Effect of Difficulty Affording Health Care on Health Status After Coronary Revascularization

John Spertus, MD, MPH; Carole Decker, PhD; Catherine Woodman, MD; John House, MS; Phil Jones, MS; James O’Keefe, MD; A. Michael Borkon, MD

Background—An objective of the United States’ Healthy People 2010 Initiative is to eliminate disparities based on socioeconomic status. We assessed the effect of difficulty affording health care on the health status (symptoms, function, and quality of life) of patients treated with percutaneous coronary intervention or CABG.

Methods and Results—A consecutive, single-center cohort of 480 patients undergoing coronary revascularization received the Seattle Angina Questionnaire at the time of their procedure and at subsequent monthly intervals for 6 months. At baseline, patients who reported somewhat of a burden to a severe burden in affording health care had significantly lower scores on the Seattle Angina Questionnaire (mean ± SD) with respect to angina (55 ± 29 versus 68 ± 25, P < 0.0001), physical limitation (55 ± 26 versus 72 ± 24, P < 0.0001), and quality of life (46 ± 22 versus 56 ± 22, P < 0.0001) than those who did not perceive healthcare costs to be burdensome. Although both groups of patients improved after revascularization, poorer health status persisted among those with difficulty affording health care after percutaneous coronary intervention (6-month mean ± SE: angina 79 ± 2.5 versus 88 ± 1.9, P = 0.002; physical function 61 ± 2.7 versus 80 ± 2.0, P < 0.0001; quality of life 67 ± 2.4 versus 82 ± 1.8, P < 0.0001) but not after CABG (angina 91 ± 2.5 versus 93 ± 1.6, P = 0.47; physical function 75 ± 3.4 versus 81 ± 2.2, P = 0.13; quality of life 84 ± 3.1 versus 84 ± 2.0, P = 0.81). Similar differences remained after adjustment for demographic and clinical characteristics.

Conclusions—Patients reporting difficulty affording health care have worse health status at the time of coronary revascularization. A persistent disparity exists after percutaneous but not surgical revascularization. Additional inquiry into the mechanism of this disparity is needed so that the goals of equitable health care, irrespective of treatment strategy, can be achieved. (Circulation. 2005;111:2572-2578.)

Key Words: prognosis ■ angioplasty ■ bypass ■ angina ■ revascularization

Understanding potential disparities in the treatment and outcomes of cardiovascular disease has been a focus of numerous research efforts,1 and eradicating such disparities is an established goal of the US Department of Health and Human Services’ Healthy People 2010 Initiative.2 Such disparities may arise between gender, racial, or socioeconomic groups. Although many have studied racial- and gender-based disparities,3,4 limited data are available to describe the consequences of low socioeconomic status on the outcomes of patients treated for coronary artery disease. Because a fundamental consequence of poor socioeconomic status is difficulty affording medical care, examination of the outcomes of patients reporting such difficulties can identify potential socioeconomic disparities. Because there are many a priori reasons to anticipate a relationship between difficulty affording health care and outcome, which include poor access to care, delay in seeking care, inadequate treatment, more severe underlying disease, greater medical comorbidities, and poorer treatment adherence, describing the relationship between socioeconomic status and outcomes is an important first step toward creating more equitable health care.

To define the association between difficulty affording health care and outcomes, we analyzed a prospective registry of patients undergoing percutaneous coronary intervention (PCI) or CABG. Patients undergoing coronary revascularization provide a unique opportunity to explore the relationship between difficulties in affording health care and outcome. Patients being treated with either PCI or CABG have arguably overcome the potential challenges of getting adequate access to care, receiving state-of-the-art therapy, and having their underlying disease (ie, their coronary stenoses) treated. Furthermore, the needs for medical care after revascularization are known to be greater for PCI because of the greater need for repeat procedures and the greater reliance on posttreatment antianginal and antithrombosis therapy.5–7 It is thus possible that disparities in outcomes between those with and without difficulty affording health care might be greater after percutaneous as opposed to surgical treatment.

