariate Model Without Literacy	Multivariate Model With Literacy
Independent						
Literacy	**0.89 (0.88 to 0.90)***	N/A	**0.90 (0.88 to 0.92)**	**0.92 (0.91 to 0.93)**	N/A	**0.96 (0.94 to 0.98)**
Black†	**1.83 (1.58 to 2.14)**	**1.54 (1.29 to 1.84)**	1.04 (0.85 to 1.26)	**1.42 (1.19 to 1.69)**	**1.24 (1.03 to 1.49)**	1.07 (0.89 to 1.30)
Hispanic	1.12 (0.85 to 1.49)	1.20 (0.82 to 1.76)	0.93 (0.63 to 1.14)	0.77 (0.57 to 1.03)	0.84 (0.58 to 1.21)	0.75 (0.51 to 1.10)
Other race	0.91 (0.59 to 1.42)	1.36 (0.88 to 2.11)	1.03 (0.63 to 1.67)	0.50 (0.31 to 0.83)	0.64 (0.41 to 1.02)	**0.57 (0.36 to 0.92)**
Education	**0.56 (0.51 to 0.61)**	**0.75 (0.69 to 0.82)**	0.99 (0.90 to 1.09)	**0.62 (0.58 to 0.66)**	**0.84 (0.79 to 0.91)**	0.93 (0.85 to 1.02)
Control						
Understand English	**1.62 (1.46 to 1.80)**	**1.44 (1.21 to 1.70)**	1.16 (0.97 to 1.40)	**1.28 (1.14 to 1.45)**	1.15 (0.99 to 1.34)	1.07 (0.92 to 1.25)
Born in U.S.A.	**1.31 (1.05 to 1.62)**	**2.26 (1.55 to 3.29)**	**3.10 (2.05 to 4.67)**	**1.65 (1.27 to 2.14)**	**1.83 (1.28 to 2.61)**	**2.00 (1.40 to 2.88)**
Unemployed	1.28 (1.00 to 1.63)	**1.43 (1.07 to 1.91)**	**1.41 (1.06 to 1.89)**	0.97 (0.76 to 1.24)	1.17 (0.90 to 1.52)	1.16 (0.90 to 1.51)
Family income	**0.86 (0.84 to 0.89)**	**0.93 (0.89 to 0.97)**	0.96 (0.92 to 1.01)	**0.87 (0.85 to 0.89)**	**0.86 (0.83 to 0.90)**	**0.88 (0.84 to 0.91)**
Income missing	**1.37 (1.16 to 1.63)**	0.80 (0.64 to 1.01)	0.82 (0.64 to 1.03)	1.15 (0.99 to 1.33)	**0.54 (0.45 to 0.66)**	**0.55 (0.45 to 0.66)**
Sex	0.88 (0.76 to 1.02)	1.01 (0.87 to 1.18)	0.97 (0.84 to 1.13)	0.94 (0.82 to 1.08)	1.14 (0.98 to 1.35)	1.14 (0.97 to 1.33)
Age	**1.04 (1.03 to 1.04)**	**1.03 (.02 to 1.04)**	**1.02 (1.01 to 1.02)**	**1.05 (1.04 to 1.05)**	**1.04 (1.04 to 1.05)**	**1.04 (1.04 to 1.05)**
Married	**0.79 (0.68 to 0.92)**	0.92 (0.77 to 1.10)	0.97 (0.82 to 1.14)	**0.78 (0.69 to 0.88)**	0.90 (0.78 to 1.04)	0.92 (0.80 to 1.05)
Get food stamps	**2.13 (1.81 to 2.50)**	**1.65 (1.34 to 2.03)**	**1.53 (1.24 to 1.88)**	**1.79 (1.50 to 2.14)**	**1.67 (1.34 to 2.08)**	**1.61 (1.29 to 2.02)**
Live in MSA	**0.67 (0.55 to 0.83)**	0.85 (0.71 to 1.01)	0.86 (0.72 to 1.04)	0.84 (0.68 to 1.04)	1.05 (0.85 to 1.29)	1.06 (0.86 to 1.30)
South†	**1.42 (1.16 to 1.74)**	**1.37 (1.07 to 1.75)**	**1.33 (1.03 to 1.71)**	1.10 (0.90 to 1.32)	1.05 (0.82 to 1.34)	1.04 (0.81 to 1.34)
Midwest	0.97 (0.78 to 1.19)	1.07 (0.82 to 1.40)	1.15 (0.88 to 1.50)	0.88 (0.72 to 1.09)	0.83 (0.61 to 1.14)	0.85 (0.62 to 1.17)
West	**0.78 (0.62 to 0.99)**	1.09 (0.81 to 1.45)	1.20 (0.89 to 1.60)	1.03 (0.84 to 1.27)	1.31 (1.00 to 1.73)	1.37 (1.04 to 1.80)

Bold indicates a statistically significant ($P<.05$) relationship.

†*East is the comparison group for census region variables in multivariate analyses.*

‡*Non-Hispanic white is the reference group for race variables in multivariate analyses.*

MSA, metropolitan statistical area; N/A, not applicable.

