Medication Non-Adherence After Myocardial Infarction: An Exploration of Modifying Factors

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BACKGROUND: Medication non-adherence is a major impediment to the management of cardiovascular disease risk factors. A better understanding of the modifying factors underlying medication non-adherence among individuals with known cardiovascular disease may inform approaches for addressing non-adherence.

OBJECTIVE: The purpose of this study was to identify demographic and patient characteristics, medical comorbidities, psychosocial factors, and health belief-related factors associated with medication non-adherence among patients with known cardiovascular disease.

DESIGN: We performed secondary analysis of baseline data from a randomized trial.

PATIENTS: The study included 405 patients with a diagnosis of hypertension and history of acute myocardial infarction that was diagnosed within a three-year period prior to enrollment.

MAIN MEASURES: Baseline demographics and patient characteristics, medical comorbidities, psychosocial factors, health belief-related factors, and patient-reported medication non-adherence were analyzed.

KEY RESULTS: Of 405 patients, 173 (42.7 %) reported medication non-adherence. Factors associated with non-adherence in bivariate analysis included younger age, non-white race, having less than 12 years of education, smoking, financial insecurity, identifying as nervous or tense, higher life chaos score, greater worry about having a myocardial infarction, and greater worry about having a stroke. Using multivariable modeling, we determined that age (OR 0.97 per additional year, 95 % CI, 0.95–0.99), life chaos (OR 1.06 per additional point, 95 % CI, 1.00–1.11), and worry about stroke (OR 1.12 per additional point, 95 % CI, 1.01–1.25) remained significantly associated with self-reported medication non-adherence.

CONCLUSIONS: We found that worry about having a stroke, higher life chaos, and younger age were all significantly associated with self-reported medication non-adherence in patients with cardiovascular disease and a history of myocardial infarction. Further research exploring these factors as targets for intervention is needed, as is additional research examining modifiable causes of medication non-adherence among patients with cardiovascular disease.

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INTRODUCTION

Cardiovascular disease is the leading cause of mortality in the United States.[1] Despite evidence regarding the benefits of cardiovascular disease risk factor control and the existence of effective treatment strategies, less than half of affected individuals achieve guideline-recommended targets for risk factors such as hypertension, dyslipidemia, and diabetes.[2] Medication non-adherence is a well-established cause of failure to meet recommended management goals for cardiovascular disease risk factors.[3]

Non-adherence to medications is common for patients with chronic conditions like cardiovascular disease.[4] Even among patients with known complications such as myocardial infarction, non-adherence to secondary preventive medications remains prevalent. In one report, over 50 % of patients with cardiovascular disease were not consistently taking recommended medications.[5] Medication non-adherence in this patient population is associated with poorer risk factor control, a higher incidence of mortality and recurrent cardiac events, and higher costs.[4,6,7] Improving medication adherence among patients with cardiovascular disease could improve risk factor control and reduce complications and costs.

According to the Health Belief Model, which explains patient engagement in health behaviors such as medication adherence, various "modifying factors" affect how patients perceive the threat of health problems like cardiovascular disease—and ultimately, their likelihood of adhering to recommended medications.[8] In order to inform the development of strategies to enhance cardiovascular disease medication adherence, studies have sought to identify factors associated with non-adherence. Known correlates of suboptimal medication adherence among patients with cardiovascular disease include demographic factors,[5,9–12] certain socioeconomic

factors (e.g., under-insurance, education level),[9,10] and medical comorbidities.[5,9]

Most available evidence regarding factors associated with medication non-adherence among cardiovascular disease patients derives from registries, clinical data repositories, and administrative datasets. While these large data sources ensure ample power, they reveal little about certain types of modifying factors, including specific behaviors, knowledge deficits, attitudes, and beliefs, that may influence medication adherence. An evaluation of patient-reported data reflecting these domains has the potential to uncover new modifiable targets for interventions in order to address barriers to medication adherence among individuals with cardiovascular disease.

To address existing evidence limitations, we evaluated detailed baseline survey data from the Secondary Prevention Risk Interventions via Telemedicine and Tailored Patient Education (SPRITE) trial. By examining the relationship between medication non-adherence and potential modifying factors, we sought to identify novel modifiable targets for strategies to improve medication adherence in cardiovascular disease.

