Educational Attainment Has a Limited Impact on Disease Management Outcomes in Heart Failure

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ABSTRACT

The objective of this study was to assess whether educational attainment moderates outcomes in the intervention group in a trial of disease management in heart failure (HF). Data were collected from a sample of 654 patients enrolled in the disease management arm of a community-based study of HF patients. The full sample was used to analyze two primary outcomes—all-cause mortality and cardiac event-free survival. Two other primary outcomes—rates of HF-related emergency department (ED) visits and inpatient admissions—and secondary outcomes (patient self-confidence in managing HF symptoms and daily dietary sodium intake in milligrams) were analyzed in a smaller sample of 602 patients who completed at least 6 months of disease management. One-way analysis of variance and $\chi^2$ tests were used to assess differences in baseline demographic and clinical characteristics. Survival analyses were conducted with proportional hazards regression, while negative binomial regression was used to assess educational differences in ED usage and inpatient admissions. Repeated measures analysis of variance models were used to assess whether secondary outcomes differed across educational strata and/or over time. All outcome analyses were adjusted for founders. Patients with the least education fared the poorest for all-cause mortality, but education-related differences failed to achieve statistical significance. No education-related differences were observed for cardiac event-free survival, or for the rates of inpatient admission and ED usage. For secondary outcomes, sodium intake differed significantly by education ($p = 0.04$), with the largest drop ($-838$ mg/day) observed in the least well-educated group. Confidence increased an approximately equal amount (2.1–3.0 points on a 100-point scale) across all educational strata ($p = ns$). Low educational attainment may not be a barrier to effective disease management. (Disease Management 2006;9:157–166)

INTRODUCTION

THE RISING PREVALENCE and expense of treating chronic diseases such as diabetes, asthma, and heart failure (HF) motivated payers and healthcare policy makers alike to seek new methods of controlling costs. In the last decade, disease management programs—comprehensive, multidisciplinary, therapeutic, and educational interventions—have been shown to improve outcomes and reduce utilization costs across a variety of chronic dis-

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Although the concept is still relatively new, an assortment of disease management initiatives are underway. Programs range from the simple (e.g., monitoring weight change in heart failure patients) to the comprehensive (e.g., offering intensive post-hospitalization follow-up care, nurse-led patient education, assistance from dietary and social services, or review of pharmaceutical regimens by a specialist). Disease management programs are rapidly growing in popularity; recent statistics show that 88% of health maintenance organizations have implemented at least one disease management program and that about 150 companies providing this service have been established.

Although the industry has grown rapidly, there have been relatively few large-scale randomized, controlled trials testing the effectiveness of such programs. Published trials have generally been small and conducted in employed, group-insured populations. The effectiveness of disease management in different and more broadly representative populations is less well understood. Despite these lacunae, the expansion to less well-studied populations is underway. Confronted by stagnating tax revenues and rapidly escalating costs of care, state Medicaid programs are rapidly adopting disease management initiatives. Medicaid populations present a number of unique challenges for effective disease management programs. Patients receiving Medicaid are often at more advanced stages of chronic disease, have more comorbidities than group-insured individuals, are more likely than privately insured patients to experience fragmented care for chronic disease, and are also more likely to present a number of nonmedical barriers to effective disease management, including high residential mobility, lack of phone service, and low educational attainment.

Of potentially large import for the effectiveness of disease management programs is patient educational attainment. Low levels of formal education have been linked with a variety of negative results across numerous chronic diseases. While there has been a great deal of debate over the mechanisms behind the observed differences, at least part of the gap appears to be due to adherence to treatment regimens. Goldman and Smith show, for example, that HIV and diabetes outcomes as well as adherence to drug and glucose monitoring regimens are substantially worse among those patients with low educational attainment. Despite the obvious centrality of patient understanding of and adherence to treatment regimens to the success of disease management, there has been little research on the question of whether disease management outcomes differ across levels of educational attainment. In the present study, we examine the relationship between educational attainment and a series of primary and secondary outcomes in the intervention arm of a randomized, controlled trial of disease management conducted in a large population of community-dwelling patients with HF.

