Medication-Taking Behaviors and Perceptions Among Adults With Heart Failure (from the REasons for Geographic And Racial Differences in Stroke Study)

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Medication regimens in adults with heart failure (HF) are complex which can complicate patient adherence. Individuals with HF frequently use beta blockers (BBs) for multiple indications, including hypertension and HF, but BBs can have significant side effects that may affect their use. We examined medication-taking behaviors and perceptions in individuals with HF with a particular focus on BBs. A mailed survey on medication use was administered to US adults with HF enrolled in the REasons for Geographic And Racial Differences in Stroke study. Among 518 respondents, 357 (69%) reported taking a BB. Nearly half (42%) reported taking ≥10 medications per day. However, 45% indicated that they did not miss any days taking medications, and over 85% reported willingness to take additional medications to prevent further healthcare encounters. Participants' perceptions of BB symptoms varied, but 56% of those who reported experiencing symptoms did not discuss this with their healthcare providers. Adults who experienced HF hospitalization had higher odds of reporting taking BBs to treat HF (odds ratio 1.51, 95% confidence interval 1.19, 1.91). Adults with hypertension were also likely to report taking BBs to treat high blood pressure (odds ratio 2.42, 95% confidence interval 1.79, 3.26). In conclusion, despite extensive medication regimens, individuals with HF were willing to take additional medications for their disease. Participant recognition of BB use for treating HF and co-morbidities was high, yet many do not report side effects to healthcare providers. In conclusion, better understanding of patients' medication-taking behaviors and perceptions may facilitate optimization of HF treatments. **(Am J Cardiol 2019;123:1667−1674)**

Adults with heart failure (HF) often take multiple medications to manage their disease.[1] Most individuals with HF also have multimorbidity[2] leading to complex treatment regimens.[3] Beta blockers (BBs) are a guideline-recommended treatment to reduce mortality and cardiovascular events for individuals with HF with reduced ejection fraction (HFrEF),[4,5] but not for HF with preserved ejection fraction (HFpEF). BBs are also indicated in other common conditions in individuals with both HFrEF and HFpEF such as coronary heart disease (CHD), hypertension, and arrhythmias.[6−9] Managing treatment regimens for HF and concomitant co-morbidities may be a barrier to medication adherence in individuals with HF. Adherence is an important self-care behavior in preventing HF exacerbations, rehospitalization, and mortality.[10−12] However, adherence to guideline-recommended HF treatments including BBs was suboptimal in previous studies.[13,14] A better understanding of overall treatment burden and knowledge of BB use in adults with HF may help direct future interventions to optimize medical management. We examined participant medication-taking behaviors and perceptions of BB use in adults with HF in the REasons for Geographic And Racial Differences in Stroke (REGARDS) study employing a medication use survey.

Methods

The REGARDS study is a nationwide study that enrolled community-dwelling black and white participants from across the continental United States who were ≥45 years of age at enrollment and were not actively receiving treatment for cancer.[15] The study oversampled black participants, and approximately half of the sample was recruited from the "stroke buckle"

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Funding: The REGARDS research project is supported by a cooperative agreement U01NS041588 from the National Institute of Neurological Disorders and Stroke, and the National Institute on Aging, National Institutes of Health (Bethesda, MD), Department of Health and Human Services (Washington, D.C.). Additional support was provided by R01 HL80477 from the National Heart Lung and Blood Institute (Bethesda, MD) for HF adjudication. Support for the collection of data in the medication survey was provided by Amgen, Inc. (Thousand Oaks, CA) Additional support for MTM was received through grant 5T32 HS013852-15 from the Agency for Health Research and Quality (Rockville, MD).

See page 1673 for disclosure information.