METHODS

Patient Population

SPRITE was a randomized controlled trial that enrolled 406 patients with a history of documented hypertension and acute myocardial infarction (ClinicalTrials.gov NCT00901277). The SPRITE trial's design and intervention have been described previously.[13] Briefly, participants were recruited between December 2009 and February 2012 from a large tertiary care health system and followed for 12 months. Patients were randomized to a post-myocardial infarction education control group, a tailored disease self-management and education intervention delivered via a nurse-telephone program, or a tailored disease self-management and education intervention delivered via an interactive Web-based tool. A detailed survey was administered at an in-person enrollment visit; the current analysis utilizes these baseline survey data. All patients provided informed consent, and the study was approved by the Duke University Institutional Review Board.

Inclusion criteria were age ≥18 years; diagnosis of acute myocardial infarction within a three-year period prior to enrollment (based on *International Classification of Diseases, 9th revision* [ICD-9] code 410.01–410.91, verified by manual chart review), with receipt of cardiac catheterization at the time of the acute myocardial infarction; diagnosis of hypertension (based on ICD-9 code 401.X or systolic blood pressure≥140 documented on two office visits in the prior year); and at least one follow-up visit with a primary care and/or cardiology provider within the year prior to enrollment. Exclusion criteria were a diagnosis of New York Heart Association Class IV heart failure, metastatic cancer, psychosis, or dementia; current receipt of hemodialysis; prior transplant of any solid organ; lack of access to a personal telephone and computer with Internet access; impaired hearing or speech that would prevent interaction by phone; receipt of skilled nursing or home health care; refusal to provide informed consent; participation in another behavioral or medication adherence study; or known plans to relocate and discontinue follow-up with the current provider. Patients for whom self-reported medication adherence could not be determined were excluded from this analysis.

Patient Factors Evaluated

The SPRITE intervention was based on the Health Belief Model,[8] which posits that "modifying factors" affect patient engagement in healthful behaviors such as medication adherence. We sought to address limitations in current evidence by exploring associations between self-reported cardiovascular disease medication adherence and potential modifying factors from the SPRITE baseline survey. For this analysis, we used Health Belief Model principles and other literature to organize potential modifying factors into four categories: demographics/patient characteristics, medical comorbidities, psychosocial factors, and health belief-related factors.[8,14] (See Appendix, Table 4 for additional information regarding these factors, including question wording, relevant scale ranges, and dichotomization thresholds.)

Demographics/patient characteristics included age, sex, race, education level, marital status, and employment status. We also included single-item self-reported measures assessing social support and financial security, the latter of which we dichotomized using a previously reported approach.[15] Additionally, health literacy was assessed via the Rapid Estimate of Adult Literacy in Medicine (REALM) score, which we dichotomized as ≤60 (<9th grade reading level) or ≥61 (≥9th grade reading level).[15–17] We also evaluated knowledge of cardiovascular disease risk factors using a validated continuous measure.[18] Medical comorbidities included diabetes status, history of stroke, smoking status, and body mass index. In addition, we evaluated control of cardiovascular risk factors (hypertension, diabetes, and dyslipidemia) at study baseline to better characterize our study population, though we did not evaluate risk factor control in association with medication adherence.

Psychosocial factors included depression, as assessed by the Patient Health Questionnaire-2 (PHQ-2),[19] along with life chaos as assessed by a validated six-question measure (continuous scale, range 0–30).[20] We also evaluated single-item self-reported measures assessing stress level and the degree to which the patient identified as nervous or tense, both of which we dichotomized based on a previously reported approach.[15]

Finally, health belief-related factors included single-item self-reported continuous measures reflecting worry about having a myocardial infarction and about having a stroke ("How worried are you about having a heart attack/stroke?" with each rated on a

scale from 1 [definitely not worried] to 10 [extremely worried]). We also examined the extent to which patients believed in turning to family in times of trouble, the extent to which patients prayed for healing when ill, and the extent to which patients relied on God for good health; these measures were worded and dichotomized as described in the Appendix, Table 4.

Self-Reported Medication Adherence Measure (Dependent Variable)

To evaluate medication adherence, we used a validated four-item self-reported scale developed by Morisky,[21,22] which detects problems following recommended medication-taking behaviors. Study patients were asked about the extent to which four statements applied to their general medication-taking behavior during the past 30 days: "I sometimes forget to take my medicine"; "I am sometimes careless about taking my medicine"; "When I feel better, I sometimes stop taking my medicine"; and "If I feel worse when I take the medicine, sometimes I stop taking it." Possible responses were based on a four-point Likert scale, ranging from "strongly agree" (1) to "strongly disagree" (4).

