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Financial Strain is Associated with Medication Nonadherence and Worse Self-rated Health among Cardiovascular Patients

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Abstract

Non-traditional indicators of socioeconomic status (SES; e.g., home ownership) may be just as or even more predictive of health outcomes as traditional indicators of SES (e.g., income). This study tested whether financial strain (i.e., difficulty paying monthly bills) predicted medication non-adherence and worse self-rated health. Research assistants administered surveys to 1,527 patients with acute coronary syndromes or acute decompensated heart failure. In adjusted models, a higher income was associated with greater adherence ($p < .001$), but was non-significant when adjusted for financial strain. Education, income, less financial strain, and being employed were each associated with better self-rated health ($p < .001$). Financial strain was associated with less adherence ($\beta = -.17, p < .001$) and worse self-rated health ($\beta = -.23, p < .001$), and mediated the effect of income on adherence (coeff = .078 [BCa 95% CI: .051 to .108]). Future research should further explore the nuanced link between SES and health behaviors and outcomes.

Keywords

Cardiovascular disease; socioeconomic status; financial strain; medication adherence; self-rated health; disparities

Cardiovascular disease (CVD) studies have identified disparities by age, gender, and race/ethnicity in disease prevalence, management, and outcomes.¹⁻³ As research has sought to determine what factors may underlie these disparities, socioeconomic status (SES) and

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medication adherence are particularly interesting. For example, macro indicators of SES (e.g., education, income) and micro indicators of SES (e.g., owning a home, having a checking account) have predicted CVD outcomes and have explained racial/ethnic disparities in CVD outcomes.⁴ In addition, medication adherence, the primary self-care behavior for patients with CVD, has explained both disparities in blood pressure control⁵ and disparities in emergency room visits for heart failure exacerbation, heart failure and cardiac rehospitalization, and all-cause mortality.⁶ For patients with CVD and heart failure, nonadherence to medications is common⁷ and has been associated with increased risk of adverse outcomes, including cardiovascular events,⁸ hospitalizations⁹ or readmission following a myocardial infarction,¹⁰ as well as premature mortality¹⁰⁻¹². Non-adherence is also associated with increased health care costs.^{9, 13}

Certain populations that tend to be at greater risk for non-adherence include people who are younger,³ female,^{3, 14} have health literacy limitations,¹⁵ are racial/ethnic minorities,^{16, 17} have less education,¹⁸ or have lower incomes.¹⁹ Among lower-income groups, having a copayment for statin therapy has distinguished between patients who are more or less adherent to their medications,²⁰ suggesting a more nuanced relationship may exist between indicators of SES and medication adherence, and, separately, health status among people with CVD. However, few studies have operationalized SES using indicators beyond education and income—for example, financial strain.

In 2014, the Institute of Medicine released a report recommending certain social and behavioral domains and measures be captured in the electronic health records (EHR).^{21, 22} The committee selected 11 domains and measures based on adequate evidence of associations with health outcomes and the utility of having the information available within the EHR. *Financial resources strain* is to be assessed with a single question asking, “How hard is it for you pay for the very basics like food, housing, medical care, and heating? Would you say it is very hard, somewhat hard or not hard at all?”²³ While there is no common metric for assessing financial resource strain, asking a single question is accepted, freely available, and has a strong association with health status.²³

Recent research suggests non-traditional, micro indicators of SES such as financial strain and owning a home may be just as or even more predictive of health status as traditional, macro indicators of SES (e.g., education, income).⁴ Moreover, depending on both the disparity in question and the outcome of interest, macro and/or micro SES indicators may explain disparities in CVD-related outcomes.⁴ In an effort to expand upon this work, this study tested whether a micro indicator of SES, specifically financial strain operationalized as having difficulty paying monthly bills, was associated with non-adherence to home medications and worse self-rated health among patients admitted to the hospital for a CVD-related event while controlling for macro indicators of SES (i.e., education and income). This study also tested whether financial strain explained disparities in medication adherence and self-rated health attributed to traditional, macro SES indicators.