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0002-9149/
https://doi.org/10.1016/j.amjcard.2019.02.024

(the coastal plain of North Carolina, South Carolina, and Georgia) and "stroke belt" (remainder of North Carolina, South Carolina, and Georgia, plus Alabama, Mississippi, Tennessee, Arkansas, and Louisiana) regions. Participants completed a telephone interview and an in-home study examination at baseline (January 2003 to October 2007), and are contacted every 6 months to identify potential stroke, CHD, and HF events for subsequent adjudication. Between May 2013 and December 2016, 14,233 participants completed a second in-home examination and telephone interview. All components of the REGARDS study were approved by the Institutional Review Board at the University of Alabama at Birmingham. All participants provided written informed consent upon baseline enrollment and again before completing the second study examination. Participants with prevalent or incident HF identified from medical records on or before December 31, 2014, or participants with Medicare claims for 1 hospitalization with HF as a primary diagnosis, 2 hospitalizations with HF as a secondary diagnosis, or 2 outpatient diagnoses for HF on or before December 31, 2013, who remained active REGARDS participants (n = 1,114) were mailed a survey in a single wave regarding their experiences with medications including BBs in August 2016. Among these participants, 518 (46%) responded to the survey. Characteristics of respondents and nonrespondents to the survey are listed in Supplemental Table 1. The final analytic sample included 357 respondents who reported ever taking a BB (Supplemental Figure 1). Characteristics of participants taking and not taking BBs are listed in Supplemental Table 2. Covariate definitions are listed in Supplemental Table 3.

Participants with a documented left ventricular ejection fraction ≥50% or diagnosis codes for HF with diastolic dysfunction were categorized as HFpEF (n = 78). Participants with a documented left ventricular ejection fraction ≤40% or diagnosis codes for HF with systolic or combined systolic and diastolic dysfunction were categorized as HFrEF (n = 117). Participants with a documented left ventricular ejection fraction between 41% and 49% were considered HF with midrange ejection fraction (HFmEF, n = 7). Due to small sample size, HFmEF and HFrEF subgroups were combined (n = 124). Participants with no documentation of an ejection fraction were considered to have "unknown" ejection fraction (n = 155).

The mailed medication use survey was developed de novo and piloted in 50 HF patients in clinic at the University of Alabama at Birmingham. The survey asked questions about the number of prescription medications taken per day, how frequently pills were missed per month, reasons for not taking medications, and willingness to take additional pills. The BB portion of the survey asked about stopping BB use, perceived symptoms of BB use, the discussion of BB symptoms with healthcare providers, and provider recommendations to manage BB symptoms. In addition, the survey asked participants "Why did you or do you take BBs?" with responses including "To reduce blood pressure," "To reduce the workload on the heart," "To help the heart beat more regularly," "To treat HF," "other" reasons, and "I don't know." Participants could respond affirmatively to more than 1 response.

Characteristics of participants were calculated overall and in adults with HFpEF, HFrEF/HFmEF, and HF with unknown EF, separately, using means and standard deviations for continuous variables and proportions for categorical predictors. We also calculated frequencies of responses to the medication use survey questions as well as questions specific to BB use, in all individuals with HF and separately in those with HFpEF, HFrEF/HFmEF, and HF with unknown EF. Survey responses of participants with HFrEF and HFmEF, listed separately, are in Supplemental Table 4. We used logistic regression to calculate odds ratios (ORs) and 95% confidence intervals (CIs) for the association of sociodemographic characteristics with reasons for taking a BB (the composite response of "To treat HF" or "To reduce the workload on the heart" and separately, "To treat high blood pressure") in all adults. We first calculated unadjusted ORs. Multivariable adjusted ORs adjusted for age, gender, race, region of residence, income, hypertension, smoking status, and having a HF hospitalization. Analyses were repeated for adults with HFrEF/HFmEF and separately, HFpEF, but were not repeated for HF with unknown EF. For the analysis in all adults with HF, we included the type of HF (HFpEF, HFrEF/HFmEF, or unknown EF) as an additional covariate. Missing covariate data were imputed using fully conditional specification.[16] Two-sided p-values <0.05 were considered statistically significant. Analyses were performed using SAS 9.4 (SAS Institute, Cary, North Carolina).