Patients were classified as non-adherent if they responded "strongly agree," "agree," "don't know," or "refused" for any of the four statements, and otherwise were classified as adherent.[15,17] If patients did not respond to any one of the four items, the non-adherence variable was considered as missing.

Statistical Analysis

Statistical analyses were performed using SAS Enterprise Guide, version 4.3 (SAS Institute, Cary, NC). Descriptive statistics were used to summarize baseline participant characteristics. We determined bivariate associations between potential modifying factors and self-reported medication adherence using simple logistic regression. In order to evaluate adjusted associations between potential modifying factors and self-reported medication adherence, we developed a multivariable logistic regression model with self-reported medication adherence as the dependent variable. The full logistic regression model included as independent variables all patient factors with bivariate associations with self-reported medication adherence to $p<0.1$. Multicollinearity was examined by computing the variance inflation factor for each independent variable in the model.

RESULTS

Table 1 summarizes the SPRITE study cohort baseline demographics/patient characteristics, medical comorbidities, psychosocial factors, and health belief-related factors, and presents these data by adherence status. In general, a majority of the population was white, male, married, and had ≥12 years of education. The population also tended to have good control of blood pressure and other cardiovascular disease risk factors at study baseline. Overall, 173 of 405 patients (42.7 %) reported medication non-adherence; one patient was excluded because self-reported medication adherence could not be determined.

Bivariate Associations with Self-Reported Medication Adherence

Numerous potential modifying factors had bivariate associations with self-reported medication non-adherence to $p<0.05$ (Table 2). Associated demographics/patient characteristics included age, non-white race, having <12 years of education, and financial insecurity. Associated medical comorbidities included active smoking. Associated psychosocial factors included identifying as nervous or tense and higher life chaos score. Associated health belief-related factors included greater worry about having a myocardial infarction and greater worry about having a stroke.

Multivariable Model Results

Our multivariable logistic regression model included all factors with bivariate associations with self-reported medication adherence to $p<0.1$ (Table 3). The variance inflation factor for the model variables was <2, indicating low multicollinearity. Three factors retained a statistically significant association with self-reported medication adherence on multivariable modeling: age (OR 0.97 for each additional year, 95 % CI, 0.95–0.99, $p<0.01$), life chaos score (OR 1.06 for each additional point, 95 % CI 1.00–1.11, $p=0.04$), and worry about stroke (OR 1.12 for each additional point, 95 % CI, 1.01–1.25, $p=0.03$). In the multivariable model, race, education level, smoking status, financial insecurity, identifying as nervous or tense, and worry about myocardial infarction were no longer significantly associated with self-reported medication adherence.

DISCUSSION

Strategies for improving medication adherence in cardiovascular disease will rely not only on accurately identifying non-adherent patients, but also on understanding the underpinnings of non-adherence in this population. Current knowledge is limited with regard to factors associated with medication non-adherence in cardiovascular disease in that there has been less emphasis on patient-reported data reflecting specific behaviors, knowledge deficits, attitudes, and beliefs that may influence adherence. By using the SPRITE trial baseline survey to examine relationships between potential modifying factors and self-reported medication non-adherence, this analysis sought to inform new approaches to improving medication adherence in cardiovascular disease. Worry about having a stroke and higher life chaos were significantly associated with self-reported medication non-adherence in our multivariable analysis, as was younger age.