METHODS

Study design

The South Texas Congestive Heart Failure Disease Management Project was a single-center, randomized controlled clinical trial that ran from 1999 to 2003. It was conducted by the University of Texas Health Science Center at San Antonio, in partnership with Wilford Hall Medical Center, Brooke Army Medical Center, William Beaumont Army Medical Center, the South Texas Veterans Health Care System, and TRICARE Region 6 and University Health System. The study enrolled a total of 1069 male and female subjects at least 18 years of age who had symptoms of HF and documented systolic or diastolic dysfunction. The screening criteria are described in detail elsewhere. Patients were followed for 18 months and were randomly assigned 2:1 to the intervention and control groups. All subjects underwent an echocardiogram at baseline and at 18 months and were assessed every 6 months by medical history, physical exam, 6-min walk test, and serum chemistries. Subjects in the traditional care group received no changes to their management. Subjects in disease management were assigned a disease manager, a registered nurse with specialized cardiac training who performed telephonic patient education and medication management in conjunction with the
patient’s primary care provider. Half of the disease management patients were issued a number of technological devices (ie, blood pressure cuff, finger pulse oximeter, and activity monitor) for enhanced self-monitoring in the home. Subjects in both intervention arms (ie, with and without technological devices) received bathroom scales and were asked to weigh themselves daily.

Disease management services were provided through a contract with CorSolutions, Inc., a disease management vendor with experience providing disease management services to patients with HF. Disease managers followed the MULTIFIT™ disease management protocol, a proprietary protocol developed by CorSolutions, Inc. Under the MULTIFIT™ protocol, patients’ care was directed by their primary care physicians with recommendations made by disease managers in accordance with the American College of Cardiology (ACC)/American Heart Association (AHA) guidelines for the care of HF. The recommendations were a part of the study protocol, but decisions about implementation of the recommendations were left to patients’ physicians. Critical components of the disease managers’ recommendations included initiation and upward titration of all recommended drug classes for HF.

Patient education included instruction in appropriate cardiac diet (ie, low fat, low sodium, fluid restricted), medication compliance, exercise, and appropriate reaction to signs of the onset of a HF exacerbation. In addition to the proactive phone calls scheduled as part of the protocol, patients also had around-the-clock telephonic access to a disease manager able to answer questions about HF symptom management. Subjects were provided with a comprehensive written (approximately 6th-grade level) patient education guide in English or Spanish as appropriate.

Subjects

Because data on educational attainment was collected only by the disease management contractor, the potential sample for education-related analyses is limited to the 710 patients randomized to the intervention arm of the trial. The sample was further modified in two additional stages. The sample for survival analysis (n = 654) was created by dropping 56 patients from whom educational attainment data were not collected. The final sample for all other analyses (n = 602) dropped an additional 52 patients who received less than 6 months of disease management services (eight were deceased; four were lost to follow-up; 29 withdrew from the study; and 11 were medically disqualified, most commonly due to admission to long-term care or diagnosis with a terminal illness). We elected to eliminate this group to ensure that all patients had a minimum and significant exposure to the intervention. The final analysis samples were statistically indistinguishable from the dropped cases across the range of demographic variables in Table 1 as well as educational attainment. Study investigators adhered to the policies regarding the protection of human subjects (as prescribed by 45 CFR 46 and 32 CFR 219).

Outcomes

Four primary outcomes were identified from a range of clinical and healthcare utilization indicators. Two were clinical outcomes, all-cause mortality, and event-free survival; two others were health care utilization outcomes, including the rates of both inpatient admission and emergency department (ED) visits for HF-related causes. Data on inpatient admission and ED visits for HF-related causes were generated from a thorough review of patient medical records. Records covering the period of a patient’s enrollment in the trial were requested from both primary care and specialty physicians. Records of inpatient and outpatient encounters and ED visits were culled from patient self-report data, reviews of hospital records, and documents received from physician and clinic charts. While the disease management intervention also addressed common comorbidities in HF patients and could reasonably be expected to reduce utilization for a broader array of symptoms, we chose to focus on HF-related utilization to minimize multiple testing and to focus on the outcomes closest to the main goal of the disease management algorithm.