Results

Among 518 respondents, 357 (69%) reported ever taking a BB. The mean age of participants taking BBs was 76.2 years (SD 7.8), 51% were male, and 35% were black (Table 1). In addition, a high proportion had hypertension, diabetes, CHD, and atrial fibrillation. Participants with HFrEF/HFmEF (n = 124), compared with HFpEF (n = 78), were more likely to be male, have income >$75,000 and be current smokers.

Nearly half of all participants reported taking more than 10 pills per day (Table 2). Approximately half also reported missing 0 days of taking their medications over a month, and a third of all participants reported they do not skip taking pills. Among those who reported skipping pills, the most common reasons included forgetting to take their medications and running out of medications. This was similar in participants with HFrEF/HFmEF and HFpEF. Other less frequent reasons for skipping medications included cost, taking too many pills, and worrying about side effects. Additionally, most respondents reported a willingness to take an additional pill to prevent unplanned outpatient provider visits, ER visits, and hospital stays.

A high proportion of all participants reported taking a BB to treat HF, to reduce the workload on the heart, to help the heart beat regularly, and to treat high blood pressure. More participants with HFrEF/HFmEF compared with their counterparts with HFpEF reported taking a BB to treat HF or taking a BB to reduce the workload on the heart. Conversely, a higher proportion of those with HFpEF compared

Table 1
Characteristics of respondents to a medication use survey who reported at least 1 reason for taking a beta-blocker, by HF type

Variable	Any HF (n = 357)	HFrEF/HFmEF (n = 124)	HFpEF (n = 78)	HF with undetermined EF (n = 155)
Age (years), mean ± SD	76.2 ± 7.8	77.2 ± 6.8	77.2 ± 6.8	76.6 ± 8.2
Men	181 (51%)	71 (57%)	32 (41%)	78 (50%)
Black	126 (35%)	38 (31%)	26 (33%)	62 (40%)
Region				
Stroke belt	114 (32%)	45 (36%)	22 (28%)	47 (30%)
Stroke buckle	80 (22%)	25 (20%)	17 (22%)	38 (25%)
Nonbelt/buckle	163 (46%)	54 (44%)	39 (50%)	70 (45%)
Hypertension	281 (79%)	92 (74%)	61 (78%)	128 (83%)
Hospitalization for HF*	101 (30%)	55 (44%)	31 (40%)	15 (11%)
Income				
< $20,000	62 (17%)	17 (14%)	17 (22%)	28 (18%)
$20,000-$34,999	87 (24%)	34 (27%)	17 (22%)	36 (23%)
$35,000-$74,999	98 (28%)	31 (25%)	21 (27%)	46 (30%)
≥ $75,000	54 (15%)	29 (23%)	8 (10%)	17 (11%)
Declined to report	56 (16%)	13 (11%)	15 (19%)	28 (18%)
Smoker				
Current	20 (6%)	10 (8%)	2 (3%)	8 (5%)
Never	152 (43%)	45 (36%)	40 (51%)	67 (43%)
Past	185 (52%)	69 (56%)	36 (46%)	80 (52%)
Diabetes mellitus*	130 (39%)	45 (39%)	31 (43%)	54 (37%)
History of coronary heart disease*	203 (62%)	79 (72%)	42 (58%)	82 (57%)
Atrial fibrillation*	135 (44%)	52 (51%)	30 (44%)	53 (39%)

Abbreviations: HF = heart failure; HFmEF = heart failure with midrange ejection fraction; HFpEF = heart failure with preserved ejection fraction; HFrEF = heart failure with reduced ejection fraction; SD = standard deviation

* Missing data for some participants.

with HFrEF/HFmEF reported taking a BB to treat high blood pressure (Table 2). Common reasons for stopping BB use in all participants were perceived side effects and being told by their provider they did not need the BB. Common perceived symptoms of BB use included dizziness, fatigue, and shortness of breath. However, over half of participants who reported perceived BB symptoms did not talk about their experience with their healthcare providers. For those who did talk to a provider, the most common recommendation by a provider was to lower the dose of the current BB.