Methods

Participants

The Vanderbilt Inpatient Cohort Study (VICS) is a prospective cohort study of patients with CVD admitted to Vanderbilt University Hospital (VUH) in Nashville, Tennessee or Williamson Medical Center (WMC) in Franklin, Tennessee. Recruited patients were 18 years of age or older and hospitalized with a diagnosis of acute coronary syndrome (ACS) and/or acute decompensated heart failure (ADHF), as determined by medical record review conducted by a physician. Exclusion criteria consisted of severe cognitive impairment or altered mental status, unstable psychiatric illness, the inability to communicate in English, previously enrolled in the study, or being on hospice, too ill to participate in the interview (e.g. were intubated or were on severely sedative medications), or discharged following eligibility screening. Patients enrolled in VICS from October 2011 to January 2014 were included in this analysis.

Procedures

Details of the VICS design and procedures have been described elsewhere.²⁴ In short, after providing written informed consent, participants completed a series of interviewer-administered baseline measures in their hospital room. The interview lasted 45 minutes. Trained research assistants (RAs) who performed these interviews collected data on a range of patient and social factors, including financial strain, medication adherence, self-rated health, and demographic characteristics, prior health status, and socioeconomic status. All data were then entered directly into the Research Electronic Data Capture (REDCap).²⁵ All study procedures were approved by the Vanderbilt University Institutional Review Board prior to participant enrollment.

Measures

Predictor variable

Financial strain: Financial strain was assessed with a single item that asked participants, “How difficult is it for you (and your family) to pay your monthly bills?” Response options were 1 = not at all difficult, 2 = not very difficult, 3 = somewhat difficult, or 4 = very difficult.

Criterion variables

Medication adherence: Adherence to the home medication regimen was measured using a shortened, 7-item version of the 12-item Adherence to Refills and Medications Scale.²⁶ The ARMS-7 has a correlation coefficient of .95 with the full-length measure (ARMS-12²⁶), allowing us to decrease interview length while accurately assessing this concept. The ARMS measure asks patients to report adherence to refilling prescriptions and taking their home medications in the past year. Response options were 1= none of the time, 2 = some of the time, 3 = most of the time, or 4= all of the time. The total ARMS-7 score is a continuous value ranging from 7 to 28, with higher scores indicating more problems with adherence. For ease of interpretation, we reverse scored the ARMS items so higher scores indicated better adherence. If participants answered six, but not all seven of the questions, their overall

score was scaled up using an average of the valid responses, allowing us to recapture missing values. The ARMS-7 was not administered to participants who reported not taking any medications (prescription or over-the-counter) prior to hospital admission.

Self-rated health: The first five items from the 10-item Patient-Reported Outcome Measurement Information System (PROMIS) Global Health Scale²⁷ constitutes our measure of self-rated health, and assesses physical, mental, and social health status as well as quality of life on a 5-point Likert response scale. Response options were 1 = poor, 2 = fair, 3 = good, 4 = very good, or 5 = excellent. The last five items assess domains (e.g., pain) that are likely to fluctuate among acutely ill hospitalized patients and were not administered in the baseline survey. The mean of all five items was calculated, and higher scores indicated better self-rated health.

A priori covariates

Demographic characteristics: Age and gender data were collected from the electronic medical record prior to the interview, and self-reported race/ethnicity was collected during the interview. Self-reported race/ethnicity was dichotomized (0=non-Hispanic White [NHW], 1=Black, Hispanic, or other).

Prior health: Hospitalizations in the past year served as the proxy for prior health. Participants were asked, “How many times have you been hospitalized in the last 12 months, not counting this time?” To address this variable's non-normality, it was dichotomized into 0=no hospitalizations and 1= at least one hospitalization.