We also examined two secondary outcomes, patient self-confidence in HF symptom management and daily dietary sodium intake in mil-
ligrams. Patient self-care confidence was measured with a 19-item questionnaire developed by CorSolutions, which asked patients to rate their confidence across three dimensions: adhering to a cardiac diet, complying with their prescribed drug regimen, and performing self-monitoring tasks such as watching for signs of a HF exacerbation. Responses were collected approximately monthly and were scored on a 0–100-point scale where higher values indicate increased confidence. Sodium intake was measured, also approximately monthly, with a 25-item food frequency questionnaire. Dietary information collected from patients was converted into an estimate of milligrams of dietary sodium consumed per day. The first and last available observations for each patient on both the confidence and dietary sodium measures were identified and extracted from the contractor’s database. Because these data were obtained in scored form from CorSolutions, no item-level reliability indices could be computed. Educational attainment was measured on a five-category ordinal scale ranging from “Less than 9th Grade” to “Four-Year College Degree or more.”

Statistical analysis

Continuous variables are expressed as mean ± standard deviation and categorical variables are expressed as percentages. Bivariate hypotheses involving continuous variables were tested with one-way analysis of variance (ANOVA). For tests of whether the distribution of categorical variables differed across levels of educational attainment, we used a χ² test. Survival analyses were conducted by proportional hazards regression while differences in the rates of inpatient hospitalization and visits to the ED were examined using negative binomial regression, given evidence of overdispersion in both measures. For the secondary outcomes of dietary sodium intake and symptom self-management confidence, we used repeated measures analysis of variance. All outcome analyses were adjusted for variables in Table 1 that were significantly different across levels of educational attainment. While the power analysis conducted for the trial ensured that the sample size was adequate to detect clinically significant study group differences across each of the primary and secondary outcomes, the present analyses by educational attainment were not part of the original analysis plan. Given the exploratory nature of this study, we assessed statistical significance with α = 0.05. All analyses were conducted with SAS Version 9.1 (SAS Institute Inc., Cary, NC).

Table 1. Descriptive Statistics by Educational Attainment

<table>
<thead>
<tr>
<th>Variable</th>
<th>Less than 9th grade (n = 63)</th>
<th>Some HS (n = 52)</th>
<th>HS diploma (n = 165)</th>
<th>Some college (n = 162)</th>
<th>4-year degree + (n = 160)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female (%)</td>
<td>41.3</td>
<td>44.2</td>
<td>30.3</td>
<td>24.7</td>
<td>22.5</td>
<td>0.004</td>
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<tr>
<td>Race/ethnicity (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Caucasian</td>
<td>23.8</td>
<td>61.5</td>
<td>68.5</td>
<td>77.2</td>
<td>86.9</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>73.0</td>
<td>34.6</td>
<td>24.9</td>
<td>14.2</td>
<td>9.4</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>3.2</td>
<td>3.9</td>
<td>6.7</td>
<td>8.6</td>
<td>3.8</td>
<td></td>
</tr>
<tr>
<td>Spanish language (%)</td>
<td>47.6</td>
<td>1.9</td>
<td>1.2</td>
<td>0.0</td>
<td>0.6</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Living alone (%)</td>
<td>22.2</td>
<td>21.2</td>
<td>22.4</td>
<td>26.9</td>
<td>20.8</td>
<td>0.743</td>
</tr>
<tr>
<td>Age (mean)</td>
<td>70.6 ± 10.7</td>
<td>70.0 ± 9.7</td>
<td>69.7 ± 10.0</td>
<td>69.8 ± 11.5</td>
<td>72.8 ± 9.7</td>
<td>0.047</td>
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<tr>
<td>NYHA class at enrollment (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.001</td>
</tr>
<tr>
<td>I</td>
<td>6.4</td>
<td>11.5</td>
<td>17.6</td>
<td>22.2</td>
<td>23.8</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>65.0</td>
<td>63.5</td>
<td>56.4</td>
<td>55.6</td>
<td>58.1</td>
<td></td>
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<tr>
<td>III/IV</td>
<td>28.6</td>
<td>25.0</td>
<td>26.0</td>
<td>22.2</td>
<td>18.1</td>
<td></td>
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<tr>
<td>Heart failure (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.229</td>
</tr>
<tr>
<td>Diastolic</td>
<td>34.9</td>
<td>36.5</td>
<td>29.7</td>
<td>26.5</td>
<td>23.1</td>
<td></td>
</tr>
<tr>
<td>Systolic</td>
<td>65.1</td>
<td>63.5</td>
<td>70.3</td>
<td>73.5</td>
<td>76.9</td>
<td></td>
</tr>
</tbody>
</table>