Among all participants with HF, those with a HF hospitalization had higher odds of reporting taking a BB to treat HF or reduce the workload on the heart compared with those without a HF hospitalization, even after multivariable adjustment. (Table 3) No statistically significant associations were observed in the subgroup of adults with HFrEF/HFmEF. Among participants with HFpEF, those with hypertension versus those without had lower odds of reporting taking a BB to treat HF or reduce the workload on the heart. Among all participants with HF, those with hypertension versus without hypertension had higher odds of reporting taking a BB to treat high blood pressure (Table 4). This was also observed in participants with HFrEF/HFmEF. Among those with HFpEF, black versus white participants had lower odds of reporting taking a BB to treat high blood pressure.

Discussion

Among all study participants with HF, nearly half reported taking 10 or more pills per day and half reported missing 0 days taking prescription medications in a month. The most common reason for missing medications was forgetting to take them. Despite this, most participants with HF reported a willingness to take an additional pill to prevent unplanned healthcare encounters. Many were taking a BB at the time of the medication survey, irrespective of HF subtype. Among those who experienced symptoms thought to be attributable to BB use; however, a large portion did not address this with their healthcare providers. Finally, participants with a HF hospitalization were more likely to report taking their BB to treat HF, and those with hypertension were also likely to report taking their BB to treat high blood pressure.

Polypharmacy[17] is nearly universal in adults with HF due to complex treatment regimens for HF and co-morbidities, and it is important to understand these individuals' perceptions of their medications. In the present study, nearly half of participants with HF reported taking 10 or more pills per day, which may partially be attributable to the high proportion with concomitant co-morbidities. This is consistent with a previous work that reported adults with HF take an average of 7.2 medications per day, inclusive of all medications self-reported.[18] Most participants reported a willingness to take an additional pill if it prevented a further healthcare encounter. This suggests that many individuals are willing to try additional therapies to improve their HF, and pill burden and potential side effects may not be a major barrier to treatment adherence in a motivated population.

There was a high prevalence of BB use in this cohort, irrespective of HF subtype. This is consistent with previous

Table 2
Medication-taking characteristics of ever-beta blocker users who reported at least 1 reason for taking a beta-blocker, by HF type