Received May 12, 2004; revision received January 22, 2005; accepted February 10, 2005.
From the Mid America Heart Institute of Saint Luke’s Hospital (J.S., C.D., J.H., P.J., J.O., A.M.B.), University of Missouri–Kansas City (J.S., C.D., J.O., A.M.B.), Kansas City, Mo; and the University of Iowa (C.W.), Iowa City, Iowa.
Correspondence to John Spertus, MD, MPH, FACC, Director of Cardiovascular Education and Outcomes Research, Mid America Heart Institute, 4401 Wornall Rd, Kansas City, MO 64111. E-mail: spertus@umkc.edu
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Circulation is available at http://www.circulationaha.org

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Rather than focus on the traditional outcomes of mortality and nonfatal infarction, we focused our assessments on quantifying patients’ disease-specific health status. Health status is a direct, patient-centered assessment of symptoms, function, and quality of life and a primary indication for treatment. By describing the effects of patients’ difficulty affording health care on the differences in their health status outcomes after coronary revascularization, we sought to identify novel determinants of outcome and to highlight opportunities to improve these outcomes in patients undergoing coronary revascularization.

Methods

Study Sample
The Post-Revascularization rEcovery and Survival Study (PRESS) enrolled a consecutive cohort of patients undergoing coronary revascularization at the Mid America Heart Institute of Saint Luke’s Hospital (Kansas City, Mo). The processes of patient recruitment and the mechanism, success, and potential selection biases of baseline health status data collection have been described previously. Two hundred seventy-one consecutive patients undergoing bypass surgery from February 8 to June 30, 1999 were eligible for the study. After having selected a mode of coronary revascularization with their physicians, patients were asked to participate in an observational research study documenting the recovery of their health status after coronary revascularization. Consenting patients were administered a series of questionnaires at baseline and monthly for 6 months after their procedures. These data were used to supplement an existing procedural database as described below. Approval from the Saint Luke’s Hospital Institutional Review Board was obtained for this study.

Patient Assessments

Assessment of Perceived Difficulty Affording Health Care
Many factors contribute to patients’ abilities to afford medical care in the United States, including income, number of dependents, level of debt, employment, health insurance, and prescription benefits (if any). Because it is difficult to measure and integrate these multiple factors, we developed a question that directly asks patients about their perceptions of their difficulty in affording health care. Patients were asked, “Have your medical costs been an economic burden to you over the past year?” Responses were recorded on a 5-point Likert scale ranging from “a severe economic burden” to “no burden at all.” Patients responding that their medical costs had been “somewhat” of a burden, a “moderate” burden, or a “severe” burden were classified as being “economically burdened,” whereas those responding that these costs were “a little of a burden” or “no burden at all” were considered not to have difficulty affording medical care and were classified as “not burdened.” Although this novel approach for quantifying patients’ difficulty in affording medical care warrants further study, evidence to support its validity was available from this investigation. Highly significant relationships were observed between both income (60% of burdened patients reported annual household income <$40,000 versus 33% of those not burdened, P < 0.0001) and paid employment (26% of burdened patients versus 42% of those without an economic burden, P = 0.002).

Clinical and Procedural Assessments of Disease Severity
The Mid America Heart Institute has maintained a procedural database for patients undergoing PCI since 1982. Trained nurses abstract a detailed description of coronary anatomy, left ventricular function, medical comorbidities, type and success of revascularization, and postprocedure complications using American College of Cardiology and Society of Thoracic Surgeons data definitions.

Assessments of Health Status

Health status assessments were performed with the Seattle Angina Questionnaire (SAQ), a 19-item, disease-specific measure for patients with coronary artery disease that has well-established validity, reproducibility, sensitivity to clinical change, and prognostic value. The SAQ quantifies 5 clinically relevant dimensions of coronary artery disease: physical limitation, anginal stability, anginal frequency, treatment satisfaction, and quality of life. The scales range from 0 to 100, where higher scores indicate better functioning, fewer symptoms, and higher quality of life. The primary measures of health status used in the present study included the SAQ angina frequency, physical limitation, and quality-of-life scores.