Table 1. SPRITE Trial Patient Baseline Characteristics

Variable*	Total cohort (*n*=405)	Adherent (*n*=232)	Non-adherent (*n*=173)
Demographics/patient characteristics			
Mean age (SD)	60.7 (10.7)	62.6 (9.8)	58.1 (11.3)
Female	27.9	27.2	28.9
Race			
White or Caucasian	65.4	72.8	55.5
Black or African American	29.6	22.0	39.9
Other	4.9	5.2	4.6
Less than 12 years of education	13.1	9.9	17.3
Married	65.7	69.4	60.7
Employed	36.9	37.1	36.6
Inadequate social support	3.7	3.9	3.5
Financial insecurity	22.7	18.1	28.9
Low health literacy (REALM≤60)	16.8	13.8	20.8
CVD knowledge score (SD)	3.3 (1.5)	3.3 (1.5)	3.3 (1.6)
Medical comorbidities			
Active smoking	19.3	13.8	26.6
History of diabetes	34.6	31.0	39.3
History of TIA or CVA	17.3	14.7	20.8
Body mass index (SD)	32.0 (6.7)	31.6 (6.3)	32.5 (7.2)
BP (mmHg)			
Mean systolic BP (SD)	124.7 (19.8)	121.7 (17.4)	128.7 (22.1)
Mean diastolic BP (SD)	75.2 (11.5)	73.9 (10.9)	76.9 (12.0)
Mean HbA1c (SD)	6.6 (1.5)	6.5 (1.3)	6.9 (1.7)
Mean LDL cholesterol (SD)	96.0 (40.4)	89.4 (35.6)	104.9 (44.7)
Psychosocial factors			
Depressed mood (positive PHQ-2)	11.1	8.6	14.6
Mean life chaos score (SD)	14.4 (4.7)	13.6 (4.7)	15.5 (4.4)
Elevated stress level	20.0	18.5	22.0
Identifies as nervous or tense	12.8	9.9	16.9
Health belief-related factors			
Mean worry about MI (SD)	4.8 (3.0)	4.5 (3.0)	5.3 (2.9)
Mean worry about stroke (SD)	3.9 (2.8)	3.4 (2.6)	4.5 (2.9)
Turns to family in times of trouble	96.5	96.9	96.0
Prays for healing when ill	89.1	87.0	91.9
Relies on God for good health	81.0	79.3	83.2

See Appendix, Table 4 for additional detail on measures

Abbreviations: BP blood pressure, CVA cerebrovascular accident (stroke), CVD cardiovascular disease, HbA1c hemoglobin A1c, LDL low-density lipoprotein, MI myocardial infarction, PHQ-2 Patient Health Questionnaire-2, REALM Rapid Estimate of Adult Literacy in Medicine, SD standard deviation, SPRITE Secondary Prevention Risk Interventions via Telemedicine and Tailored Patient Education, TIA transient ischemic attack

**Missing data: employed n=1 (0 adherent, 1 non-adherent); financial insecurity n=12 (7 adherent, 5 non-adherent); history of diabetes n=5 (2 adherent, 3 non-adherent); history of TIA n=8 (3 adherent, 5 non-adherent); BMI n=2 (1 adherent, 1 non-adherent); systolic BP n=3 (1 adherent, 2 non-adherent); diastolic BP n=3 (1 adherent, 2 non-adherent); HbA1c n=21 (10 adherent, 11 non-adherent); LDL n=22 (10 adherent, 12 non-adherent); depressed mood n=4 (2 adherent, 2 non-adherent); mean chaos score n=1 (0 adherent, 1 non-adherent); elevated stress level n=3 (3 adherent, 0 non-adherent); identifies as nervous or tense n=2 (1 adherent, 1 non-adherent); mean worry about MI n=5 (3 adherent, 2 non-adherent); mean worry about stroke n=3 (3 adherent, 0 non-adherent); turns to family in times of trouble n=3 (1 adherent, 2 non-adherent); prays for healing when ill n=3 (2 adherent, 1 non-adherent); relies on God for good health n=10 (6 adherent, 4 non-adherent)*

Worry About Having a Stroke

We found that worry about having a stroke had a statistically significant association with self-reported medication non-adherence, which had not previously been reported. Given our use of cross-sectional data, we can only theorize about potential causal relationships between stroke-related worry and medication non-adherence in the post-myocardial infarction population. There are several possible interpretations of this association. First, patients with high levels of worry about stroke may believe that cerebrovascular events are inevitable for them following myocardial infarction, and thus may become fatalistic about the value of appropriate medication adherence. Alternatively, patients may believe that prescribed medications actually increase their risk for stroke, and so they might choose not to adhere to recommended medications as a result of stroke-related worry. Finally, patients reporting suboptimal medication adherence in the post-myocardial infarction period may recognize that their non-adherence puts them at higher risk for complications, and consequently, they may worry more about stroke. Under any of these interpretations, patient education and behavioral support highlighting the important role of cardiovascular disease risk factor control in stroke prevention might improve medication adherence.