Variable	Any HF (n = 357)	HFrEF/HFmEF (n = 124)	HFpEF (n = 78)	HF with undetermined EF (n = 155)
Pills per day*				
1-4	43 (13%)	14 (12%)	8 (11%)	21 (15%)
5-10	150 (45%)	48 (41%)	31 (41%)	71 (50%)
11-15	84 (25%)	36 (31%)	18 (24%)	30 (21%)
>15	57 (17%)	18 (16%)	19 (25%)	20 (14%)
Frequency of missing pills*, (days/month)				
0	153 (45%)	60 (51%)	31 (41%)	62 (43%)
1-3	153 (45%)	46 (39%)	41 (54%)	66 (46%)
4-10	24 (7%)	7 (6%)	3 (4%)	14 (10%)
11-20	5 (2%)	3 (3%)	1 (1%)	1 (1%)
>20	2 (1%)	1 (1%)	0 (0%)	1 (1%)
Reasons for skipping pills				
Cost	11 (3%)	4 (3%)	0 (0%)	7 (5%)
Too many	6 (2%)	2 (2%)	1 (1%)	3 (2%)
Forget	154 (43%)	49 (40%)	31 (40%)	74 (48%)
Trouble taking pills	2 (1%)	1 (1%)	1 (1%)	0 (0%)
Don't need them	6 (2%)	1 (1%)	3 (4%)	2 (1%)
Ran out	41 (12%)	14 (11%)	5 (6%)	22 (14%)
Worry about side-effects	12 (3%)	4 (3%)	5 (6%)	3 (2%)
Advice from provider	11 (3%)	5 (4%)	2 (3%)	4 (3%)
Don't like the way they make me feel	5 (1%)	0 (0%)	2 (3%)	3 (2%)
Don't skip	116 (33%)	44 (36%)	24 (31%)	48 (40%)
Willingness to take 1 more pill*				
To prevent unplanned outpatient provider visit	265 (85%)	97 (88%)	63 (90%)	105 (80%)
To prevent ER visit	279 (92%)	104 (95%)	64 (93%)	111 (90%)
To prevent unplanned hospital stay	286 (94%)	103 (95%)	65 (94%)	118 (93%)
Reasons for taking a BB†				
To treat heart failure	129 (36%)	68 (55%)	22 (28%)	39 (25%)
To reduce the workload on the heart	118 (33%)	54 (44%)	24 (31%)	40 (26%)
To help the heart beat more regularly	146 (41%)	47 (38%)	38 (49%)	61 (39%)
To treat high blood pressure	239 (67%)	74 (60%)	61 (78%)	104 (67%)
Other	15 (4%)	6 (5%)	4 (5%)	5 (3%)
Don't know	25 (7%)	9 (7%)	3 (4%)	13 (8%)
Ever stopped taking a BB?				
No, still taking	284 (80%)	98 (79%)	61 (78%)	126 (81%)
Yes, side-effects	22 (6%)	10 (8%)	4 (5%)	8 (5%)
Yes, concern of side-effects	6 (2%)	1 (1%)	0 (0%)	5 (3%)
Yes, provider said I didn't need them	38 (11%)	11 (9%)	14 (18%)	13 (8%)
Yes, cost too much	4 (1%)	1 (1%)	1 (1%)	2 (1%)
Yes, taking too many pills	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Ever thought your BB causes:				
Shortness of breath	41 (12%)	18 (15%)	9 (12%)	14 (9%)
Wheezing	20 (6%)	8 (7%)	6 (8%)	6 (4%)
Dizziness/lightheadedness	55 (15%)	24 (19%)	13 (17%)	18 (12%)
Tiredness/fatigue	63 (18%)	27 (22%)	13 (17%)	23 (15%)
Impotence	25 (7%)	12 (10%)	6 (8%)	7 (5%)
Ever talked to healthcare provider about BB symptoms?*				
Yes‡	107 (44%)	42 (47%)	28 (48%)	37 (38%)
No‡	138 (56%)	47 (53%)	30 (52%)	61 (62%)
Did not think they caused symptoms	96 (27%)	32 (27%)	17 (23%)	47 (32%)
If you talked to your provider about BB symptoms, what was the recommendation?				
Keep taking	44/107 (41%)	17/42 (41%)	10/28 (36%)	17/24 (71%)
Lower dose	45/107 (42%)	17/42 (41%)	15/28 (54%)	13/24 (54%)
Change BB	20/107 (19%)	7/42 (17%)	7/28 (25%)	6/24 (25%)
Change time of day BB is taken	16/107 (15%)	2/42 (5%)	6/28 (21%)	8/24 (33%)
Reduce frequency of use	8/107 (8%)	2/42 (5%)	3/28 (11%)	3/24 (13%)

Abbreviations: BB = beta blocker; ER = emergency room; HF = heart failure; HFmEF = heart failure with midrange ejection fraction; HFpEF = heart failure with preserved ejection fraction; HFrEF = heart failure with reduced ejection fraction;

* Missing data for some participants.

† participants can respond affirmatively to more than 1 reason for taking a beta blocker.

‡ % among participants who thought their BBs caused symptoms.

Table 3
Odds ratios for the association of participant characteristics with reporting taking beta-blockers to treat HF or to reduce the workload on the heart.