Statistical Analysis

Baseline demographic and clinical characteristics of economically burdened and nonburdened patients were compared. Categorical data are reported as frequencies and were compared with χ² or Fisher exact tests. Continuous data are reported as mean±SD and were compared with Student t tests. To describe the association of severity of economic burden and baseline health status, comparisons across each of the 5 economic burden response categories were performed with 1-way ANOVA. Comparisons of health status over time between burdened and nonburdened patients were conducted with repeated-measures ANOVA, stratified by the type of revascularization procedure.

The primary hypotheses of interest were (1) does health status at presentation of patients who report difficulty affording health care differ from those without such difficulties, and (2) does this difference persist after revascularization? These hypotheses were evaluated by point-wise comparisons of means at each assessment, with baseline and 6-month assessments considered to be of primary importance. Repeated-measures analyses were conducted with a cell means model for economic burden by time and an autoregressive moving-average covariance structure. Unadjusted means were calculated, as well as multivariable-adjusted estimates that incorporated baseline sociodemographic factors (age, race, and gender), clinical characteristics (hypertension, heart failure, renal disease, peripheral vascular disease, diabetes, cerebrovascular disease, and smoking), and disease severity markers (acute myocardial infarction, unstable angina, procedural urgency, number of diseased vessels, left main disease, and ejection fraction) that differed between burdened and nonburdened patients. Unless otherwise specified, health status estimates are summarized as mean±SEM, and estimated differences between burdened and nonburdened patients are presented with 95% CIs. Significance for all statistical tests was established as a probability value of ≤ 0.05. Analyses were performed with SAS version 8.2 (SAS Institute, Inc).

Handling of Missing Data

Of the 495 patients initially enrolled in the trial, 11 did not have economic burden information, and 4 did not complete their SAQ assessments at baseline or follow-up; these patients were not included in the analyses. Of the remaining 3360 patients, 3360 SAQs could have been completed across all 7 possible assessment times. Given the focus of the present study on the anginal frequency, physical limitation, and quality-of-life domains, 10,080 scores could have been calculated. Of these, 2.5% were missing because death had occurred by 6 months, 8.6% were not completed because of patients who did not participate in any follow-up surveys after their baseline assessment, and 17% were not completed by the patients (eg, partial completion of SAQ scales). For missing scores due to death or refusal to participate, no imputations for missing data were made.