Of note, this analysis utilized a single-item measure reflecting worry about stroke. It is possible that a more detailed measure exploring different dimensions of stroke-related worry could better elucidate how an intervention could target medication non-adherence. For example, individual questions could address patient perceptions regarding the relationship between myocardial infarction and stroke, the effect of cardiovascular disease medications on stroke risk, and the impact of cardiovascular disease medication non-adherence on the risk of stroke. Further research is needed to better understand the

Table 2. Unadjusted Associations Between Baseline Patient Factors and Self-Reported Medication Non-Adherence

Variable	*n*	OR	95 % CI	*p* value
Demographics/patient characteristics				
Age (per year)	405	0.96	0.94–0.98	<0.001
Female	405	1.09	0.70–1.69	0.70
Non-white race	405	2.15	1.42–3.26	<0.001
Less than 12 years of education	405	1.91	1.06–3.42	0.03
Unmarried	405	1.47	0.97–2.22	0.07
Unemployed	404	1.02	0.68–1.53	0.93
Inadequate social support	405	0.89	0.31–2.55	0.83
Financial insecurity	393	1.85	1.15–2.96	0.01
Low health literacy (REALM≤60)	405	1.64	0.97–2.77	0.06
CVD knowledge score (per point)	405	1.03	0.91–1.17	0.66
Medical comorbidities				
Active smoking	405	2.26	1.37–3.74	0.0015
History of diabetes	400	1.46	0.97–2.21	0.07
History of TIA or CVA	397	1.56	0.93–2.63	0.09
Body mass index (per point)	403	1.02	0.99–1.05	0.17
Psychosocial factors				
Depressed mood (positive PHQ-2)	401	1.80	0.96–3.36	0.07
Life chaos score (per point)	404	1.10	1.05–1.15	<0.001
Elevated stress level	402	1.22	0.75–1.99	0.43
Identifies as nervous or tense	403	1.83	1.02–3.30	0.04
Health belief-related factors				
Worry about MI (per point)	400	1.11	1.03–1.18	0.0036
Worry about stroke (per point)	402	1.16	1.08–1.25	<0.001
Doesn't turn to family in times of trouble	402	1.13	0.34–3.77	0.84
Prays for healing when ill	402	1.70	0.85–3.38	0.13
Relies on God for good health	395	1.31	0.77–2.26	0.32

Abbreviations: CVA cerebrovascular accident (stroke), CVD cardiovascular disease, MI myocardial infarction, PHQ-2 Patient Health Questionnaire-2, REALM Rapid Estimate of Adult Literacy in Medicine, TIA transient ischemic attack

potential value of worry about stroke as a target for interventions combating cardiovascular disease medication non-adherence.

The association between medication adherence and stroke-related worry in our population is noteworthy, as we did not see a similar relationship with worry about myocardial infarction. In the post-myocardial infarction population, therefore, adherence to recommended medications may be more influenced by worry about stroke than by worry about recurrent myocardial infarction. It is possible that surviving a myocardial infarction leaves patients less inclined to worry about repeat myocardial infarction than about stroke. Because patients with prior myocardial infarction without appropriate risk factor modification are at high risk for recurrent myocardial infarction, further research exploring cardiovascular disease patients' relative perceptions of myocardial infarction and stroke risk is indicated.

Life Chaos

Our analysis supports prior findings regarding the association between life chaos and medication non-adherence after myocardial infarction,[20] even with the adjustment in this study for additional demographic, psychosocial, and health belief-related factors. Although further research is needed to determine whether life chaos is a modifiable risk factor for non-adherence, our findings suggest that interventions that impart organizational skills may help patients better manage life chaos and reduce medication non-adherence.

Younger Age

The observed association between younger age and medication non-adherence is consistent with prior work in hypertension using the same adherence measure.[15] There are many possible explanations for the observed link between younger age and medication non-adherence. For example, younger patients tend to experience higher employment and social engagement, and such activities may make them less likely to adhere to recommended medications. Strategies to address non-adherence, therefore, may be more effective if delivered using strategies that account for job demands and other competing factors better than clinic-based interventions (e.g., telehealth, mobile health, or eHealth-based strategies). Similarly, younger patients' active lifestyles may make them less prone to tolerate cardiovascular disease medication side effects (e.g., fatigue or erectile dysfunction with beta blockers), producing higher rates of non-adherence. Finally, younger patients could feel that their risk for stroke or recurrent myocardial infarction is low, and may be less motivated to take recommended medications.