	Odds ratio (95% CI)					
	All HF (n = 357)		HFrEF/HFmEF (n = 124)		HFpEF (n = 78)	
Characteristics	Unadjusted	Multivariable Adjusted	Unadjusted	Multivariable Adjusted	Unadjusted	Multivariable Adjusted
Age quartiles (years)						
<73	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)
73-77	0.93 (0.53, 1.64)	1.11 (0.75, 1.66)	0.52 (0.18, 1.50)	0.59 (0.19, 1.83)	0.64 (0.18, 2.28)	0.71 (0.17, 3.08)
78-81	0.94 (0.52, 1.71)	1.14 (0.74, 1.74)	0.58 (0.18, 1.81)	0.75 (0.20, 2.79)	1.10 (0.30, 4.04)	1.10 (0.22, 5.58)
≥82	0.53 (0.30, 0.93)	0.65 (0.43, 0.98)	0.37 (0.11, 1.23)	0.44 (0.11, 1.72)	0.76 (0.23, 2.55)	0.58 (0.13, 2.67)
Black	1.28 (0.83, 1.98)	1.21 (0.93, 1.57)	1.64 (0.69, 3.92)	1.95 (0.68, 5.62)	1.48 (0.57, 3.81)	1.82 (0.56, 5.90)
Men	1.03 (0.68, 1.56)	1.05 (0.83, 1.34)	0.96 (0.45, 2.09)	0.94 (0.38, 2.31)	0.66 (0.26, 1.64)	0.96 (0.30, 3.06)
Region of residence						
Nonbelt/buckle	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)
Stroke belt	1.67 (1.03, 2.72)	1.44 (1.03, 2.02)	1.49 (0.63, 3.55)	1.57 (0.59, 4.16)	1.67 (0.57, 4.87)	1.94 (0.50, 7.45)
Stroke buckle	0.94 (0.55, 1.60)	0.76 (0.52, 1.09)	1.40 (0.50, 3.94)	1.27 (0.41, 3.90)	3.67 (1.11, 12.1)	3.43 (0.80, 14.6)
Hypertension	0.77 (0.46, 1.29)	0.80 (0.60, 1.06)	1.26 (0.54, 2.97)	0.98 (0.36, 2.65)	0.45 (0.15, 1.36)	0.22 (0.05, 0.96)
Hospitalization for HF	1.51 (1.19, 1.91)	1.46 (1.11, 1.93)	1.84 (0.83, 4.05)	2.17 (0.89, 5.28)	1.72 (0.69, 4.30)	1.82 (0.56, 5.90)
Income						
<$20,000	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)
$20,000-$34,999	0.59 (0.30, 1.15)	0.94 (0.61, 1.44)	0.87 (0.25, 3.09)	0.84 (0.22, 3.31)	0.17 (0.04, 0.75)	0.19 (0.03, 1.02)
$35,000-$74,999	0.49 (0.25, 0.94)	0.93 (0.62, 1.41)	0.88 (0.24, 3.17)	1.13 (0.28, 4.60)	0.23 (0.06, 0.95)	0.38 (0.08, 1.88)
≥$75,000	0.80 (0.38, 1.70)	1.24 (0.73, 2.11)	1.31 (0.34, 5.03)	1.96 (0.44, 8.65)	0.10 (0.02, 0.72)	0.21 (0.02, 2.07)
Declined to report	0.33 (0.16, 0.70)	0.55 (0.33, 0.92)	0.67 (0.15, 3.08)	1.16 (0.21, 6.47)	0.11 (0.02, 0.56)	0.12 (0.02, 0.69)
Current/former smoker	0.93 (0.61, 1.41)	0.81 (0.63, 1.04)	1.04 (0.47, 2.29)	0.87 (0.34, 2.21)	0.58 (0.24, 1.44)	0.48 (0.14, 1.65)
HF type						
HFrEF/HFmEF	1 (ref)	1 (ref)	N/A	N/A	N/A	N/A
HFpEF	0.31 (0.19, 0.51)	0.68 (0.47, 0.98)				
Undetermined EF	0.34 (0.19, 0.62)	0.77 (0.55, 1.06)				

Abbreviations: CI = confidence interval; EF = ejection fraction; HF = heart failure; HFmEF = heart failure with midrange ejection fraction; HFpEF = heart failure with preserved ejection fraction; HFrEF = heart failure with reduced ejection fraction.

Multivariable adjusted model includes all covariates listed in table.

work in a Medicare population[19] but lower than the observed prevalence of BB use in US HF registries.[20,21] BB use in adults with HFrEF is a class I indication based on the most recent HF treatment guidelines.[4] The optimal treatment for individuals who have HFpEF remains uncertain.[22] BB use is included in the guidelines for treatment of HFpEF specifically in the context of treating hypertension.[5] Furthermore, randomized clinical trials of BBs have not yielded improvements in mortality or quality of life for those with HFpEF.[23,24] The higher prevalence of BB use in HF registries may be explained by including hospitals involved in quality improvement efforts or differences between medications recommended at discharge and medications used in community settings.