Socioeconomic status: Socioeconomic information, such as educational attainment, employment status, and annual household income was also collected during the interview. Participants were asked to report the highest grade or year of school they had completed. Employment status was recorded as employed for wages (part-time or full-time), self-employed, retired, unable to work (disabled), out of work for more than one year, out of work for less than one year, or a homemaker. These categories were later collapsed into 0=unemployed (retired, disabled, out of work, or homemaker) and 1=employed (for wages or self-employed). Annual household income was self-reported and coded into one of nine possible categories, ranging from less than \$10,000 to more than \$100,000.

Analyses

Analyses were performed using SPSS 21.0. Cronbach's α assessed the internal consistency of the ARMS-7 and PROMIS Global-5. Means and standard deviations or frequencies summarized our observed variables. Spearman's rho correlation coefficients and a single Mann-Whitney test examined the bivariate relationships between financial strain and medication adherence, medication adherence and self-rated health, financial strain and self-rated health, and financial strain and each macro indicator of SES (i.e., education, employment status, income). Finally, two four-step multiple linear regression models with pairwise deletion (to maximize all available data) tested the unique contribution of financial strain in determining home medication adherence and self-rated health after adjusting for *a priori* covariates at one of three steps. In our largest model, we estimated eight predictors

with $N=1,527$. Power is optimized to detect even a small effect with 30 participants per predictor,²⁸ and we had a ratio of 190.87 per predictor. First, ARMS-7 scores were regressed on demographic characteristics (age, gender, race/ethnicity) in Step 1, prior health in Step 2, macro SES indicators (education, employment status, income) in Step 3, and financial strain in Step 4. Second, PROMIS Global-5 scores were regressed on the same variables entered into the model at each of the four steps previously described. Finally, when the introduction of financial strain in Step 4 reduced the effect of variables entered in Steps 1-3 on the outcome of interest, tests for indirect effects with bootstrapped (5,000 samples) bias-corrected and accelerated (BCa) confidence intervals^{29, 30} were performed to test whether financial strain mediated the relationship between the predictor and the outcome.

Results

Of the 6,719 patients admitted for ACS and/or ADHF from October 2011 to January 2014, 3,645 (54.2%) were not eligible for enrollment for reasons such as being discharged, too ill, previously enrolled, or having impaired cognition. Trained RAs approached the 3,074 eligible patients and 1,132 declined additional screening. Of the 1,942 fully eligible patients, RAs enrolled 1,545 (79.6%), as 397 patients were either discharged after they had been screened or elected to not participate after the details of informed consent. Finally, 18 patients were withdrawn because they did not complete the baseline interview or asked to be removed from the study, resulting in 1,527 participants included in this analysis. As shown in Table 1, participants were on average 59.97 ± 12.79 years old and predominately non-Hispanic White (81.7%). The majority of participants were male (56.2%), had some college education (54.6%), and had an annual household income greater than 35K (50.1%). Two-thirds of participants were not employed (67%), and nearly two thirds had a diagnosis of ACS (63.3%). More than half (52.8%) of participants reported being hospitalized at least once in the past year. Participants were relatively adherent to their home medications (a median of 26 on a 7-28 scale), and rated their health as average (a mean of 2.92 on a 1 – 5 scale). In our sample, the ARMS-7 was both unidimensional and internally consistent with a Cronbach's alpha of .93. Additionally, the PROMIS Global-5 was also unidimensional and internally consistent with a Cronbach's α of .83.

Spearman's rho and Mann-Whiney U examined bivariate relationships. Having more financial strain was significantly associated with being less adherent to home medications (Spearman's $\rho = -.24, p < .001$). Medication adherence was significantly associated with better self-rated health (Spearman's $\rho = .21, p < .001$), but medication adherence did not mediate the relationship between financial strain and self-rated health in unadjusted (indirect effect = $-.022$ [BCa 95% CI: $-.034$ to $-.013$]) or adjusted analyses (indirect effect = $-.016$ [BCa 95% CI: $-.027$ to $-.009$]). In addition, having more financial strain was significantly associated with worse self-rated health (Spearman's $\rho = -.37, p < .001$). Finally, having more financial strain was also associated with having less education (Spearman's $\rho = -.26, p < .001$), being unemployed (2.44 ± 1.13 vs. $2.18 \pm 1.03, p < .001$), and having a lower income (Spearman's $\rho = -.47, p < .001$).