HS, high school; NYHA, New York Heart Association.
RESULTS

Sample profile

The sample included patients with a variety of educational backgrounds with a near majority (46.5%) having a high school degree or less education. Table 1 provides a demographic profile of the sample across educational strata. Both ethnicity and gender were strongly and significantly associated with educational attainment. The least well-educated group was approximately 40% female while the best-educated group was only 22.5% female. Hispanics (primarily Mexican American) constituted nearly three quarters (73%) of the lowest educational stratum but represented only 9.4% of patients with a four-year degree or more education. Primary language had a similarly strong and statistically significant relationship with educational attainment, with nearly half (47.6%) of the least well-educated group preferring Spanish compared to 0.6% of the best-educated group. New York Heart Association (NYHA) class also was strongly related to educational attainment: patients with more education were typically less symptomatic at enrollment than less well-educated patients. Age was also significantly different by educational attainment, although the differences did not follow a clear pattern. Given these subgroup differences at baseline, we adjusted the multivariate analyses reported below for gender, race/ethnicity, age, primary language, and NYHA class at enrollment.

Primary outcomes

Adjusted mortality and event-free survival curves are displayed in Figure 1. Although patients with the least education had higher mortality than other patients, the differences were not statistically significant ($p > 0.17$). There were no clinically or statistically significant differences in event-free survival by educational attainment ($p > 0.22$). For HF-related health care utilization, well-educated and less well-educated patients consumed healthcare resources at similar rates over the course of the study (Tables 2 and 3). Neither the inpatient hospitalization rate nor the ED visit rate showed substantively or statistically significant differences between levels of educational attainment.

Secondary outcomes

Notable decreases in dietary sodium intake of 400–800 mg were observed across all five ed-
ucational strata (Fig. 2). While the main effect of education was not significant in the repeated measures ANOVA, the education by time interaction effect was significant \( (p = 0.040) \), indicating a different time trend across levels of educational attainment. The drop in sodium intake was largest \( (-838 \text{ mg/day}) \) in the least well-educated group, the group that also had the highest sodium consumption prior to initiation of disease management. In addition, large decreases were observed among patients with at least some college education, and those who completed a 4-year degree or more. It is worth noting that despite the best efforts of the disease managers, no group ended the trial with sodium intake at the prescribed level of 2 g/day, indicating the difficulty in controlling this parameter across all educational levels. The finding of most improvement in the lowest educational group is in this regard even more striking.

Figure 3 shows that while there were increases in scores for self-management confidence in each group, these were neither clinically nor statistically significant. Confidence increased an approximately equal amount (1.8–2.5 points on a 100-point scale) across all educational strata. The observed rates of confidence—near maximum scores across all educational strata—make the discernment of improvements in this variable difficult.

**DISCUSSION**

Many studies have explored the ways in which differences in educational attainment—often as a component of socioeconomic status—impact chronic disease outcomes. To our knowledge, our study is the first to investigate whether the educational attainment of patients moderates outcomes in the experimental group of a trial of disease management among HF patients. In sum, these data suggest that educational attainment plays only a limited role as a moderator. While a modest and statistically significant relationship was observed between dietary sodium intake and educational attainment among patients in the intervention group, no effect of education was observed in the intervention group.
group on symptom self-management confidence, or on any of the primary outcome measures of the study, including mortality, event-free survival, and HF-related healthcare resource utilization.