African-American race and education diminished to the point of losing statistical significance in most cases for both health status variables after considering literacy, the degree of change in the OR was slightly smaller for the elderly group than they were for the larger sample. For instance, in the 65+ sample, the OR for African-American race went from 2.06 (CI, 1.46 to 2.90) in the model predicting having a work-impairing condition without literacy to 1.50 (1.04 to 2.17), a 27% reduction, compared with a 32% reduction in entire sample for that dependant variable. Second, in predicting having a work-impairing condition among the elderly sample, African-American race maintained statistical significance after the inclusion of literacy. This was the only time one of our focal variables (African-American race or education) retained statistical significance after literacy was included in any model with any sample.

DISCUSSION

Including literacy in predictive health status models removed the predictive power of both education and African-American race. This offers an insight into the mechanisms that might explain the influence of 2 of the most commonly documented sources of health disparities.

Although education is a well-established and commonly used predictor of health, the pathways and mechanisms that account for this association remain both empirically and theoretically unspecified.[14] Education, as traditionally measured in health research, is simply a tally of years completed or degrees achieved within school systems that are not necessarily equivalent, by individuals who may not have gained or retained the same skills. This may be particularly true for the elderly who have not been in school in many years, but may continue to increase, or decrease, their literacy skills throughout their lives.[15] Thus, the traditional education variable does not necessarily measure true "education" at all.[3,4,16] Literacy, conversely, is conceived and measured as a set of functional skills that are relevant to the demands of everyday life[11] and has been found to vary widely among individuals with the same educational attainment.[11,17] As a direct measure of practical skills, only some of which are imparted through the formal educational system, literacy could impact health on a variety of levels from health care access to health knowledge accumulation to disease-specific management.[18]

If discrepancies between education and literacy occurred at random, the addition of adult literacy to predictive models of health might lessen education's association with health, but may not impact the relationship of race and health. However, the education/literacy discrepancy does not occur randomly. On average, African-American and Hispanic adults are more likely to have lower literacy when education is controlled.[11] The lack of equivalency of skills by education level means that education, as traditionally measured, is not an adequate control for educational attainment. In predicting health status, adult literacy could reduce the predictive power of race, not because literacy is a better measure of the theoretical influence of this variable on health (as is the case with education), but because literacy is a more equivalent statistical control for educational attainment than traditional education variables. Undoubtedly, there are other reasons besides unequal literacy for race-based health inequalities. In this study, African-American race remained a significant predictor of health status among the sample of adults 65+, indicating that race and literacy had independent relationships with health.

Limitations

As the NALS was not a health survey by design, the health status measures were not standard. The relationship of literacy, education, and race with health should be tested using more traditional measures of health status and disease-specific outcomes. National health surveys should include literacy evaluation to allow full exploration of these relationships.

Literacy in this study was only measured as English literacy. Some individuals, particularly recent immigrants, may have low English literacy skills, yet may be highly literate in other languages. Health care outreach, health measures, patient education, and doctor-patient care can be provided in other languages, although the availability of these services differs greatly across regions and health care facilities. Exploring the relationship of health and literacy in languages other than English is an important area for further study. This could also help us better understand the relationship between literacy, ethnicity, and health. In this study, no relationship was seen between Hispanic heritage and health, perhaps due to the peculiarities of this sample, cultural differences in responses concerning self-reported health,[19] or the so-called "Hispanic paradox" wherein some Hispanic groups have better than expected health outcomes, despite greater socioeconomic disadvantage.[20]

The data analyzed are somewhat outdated as the NALS is from 1992. Important changes in health care delivery, such as the growth of managed care, more complicated protocols for seeing a specialist, and advances in technology leading to more complicated clinical regimens, have occurred in the last decade. As these changes have made the health care system even more complex, these could increase the impact that functional skills might have on health. However, literacy has started to gain recognition as an important issue in health care and some effort has been made to improve the literacy demands of patient education and other health-related materials. This may actually decrease the relationship of literacy with health. The 2003 National Assessment of Adult Literacy (NAAL), a follow-up to the NALS, included more specific health status and health use questions.[21] Replicating the analyses reported here with these soon-to-be-released data should provide more definitive information about the relationship of literacy, education, race, and health status. Also, while the NALS only measured general literacy, the NAAL measured both general and health literacy. A consideration of the NAAL data will allow practical comparisons of a general functional literacy measure compared with a health literacy assessment, in general, and specifically in relationship with health.

This study provides some illumination into a possible causal pathway of health disparities. Literacy was significantly associated with both health status measures. Although the OR for literacy (0.90 and 0.96) may at first appear small, each point-increase in the literacy variable represents a 10-point increment on a 500-point scale. Across large differences in literacy skill, the cumulative effects of each 10-point difference result in very different probabilities of having a work-impairing condition or a long-term illness. However, this study did not specifically test for causality. We cannot rule out the possibility that literacy may not be a direct measure of skills relevant to

health, but rather a better proxy than education and race for other crucial, unmeasured aspects of socioeconomic status, such as discrimination or adverse opportunity structures, that are the actual causal factors. Further research into possible causal pathways exploring the health literacy relationship will help illuminate these issues.

Conclusions

This study has important implications for the large, well-established field of research into health disparities and the social determinants of health. When literacy was considered in a nationally representative sample of noninstitutionalized adults, as well as separately among younger (<65) and older (65+) adults, education and race ceased to maintain their traditional importance for understanding health disparities. This suggests that literacy may be an important predictor of health disparities that explains differences by race and education observed in previous studies. Literacy may also provide a particularly effective area to focus the fight to eliminate health disparities as adult literacy can be potentially improved across the lifespan, and the literacy-related demands of the health care system can be directly targeted by both large-scale policy and individual clinical action.

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