According to a four-step hierarchical linear regression model, being younger and being a racial/ethnic minority was significantly associated with being less adherent to home

medications in all four steps, whereas being female was significantly associated with being more adherent to home medications in the last two steps, after macro and micro SES indicators were in the model. Prior health, education, and employment status were not associated with home medication adherence at any step. In Step 3, having more income was significantly associated with being more adherent to home medications ($p < .001$), but that relationship was reduced to non-significance when financial strain was introduced in Step 4. In Step 4, having more financial strain was significantly associated with being less adherent to home medications ($\beta = -.17, p < .001$), explaining 2.1% of unique variance in ARMS-7 scores (Total $R^2 = 11.5\%$).

Table 3 presents the indirect effects of income on medication adherence via financial strain. Having more income was associated with being more adherent (total effect, $p < .001$), but this relationship was attenuated to non-significance when adjusted for financial strain (direct effect, $p = ns$), such that income was related to adherence via financial strain (indirect effect = .078 [BCa 95% CI: .051 to .108]).

According to a second four-step hierarchical linear regression model (see Table 4), male gender was associated with worse self-rated health in Steps 1 and 2, but this relationship was no longer significant when SES variables were introduced in Step 3. Race/ethnicity was not related to self-rated health at any step. By Step 4, reporting worse prior health was associated with worse self-rated health, and older age and higher SES were each associated with better self-rated health (all $p < .001$). Furthermore, having more financial strain was significantly associated with worse self-rated health ($\beta = -.23, p < .001$), explaining 3.8% of unique variance in self-rated health scores (Total $R^2 = 26.2\%$). The introduction of financial strain in Step 4 did not change the relationships between variables entered into the equation at Steps 1-3 and self-rated health, so indirect effect tests were not performed to test for financial strain as a mediator of those relationships.

Discussion

This study examined the relationships between financial strain, medication adherence, and self-rated health in a large sample of patients hospitalized for acute coronary syndrome and/or heart failure. Participants reporting more financial strain were significantly less adherent to their home medications, and this effect persisted after adjustment for demographic characteristics, prior health care utilization, and traditional, macro indicators of SES. Financial strain was also independently associated with worse self-rated health, after adjustment for the same covariates. This research both supports the IOM's recent recommendation to measure *financial resource strain* in EHRs^{21, 22} and sheds light on the importance of perceived financial circumstances, in this case difficulty paying bills, above and beyond traditional markers of SES such as education, employment status and income.

Furthermore, financial strain mediated the relationship between income and medication adherence, but did not mediate the relationships between income (employment status or education) and self-rated health. In this latter instance, the traditional markers for SES, education, employment status and income, remained significantly associated with self-rated health along with financial strain. When it comes to adhering to one's medication regimen,

the actual amount of annual income a person has is apparently not as critical as whether or not that amount is sufficient to meet one's monthly expenses. To our knowledge, this is one of the first reports of the critical role that discrepancies between income and expenses (i.e., *financial strain*) plays in understanding why patients with heart disease might not take their medication as prescribed.

There were other findings related to medication adherence worth noting. Older age was associated with better adherence to home medications, a finding consistent with other studies.^{3, 14} Female gender was associated with better adherence, which is inconsistent with a few others that have found the opposite relationship.^{3, 17, 18, 31} However, this relationship did not become significant until SES indicators were entered into the model. In addition, being a racial/ethnic minority was significantly associated with being less adherent, as reported consistently in the literature.^{16, 17} Interestingly, in this sample of cardiovascular patients, race/ethnicity was unrelated to self-rated health, as was gender, once prior health was entered in the model in Step 3. Without controlling for prior health, however, males rated their health more favorably than females did.