There has been little research on the ways in which educational attainment influences the effectiveness of disease management programs. However, there has been substantial work on the relationship between health literacy and a variety of outcomes in chronic disease. Although the development of health literacy instruments such as the Test of Functional Health Literacy in Adults \(^{23}\) and the Rapid Estimate of Adult Literacy in Medicine \(^{24}\) has revealed important differences between formal educational attainment and the ability to comprehend and use health-related information, educational attainment has nonetheless been shown to correlate strongly with both literacy in general \(^{25}\) and health literacy. \(^{26}\) In contrast to the present findings, studies of the impact of health literacy on chronic disease have shown statistically significant differences in disease knowledge \(^{27}\) and chronic disease morbidity \(^{28}\) across a variety of chronic diseases. Health literacy has also

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**FIG. 2.** Adjusted average dietary sodium consumption by educational attainment. Analysis was adjusted for gender, race/ethnicity, age, Spanish language, and New York Heart Association (NYHA) class at enrollment.

**FIG. 3.** Adjusted average symptom self-management scores by educational attainment. Analysis was adjusted for gender, race/ethnicity, age, Spanish language, and New York Heart Association (NYHA) class at enrollment.
been found to mediate the effectiveness of disease management programs: Rothman and colleagues found, for example, that disease management intervention was more effective in improving hemoglobin A1c levels in a low literacy group than in a higher literacy group.\(^2^9\)

The divergence between our observations and published findings on health literacy and chronic disease/disease management outcomes may stem from any of a number of causes. The lack of difference across educational strata may be partly related to the self-selected nature of the study sample. Because the study was conducted in a research-only clinic outside of the normal hospital and outpatient setting, patients who enrolled in the study generally did so not on the advice of their primary care physician, but on their own initiative as a response to publicity about the study. This self-selection may have produced a sample in which the impacts of educational differentials were muted by a generally high degree of motivation for self-improvement in health status. The high degree of self-management confidence across all levels of educational attainment in our study supports the notion that this sample of patients may have had high intrinsic motivation for health status improvement. Alternatively, the failure to uncover a relationship between disease management outcomes and educational attainment in the present case may be due to the advantages conferred by the specialized, and likely more sensitive, health literacy-specific instrumentation used in other studies.

While novel, our findings are limited by the nature of the data available. Because the data on educational attainment and the secondary outcomes of the trial were collected by the organization which managed the disease management intervention, no such data are available for the population of patients in the control group. As a result, it is impossible to assess whether our positive finding of educational differences in sodium reduction is attributable to the intervention or is merely spurious. However, we believe these data are important in spite of this limitation, particularly since the chief findings are negative in nature—a patient’s educational attainment did not moderate the impact of the intervention. Even with data from intervention patients alone, if education had a strong impact on the effectiveness of disease management in HF, we should have seen a pattern of educational differentials in primary and secondary outcomes. Nonetheless, complete data from both intervention and control arms is an important condition for future studies. A second possible concern pertains to the nature of the utilization data. The bias of self-reported utilization data, particularly over long recall periods, is well known.\(^3^0\)

The bias inherent in self-reported utilization data might be compounded if the ability to recall prior utilization varies with a patient’s level of education. While the present data have some basis in self-report, the data collection process involved requesting records on encounters reported by patients as well as requesting records from all primary care and specialty physicians for the period of a patient’s participation in the trial. Furthermore, records were also requested and reviewed inductively without input from the patient. If, for example, a patient’s chart held evidence of an ED visit, inpatient discharge summary, or a consultation, records were obtained from the hospital or consulting physician. The exhaustive nature of the records search and request process resulted in a utilization database that provided the maximum possible reduction in self-report bias. For the same reason, we do not expect that educational attainment introduced additional bias in the utilization data.

There is a clear need for additional research to add to the body of evidence on this topic, and studies should continue to explore the impact that educational attainment—and socioeconomic status more generally—may have on the effectiveness of disease management programs. Studies of other chronic illnesses such as asthma and diabetes are natural directions for further inquiry, as are studies utilizing richer conceptualizations of socioeconomic status than were permitted by the present data.

Our results have potentially important implications for healthcare policy. Chiefly, they suggest that lack of educational attainment may not be a significant barrier for disease management programs implemented in broadly representative populations. The present results show no difference by educational
attainment in the clinical or utilization outcomes observed in the intervention group of a long-term disease management program in HF patients. Inasmuch as this suggests that low educational attainment may not hamper the potential positive benefit of disease management, this is encouraging. Moreover, our data provide some evidence that disease management may have the potential to produce notable behavioral change even in the least well-educated patients.

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