Our findings regarding the link between age and adherence run counter to some studies of medication adherence in patients post-myocardial infarction, which suggests increasing

Table 3. Multivariable Logistic Regression Model Results Showing Adjusted Associations Between Baseline Patient Factors and Self-Reported Medication Non-Adherence (n=369)

Variable	OR	95 % CI	p value
Demographic/clinical factors			
Age (per year)	0.97	0.95–0.99	0.0082
Non-white race	1.27	0.77–2.09	0.35
Less than 12 years of education	1.11	0.54–2.31	0.77
Unmarried	0.83	0.50–1.38	0.47
Financial insecurity	1.32	0.77–2.28	0.31
Low health literacy (REALM ≤60)	0.92	0.48–1.77	0.80
Active smoking	1.82	0.99–3.33	0.052
History of diabetes	1.35	0.85–2.16	0.21
History of TIA or CVA	1.36	0.74–2.50	0.32
Psychosocial/health belief-related factors			
Depressed mood (positive PHQ-2)	0.96	0.44–2.14	0.93
Life chaos score (per point)	1.06	1.00–1.11	0.04
Identifies as nervous or tense	1.03	0.51–2.09	0.93
Worry about MI (per point)	0.95	0.86–1.05	0.32
Worry about stroke (per point)	1.12	1.01–1.25	0.03

Thirty-six patients not included in model due to missing covariate data; c-statistic= 0.70 for model
Abbreviations: CVA cerebrovascular accident (stroke), MI myocardial infarction, PHQ-2 Patient Health Questionnaire-2, REALM Rapid Estimate of Adult Literacy in Medicine, TIA transient ischemic attack

medication non-adherence with age.[5,9–12] Noting the differences between this analysis and prior studies may help to contextualize these divergent findings. First, our population is distinct from the European or multinational populations examined in some studies.[10–12] Due to possible variation in prescription coverage systems and attitudes toward taking medication, it is feasible that age could relate differently to medication adherence in our cohort. Further, our strategy for assessing adherence differed from prior analyses that used pharmacy refill data[10,11] or simply reported current medication use .[5,12] While these measures likely accurately reflect medication prescribing, we used a validated measure that explores patient attitudes toward medication-taking,[21,22] which in this case may better capture true medication adherence. Though some have questioned the correlation between self-reported and objective medication adherence,[23,24] self-reporting remains among the most common strategies for assessing medication adherence because it is simple and reliable.[25–27]

Factors Not Associated with Medication Adherence

Importantly, we found that several potential modifying factors may not be associated with medication non-adherence in the post-myocardial infarction patient population. Although factors such as financial insecurity, low health literacy, depression, and self-identification as nervous or tense had significant or near-significant bivariate associations with medication non-adherence, all of these lost significance on multivariable modeling. While the present analysis is not powered to definitively exclude these factors, they may represent less fruitful targets for improving medication adherence in patients with cardiovascular disease.

Limitations

As noted above, the size of our patient population may have increased the possibility of a type II error in this analysis. For example, active smoking might have achieved statistical significance in association with medication non-adherence with a larger population (p=0.052). However, our cohort offered advantages that helped to offset concerns regarding its size—namely, allowing us to address an existing evidence gap by exploring potential modifying factors in the psychosocial and health belief-related domains.

Multiple factors may affect the generalizability of our results, including 1) the demographics of our population (majority male, white, well-educated); 2) our population's good baseline cardiovascular disease risk factor control; and 3) the exclusion criteria of the SPRITE trial, which excluded certain patients based on factors that may impact medication adherence (e.g., lacking telephone/Internet access). Our findings are best applied to individuals with cardiovascular disease receiving quality secondary prevention care in academic health care settings.

It should be noted that we did not examine all possible modifying factors for cardiovascular disease medication adherence, but rather measures available through the SPRITE trial baseline survey. As mentioned above, our measure of stroke-related worry has potential limitations, as does our medication adherence measure. Although the adherence measure is validated,[21,26,27] it may be susceptible to social desirability bias as a self-reported measure. Further, our adherence measure assessed general medication-taking behavior and did not distinguish between specific medication classes for which adherence may differ.[5]

Conclusions

We found that worry about having a stroke, higher life chaos, and younger age were all significantly associated with self-reported medication non-adherence in patients with cardiovascular disease, a history of myocardial infarction, and hypertension. Although these findings enhance our knowledge regarding potential modifying factors for medication adherence, further research is needed to better understand the causes and solutions for non-adherence among patients with cardiovascular disease.