Cost-related underuse of medications is a widespread problem regardless of the health context. In a representative sample of older adults in the U.S., 20% reported cost-related nonadherence, and financial stress, operationalized as having a higher out-of-pocket payment for medications and a lower net worth, and each were significantly associated with nonadherence.³² People reporting cost-related underuse of medications are also more likely to be hospitalized than those who do not report cost-related underuse.³³ However, providing full drug coverage improves medication adherence among both racial/ethnic minorities and Whites, but the health benefits for minorities are profound, with a reduction in major cardiovascular events or revascularization by 35% and reduced health care spending by 70%.³⁴

There are several study limitations to acknowledge. First, participants were recruited from an academic medical center and an affiliated community hospital and had a relatively high SES on average, and only 18% of participants were members of racial/ethnic minority groups. The nature of the study population may limit generalizability, particularly to settings with patients that have lower SES or a high percentage of racial/ethnic minorities. Second, though validated measures were employed, outcome variables were self-reported and may be subject to social desirability. We also shortened the ARMS, and our results may be limited by skewed responses to this measure for participants who did not answer all questions (i.e., a dilution effect). Third, the variable no hospitalizations versus at least one hospitalization in the past year was used as a proxy for health status, and, for patients with multiple admissions, interviewing at the first admission impacts this outcome. Finally, while RAs were trained on data entry and management, as with all studies, data entry errors may have affected our results.

Balancing out those limitations, however, were a number of strengths. Our sample size was relatively large and, in this referral center, consisted of patients from over 15 different states, spanning 150 different counties. There was a high rate of enrollment from eligible patients. Our self-report measures of medication adherence and health status were from previously

validated instruments that were administered by highly trained RAs who entered the data directly into the REDCap data management system. Finally, the survey includes patients hospitalized with two different, but prevalent conditions, ACS or ADHF, thus increasingly the likelihood the findings apply broadly to cardiovascular patients.

In summary, having difficulty paying monthly bills determined medication nonadherence and worse self-rated health beyond age, gender, race/ethnicity, education, employment status and income. Our findings are consistent with recent literature suggesting nontraditional indicators of SES such as whether someone has a checking account⁴ or lives in a higher SES community³⁵ (e.g., determined by proportion of car and home owners, welfare recipients) are important predictors of CVD outcomes. Our study particularly adds to a limited literature examining the link between nontraditional SES indicators, specifically financial strain, and health behaviors³⁶ and self-rated health.³⁷ Linking *financial strain* to CVD outcomes and their disparities highlights the need for socio-medical interventions such as improving access to affordable medications and upstream social policies to promote equity. Research to further this agenda must adequately measure the more nuanced aspects of SES.

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Table 1Participant characteristics ($N = 1527$).

	<i>n</i> (%) or <i>M</i> ± <i>SD</i>
Age	59.97 ± 12.79
Gender, female	669 (43.8)
Race/ethnicity, non-White	279 (18.3)
Education, years	13.48 ± 2.94
0-8 years	67 (4.4)
9-11 years	155 (10.2)
12/GED years	472 (30.9)
13-15years	456 (29.9)
16 years	197 (12.9)
17+ years	180 (11.8)
Employment status, employed	504 (33.0)
Annual household income, dollars	
0 to 9,999	114 (7.7)
10,000 to 14,999	118 (8.0)
15,000 to 19,999	108 (7.3)
20,000 to 24,999	170 (11.5)
25,000 to 34,999	228 (15.4)
35,000 to 49,000	252 (17.0)
50,000 to 74,999	203 (13.7)
75,000 to 99,999	142 (9.6)
100,000 +	145 (9.8)
Prior hospitalizations [‡]	801 (52.8)
Primary diagnosis	
Acute coronary syndromes (ACS)	967 (63.3)
Acute decompensated heart failure (ADHF)	452 (29.6)
Both ACS and ADHF	108 (7.1)
Medication adherence, 7-item ARMS score [†] (range 7-28)	25.6 ± 2.52
Self-rated health, 5-item PROMIS score (range 1-5)	2.93 ± 0.85