To estimate the influence of missing covariate information and partially complete assessments, the primary analyses were replicated with multiple imputation methods, which incorporated baseline characteristics and other available health status information in the imputation model. These analyses showed no substantive differences, which suggests that any bias due to incomplete data was...
### Baseline Patient Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total Sample</th>
<th>CABG Patients</th>
<th>PCI Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Burden (n=166)</td>
<td>No Burden (n=314)</td>
<td>P</td>
</tr>
<tr>
<td><strong>Sociodemographic characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, y</td>
<td>66.3±10.8</td>
<td>63.6±11.8</td>
<td>0.02</td>
</tr>
<tr>
<td>White race</td>
<td>152 (92)</td>
<td>298 (96)</td>
<td>0.02</td>
</tr>
<tr>
<td>Male gender</td>
<td>103 (62)</td>
<td>222 (71)</td>
<td>0.05</td>
</tr>
<tr>
<td><strong>Clinical characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>125 (77)</td>
<td>219 (71)</td>
<td>0.18</td>
</tr>
<tr>
<td>History of heart failure</td>
<td>27 (17)</td>
<td>31 (10)</td>
<td>0.04</td>
</tr>
<tr>
<td>Renal disease</td>
<td>15 (10)</td>
<td>15 (5)</td>
<td>0.07</td>
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<tr>
<td>Peripheral vascular disease</td>
<td>24 (15)</td>
<td>47 (15)</td>
<td>0.89</td>
</tr>
<tr>
<td>Diabetes</td>
<td>56 (34)</td>
<td>78 (25)</td>
<td>0.04</td>
</tr>
<tr>
<td>Current smokers</td>
<td>31 (19)</td>
<td>46 (15)</td>
<td>0.27</td>
</tr>
<tr>
<td>History of cerebrovascular disease</td>
<td>34 (21)</td>
<td>36 (12)</td>
<td>0.007</td>
</tr>
<tr>
<td><strong>Disease severity characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute myocardial infarction</td>
<td>5 (3)</td>
<td>11 (4)</td>
<td>0.78</td>
</tr>
<tr>
<td>Unstable angina</td>
<td>63 (39)</td>
<td>111 (36)</td>
<td>0.59</td>
</tr>
<tr>
<td>Urgent status</td>
<td>12 (7)</td>
<td>24 (8)</td>
<td>0.90</td>
</tr>
<tr>
<td>Left main disease</td>
<td>16 (10)</td>
<td>46 (15)</td>
<td>0.12</td>
</tr>
<tr>
<td>No. of diseased vessels</td>
<td>2.3±0.8</td>
<td>2.35±0.8</td>
<td>0.73</td>
</tr>
<tr>
<td>Ejection fraction &lt;40%</td>
<td>50 (32)</td>
<td>90 (30)</td>
<td>0.65</td>
</tr>
<tr>
<td><strong>SAQ health status domains</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Physical limitation</td>
<td>55±26</td>
<td>72±24</td>
<td>0.0001</td>
</tr>
<tr>
<td>Angina frequency</td>
<td>55±29</td>
<td>68±25</td>
<td>0.0001</td>
</tr>
<tr>
<td>Treatment satisfaction</td>
<td>81±18</td>
<td>89±15</td>
<td>0.0001</td>
</tr>
<tr>
<td>Quality of life</td>
<td>46±22</td>
<td>56±22</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

Values are mean±SD or n (%).

No differences in mortality or repeat procedures were detected over time between those reporting an economic burden in affording their health care and those who did not. There were no in-hospital deaths among economically burdened patients compared with 4 (1%) among those not economically burdened (P=0.15). During the first 6 months of follow-up, there were 5 deaths (3%) and 23 repeat procedures (14%) among those with an economic burden, which was not significantly different from the 10 deaths (3%) and 28 repeat procedures (9%) among those without an economic burden (P=0.47 and 0.09, respectively).

**Role of the Funding Source**
The sponsors had no role in study design, data collection, data analysis, data interpretation, the writing of the report, or the decision to submit the paper for publication.

**Results**
Overall, 35% of patients reported a burden in affording their medical care. With respect to type of procedure, 31% of patients undergoing surgical revascularization, and 37% of those having a percutaneous procedure reported an economic burden. The Table describes the sociodemographic, economic, clinical, disease severity, and health status characteristics of the patient sample. Significant differences among those with and without a self-reported economic burden were noted for age, race, gender, diabetes, history of heart failure, and history of cerebrovascular disease.

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**Relationship Between Difficulty Affording Health Care and Health Status at Time of Revascularization**
Baseline health status was strongly associated with perceived economic burden at the time of coronary revascularization. Scores (mean±SD) for patients reporting difficulty in affording health care were substantially lower than for those not reporting such difficulties (physical limitation=55±26 versus 72±24, angina frequency=55±29 versus 68±25, and quality of life=46±22 versus 56±22; P<0.0001 for all). This relationship was present regardless of the mode of coronary revascularization (Table). Furthermore, a strong association between health status and economic burden within gradations of the Likert responses on the economic burden question was observed (Figure 1). In general, the greater the economic burden reported by patients, the greater their physical limitations, the more frequent their angina, and the worse their quality of life (P<0.0001 by 1-way ANOVA with a significant test for linear trend [P<0.001] for all SAQ domains).
Effect of Economic Burden on Health Status
Recovery After Revascularization