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Conflict of Interest: *The authors each declare that they have no conflict of interest.*

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APPENDIX

Table 4. Additional Information Regarding Potential Modifying Factors from the SPRITE Trial Baseline Survey

Variable	Instrument used to assess
Demographics/patient characteristics	
Age	Derived from electronic health records
Sex, race, education level, marital status, employment status	Single-item, self-reported measures from baseline study patient survey
Social support	Patients asked, "Do you have someone you feel close to, can trust, and confide in?" with responses yes/no.
Financial insecurity	Patients asked, "How would you describe your household's financial situation?" with responses from 1 ('After paying bills, I have money for special things') to 4 ('I have difficulty paying bills, no matter what'), dichotomized based on response content as lack of financial security present (≥3) or absent (≤2)
Health literacy (REALM)[16,17]	Patients asked to read 66 medical terms, with score representing number of correctly read items; dichotomized as ≤60 (<9th grade reading level) or ≥61 (≥9th grade reading level)
CVD knowledge[18]	Patients asked, "Based on your understanding of cardiovascular disease, please tell me as many risk factors you know that affect someone's risk of having a cardiovascular event," with score representing number of correctly identified factors (hypertension, smoking, obesity, physical inactivity, poor diet/nutrition, hypercholesterolemia, diabetes, family history of heart attack or stroke, prior heart disease, age, and male gender)
Medical comorbidities	
Smoking status, history of diabetes, history of TIA/CVA	Single-item self-reported measures from baseline study patient survey
BMI	Derived from electronic health records
Psychosocial factors	
Depressed mood (PHQ-2)[19]	Patients asked, "Over the past 2 weeks, how often have you experienced: little interest or pleasure in doing things; feeling down, depressed, or hopeless?" Responses for each item ranged from 1 (none of the time) to 4 (all of the time); summary of two items dichotomized as depressive symptoms absent (0–2) or present (3–5)
Confusion, Hubbub, and Order Scale (CHAOS)[20]	Patients asked about the degree to which six statements applied to them: "my life is organized"; "my life is unstable"; "my routine is the same from week to week"; "my daily activities from week to week are unpredictable"; "keeping a schedule is difficult for me"; "I don't like to make appointments too far in advance because I don't know what might come up." Each item rated on a scale from 1 (definitely true) to 5 (definitely not true); items 2 and 4–6 reverse-coded, and all responses summed as a continuous variable, with higher score indicating a more chaotic lifestyle (range 5–30)
Stress level	Patients asked, "How often in the past month have you felt stressed?" with responses ranging from 1 (all of the time) to 4 (none of the time); responses dichotomized as stress present (1–2) or absent (3–4)
Nervous or tense person	Patients asked, "Do you consider yourself a nervous or tense person?" with responses ranging from 1 (all of the time) to 4 (none of the time); responses dichotomized as yes (1–2) or no (3–4)
Health belief-related factors	
Worry about MI	Patients asked, "How worried are you about having a heart attack?" Rated on a scale from 1 (definitely not worried) to 10 (extremely worried); continuous variable
Worry about stroke	Patients asked, "How worried are you about having a stroke?" Rated on a scale from 1 (definitely not worried) to 10 (extremely worried); continuous variable
Turns to family in times of trouble	Patients asked, "How much do you agree or disagree that it is important that you and your family turn to each other in times of trouble?" Rated on a scale from 1 (strongly disagree) to 4 (strongly agree); responses dichotomized as disagree (1–2) or agree (3–4)
Prays for healing when ill	Patients asked, "How much do you agree or disagree with the following statement? When you are ill, you pray for healing." Rated on a scale from 1 (strongly disagree) to 4 (strongly agree); responses dichotomized as disagree (1–2) or agree (3–4)
Relies on God for good health	Patients asked "How much do you agree or disagree with the following statement? You rely on God to keep you in good health." Rated on a scale from 1 (strongly disagree) to 4 (strongly agree); responses dichotomized as disagree (1–2) or agree (3–4)

Abbreviations: CVA cerebrovascular accident, PHQ-2 Patient Health Questionnaire-2, REALM Rapid Estimate of Adult Literacy in Medicine, SPRITE Secondary Prevention Risk Interventions via Telemedicine and Tailored Patient Education, TIA transient ischemic attack

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