Notes. M = mean; SD = standard deviation; GED = general education development;

[‡]dichotomized as 0 = no hospitalizations or 1 = at least one hospitalization in the past year;

[†]the ARMS score was reversed, so high scores mean better adherence;

ARMS = Adherence to Refills and Medications Scale

PROMIS = Patient-Reported Outcome Measurement Information System

Table 2
 Hierarchical multiple regression models presenting the unique contribution of financial strain on medication adherence.

Predictors	Step 1	R ²	Step 1 Demographics	Step 2 + Prior health	Step 3 + SES	Step 4 + Financial strain
			.08 ^{***}			
Age	β		.22 ^{***}	.22 ^{***}	.19 ^{***}	.16 ^{***}
Gender (1 = female)	β		.03	.03	.06 [*]	.06 [*]
Race/ethnicity (1 = non-White)	β		-.14 ^{***}	-.14 ^{***}	-.12 ^{***}	-.14 ^{***}
				.00		
Prior health [‡] (1 = 1 hospitalizations)	β			-.01	.01	.02
					.02 ^{***}	
Education	β				.05	.04
Employment status (1 = employed)	β				-.04	-.03
Income	β				.12 ^{***}	.05
						.02 ^{***}
Financial strain	β					-.17 ^{***}
Total R ²			.08	.08	.09	.11

Notes. SES = socioeconomic status;

[‡] dichotomized as 0 = no hospitalizations or 1 = at least one hospitalization in the past year.

* $p < .05$;

**

$p < .01$;

$p < .001$

Table 3

Indirect effect test of income on medication adherence via financial strain.

	Income
Predictor to financial strain (a path)	-.20***
Financial strain to medication adherence (b path)	-.39***
Total effect of predictor on medication adherence (c path)	.13***
Direct effect of predictor on medication adherence (c' path)	.05
Partial effect of control variables on medication adherence	
Age	.03***
Gender (1 = female)	.32*
Race/ethnicity (1 = non-White)	-.85***
Prior health [‡] (1 = 1 hospitalizations)	.14
Education	-.21
Employment status(1 = employed)	.04
Indirect effect of predictor on medication adherence via financial strain (ab paths)	.078 [‡] (.051, .108)

Notes.[‡] dichotomized as 0 = no hospitalizations or 1 = at least one hospitalization in the past year.[‡] point estimate (95% BCa bootstrap CI).* $P < .05$;*** $P < .001$

Table 4

Hierarchical multiple regression models presenting the unique contribution of financial strain on self-rated health.

Predictors	Step 1	R ²	Step 1 Demographics	Step 2 + Prior health	Step 3 + SES	Step 4 + Financial strain	
	Step 1	R ²	.03	***			
Age	β		.10	***	.13	***	
Gender (1 = female)	β		-.13	***	-.03	-.03	
Race/ethnicity (1 = non-White)	β		-.04	-.02	.02	.00	
	Step 2	R ²		.08	***		
Prior health [‡]				-.28	***	-.21	***
	Step 3	R ²			.12	***	
Education	β				.10	***	
Employment status (1 = employed)	β				.18	***	
Income	β				.21	***	
	Step 4	R ²				.04	***
Financial strain	β					-.23	***
Total R ²			.03	.11	.22	.26	

Notes. SES = socioeconomic status;

[‡] dichotomized as 0 = no hospitalizations or 1 = at least one hospitalization in the past year.

* $p < .05$;

** $p < .01$;

*** $p < .001$