Both patient groups experienced improvements in the control of their angina and quality of life after revascularization. Figure 2 plots the mean health status scores over time for the SAQ angina frequency, physical limitation, and quality-of-life domains by type of revascularization. For PCI patients, the mean baseline difference in SAQ angina frequency scores was 14.7 points worse (95% CI 9.0 to 20.4) in economically burdened patients, and their follow-up scores were significantly lower throughout the next 6 months of follow-up ($P_{\text{baseline}}=0.043$ at month 1; $P<0.01$ at all other time points; 9.6 points lower at 6 months, 95% CI 3.4 to 15.8, $P=0.002$). For patients treated surgically, the baseline difference in angina frequency was 9.6 (95% CI 4.4 to 14.8), but these differences dissolved 1 month after the procedure and were not signifi-
cant throughout follow-up ($P>0.36$ for all subsequent time points). A similar pattern of statistically significant differences in SAQ quality-of-life scores was observed at baseline and throughout follow-up among those treated with PCI, and only baseline differences without any significant posttreatment differences in scores were seen among patients revascularized surgically (Figure 2). For the SAQ physical limitation scale, large differences between those with and without an economic burden were seen at all time points after PCI. Although surgery reduced the disparity in scores, some significant differences between groups were noted during follow-up (Figure 2).

**Multivariable Models of Health Status Recovery**

Multivariable repeated-measures analyses tested the association of economic burden and health status after adjustment for baseline differences in patient demographic, clinical, and disease severity characteristics between those with and without perceived difficulty in affording their medical care. Among patients treated with PCI, economic burden retained a strong association with all 3 health status domains both before and after revascularization after adjustment for age, gender, race, hypertension, diabetes, history of heart failure, and cerebrovascular disease. Baseline and 6-month differences are shown in Figure 3; all differences were statistically significant except for angina frequency at 6 months, which was marginally significant ($P=0.08$) but still suggestive of greater residual symptoms among burdened patients. In contrast, among those treated surgically, baseline disparities in health status disappeared by 6 months ($P>0.42$ for all), consistent with the unadjusted results. These data demonstrate that after PCI, patients reporting burdensome healthcare costs have worse control of their angina, more physical limitations, and worse quality of life both before and after revascularization, whereas such baseline differences were resolved after bypass surgery.

**Discussion**

Using a well-validated measure of health status, this study reports substantial differences in the presentation and outcomes of patients undergoing coronary revascularization with and without a perceived economic burden in affording their health care. Regardless of the procedure performed (PCI or CABG), those with an economic burden had more angina, worse physical function, and poorer quality of life at the time of their procedure than those without a burden. The absence of differences in coronary anatomy, left ventricular function, or clinical setting (acute myocardial infarction, unstable angina, or urgent procedure status) argues that the differences in baseline health status were not simply due to more severe underlying disease. Whether this reflects poorer access to care such that patients present later in the course of their disease, poorer adherence with recommended medical therapies before revascularization, or some other factor will need to be explored in future studies.

Once the decision to perform revascularization is made, the choice of technique is often based on the amenability of the coronary anatomy to alternative revascularization strategies. Although this approach of choosing between percutaneous and surgical procedures seems appropriate when mortality is the outcome of interest, it may not be ideal when patient-centered outcomes, such as symptoms, function, and quality of life are considered. The present study detected important disparities in the health status outcomes of patients with and without difficulty affording health care based on the technique of revascularization that they received. Among patients treated with PCI, economically burdened patients had significantly worse physical function, angina control, and quality of life throughout the 6 months after their procedure than nonburdened patients undergoing PCI. In contrast, a disparity in postrevascularization health status outcomes was not observed among surgically treated patients.

Several potential explanations may account for these findings, including limited access to follow-up care, physician-patient relationships, time devoted to counseling and education, delays in seeking additional treatment for recurrent symptoms, and poor adherence to adjunctive medical therapy. This latter explanation appears likely in light of previous
investigations. Several recent clinical trials have demonstrated that patients treated percutaneously have a greater need for medications to control their angina than patients treated surgically. For example, 1 year after revascularization in the Arterial Revascularization Therapies Study, only 21.1% of stented patients were not treated with antianginal medicines compared with 41.5% of surgical patients (P<0.001). Similarly, 5 years after revascularization in the Balloon Angioplasty Revascularization Investigation, only 24% of percutaneously revascularized patients did not require antianginal medications compared with 43% of surgically treated patients. Given the greater need for medications after percutaneous revascularization, we suspect that limited access to these medications may explain the worse health status outcomes (symptoms, function, and quality of life) observed after treatment among those who report difficulty in affording their health care.

The absence of insurance coverage for prescription drugs in low-income and elderly patients has been called “a glaring defect in the American healthcare system.” The challenge for Americans, not just the poor, to obtain access to medications is likely to increase because the cost of prescription drugs is the fastest-growing component of personal health expenditures. The cost of drugs is particularly important in coronary artery disease because the disease is so prevalent (>12 million affected Americans in 1998) and because it is a chronic condition that requires indefinite medication use. Although socioeconomic factors are not generally considered the most important predictors of adherence, a recent study that provided free medications to indigent cardiac patients reported an improvement in medication adherence, blood pressure control, and lipid management. Future research will need to be conducted to determine whether access to supplemental medications mediates the effects observed in this study and whether different prescription benefit programs can overcome the observed disparities in health status outcomes.

There are several potential limitations to the present study. First, it is difficult to collect serial health status data on a consecutive cohort of patients, and there was an attrition of patients over time from the study. Although no significant difference between economic burden and participation in follow-up was detected (89.6% of patients without an economic burden participated in at least 1 follow-up survey versus 86.7% of those with an economic burden, P=0.34), we cannot exclude a potential bias due to nonresponders. A second weakness is that these data come from one center. Replication of these results in other settings would support the findings. A third limitation is that careful quantification of patient medication use at the time of their procedure or during follow-up was not available. Although we postulate this as a potential mechanism for our findings, we are unable to explore whether need for or access to medications mediates these results. Such analyses will need to be conducted in future investigations. Finally, the present study did not directly compare surgical and percutaneous revascularization techniques. Thus, the finding of a disparity in one treatment arm but not the other does not necessarily mean that CABG is a better treatment for patients reporting difficulties in affording health care. Such a conclusion could best be reached with a randomized trial of PCI and CABG in patients who have difficulty affording medical care.

In summary, we observed that patients requiring revascularization who reported difficulty affording their medical care had worse symptoms, function, and quality of life at the time of their procedure than patients without such financial difficulties. Although improvements in health status were observed for both groups of patients after both percutaneous and surgical revascularization, the baseline disparity for patients with and without difficulty in affording health care persisted after PCI but dissolved after CABG. Examination of patient-centered outcomes, such as the frequency of angina, physical function, and quality of life, is important because patients are at least as concerned with the quality of their lives as with their longevity. As a broader range of outcomes is considered, new factors will warrant consideration when therapy is recommended to patients. Whereas a recent survey suggests that 88% of physicians report that patients’ costs are an important consideration when selecting medications for their patients, it follows that similar considerations might be appropriate when choosing the mode of coronary revascularization. Such thought processes may maximize patients’ outcomes when they have difficulty affording the costs of their medical care and may ultimately reduce the observed disparities in outcome. More importantly, these findings may stimulate future research to understand the mechanism of these observed disparities so that novel strategies to overcome them in percutaneously treated patients may be developed.

Acknowledgments

This project was supported in part by an unrestricted grant from Searle Pharmaceuticals and by R-01 HS11282-01 from the Agency for Healthcare Research and Quality.

References


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_Circulation_. 2005;111:2572-2578; originally published online May 9, 2005; doi: 10.1161/CIRCULATIONAHA.104.474775

_Circulation_ is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0009-7322. Online ISSN: 1524-4539

The online version of this article, along with updated information and services, is located on the World Wide Web at:
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