Participants reported a variety of perceived symptoms related to BB use; however, a large proportion did not discuss these symptoms with their healthcare providers. There is limited research examining patient-physician communication and the reporting of side effects. Our findings are consistent with previous studies showing that individuals with long-term illnesses often do not discuss perceived symptoms from medications with their medical providers. [25,26] As far as we know, this is one of few studies to examine HF in particular and behavior as it relates to BBs, a commonly prescribed agent for individuals with HF, irrespective of subtype. With national efforts focused on increasing the use of guideline-directed medical therapy for HF, this study adds to the literature by shedding light on practical issues that underlie medication-taking behavior and the subsequent benefits (and potential harms) of their use. Discussing potential medication side effects related to HF treatments may facilitate more meaningful patient-provider interactions and ultimately help optimize treatment for HF.

A high proportion of participants reported taking a BB to treat HF and high BP. Many also reported taking BBs to help the heart beat regularly, and this may be attributable to the high prevalence of atrial fibrillation and CHD in this population. Among all participants after covariate adjustment, those who had a hospitalization for HF were more likely to report taking a BB to treat HF. Hospitalizations are more likely to occur with severe HF or less than optimal HF management, and may expose individuals to more education about the purposes of their BB treatment. This also suggests that individuals with HF who present to ambulatory care settings may need education about the purpose of their BBs before an exacerbation occurs. Additionally, participants in the present study who had hypertension were more likely to report taking a BB to treat high blood pressure. Participants with HFpEF were more likely to perceive that the use of BBs was to treat high blood pressure. This suggests that, based on participant perspectives, a significant proportion of individuals with HFpEF are prescribed BBs for hypertension. Among the general population, the

Table 4
Odds ratios for the association of participant characteristics with reporting taking beta-blockers to treat high blood pressure

	Odds ratio (95% CI)					
	All HF (n = 357)		HFrEF/HFmEF (n = 124)		HFpEF (n = 78)	
Characteristics	Unadjusted	Multivariable Adjusted	Unadjusted	Multivariable Adjusted	Unadjusted	Multivariable Adjusted
Age quartiles (years)						
<73	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)
73-77	0.98 (0.55, 1.76)	0.85 (0.56, 1.30)	0.72 (0.28, 1.84)	0.48 (0.14, 1.63)	1.50 (0.35, 6.42)	3.35 (0.53, 21.3)
78-81	1.13 (0.61, 2.12)	0.85 (0.54, 1.34)	1.01 (0.37, 2.81)	1.27 (0.31, 5.28)	1.20 (0.27, 5.25)	7.42 (0.87, 63.5)
≥82	1.68 (0.90, 3.13)	1.79 (1.12, 2.87)	1.08 (0.36, 3.29)	3.26 (0.62, 17.1)	2.53 (0.54, 11.8)	13.8 (1.24, 154)
Black	1.38 (0.86, 2.20)	0.99 (0.75, 1.31)	2.94 (1.24, 6.93)	1.87 (0.59, 5.96)	0.25 (0.08, 0.76)	0.10 (0.02, 0.51)
Men	0.73 (0.47, 1.14)	0.87 (0.67, 1.13)	1.43 (0.69, 2.96)	2.57 (0.92, 7.19)	0.73 (0.25, 2.15)	0.44 (0.10, 1.88)
Region of residence						
Nonbelt/buckle	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)
Stroke belt	0.83 (0.50, 1.38)	0.91 (0.64, 1.30)	0.62 (0.28, 1.37)	0.40 (0.13, 1.18)	2.18 (0.53, 8.98)	6.16 (0.76, 49.6)
Stroke buckle	1.03 (0.58, 1.83)	1.15 (0.77, 1.70)	1.25 (0.46, 3.42)	1.66 (0.46, 5.91)	1.12 (0.30, 4.24)	2.11 (0.35, 12.9)
Hypertension	4.79 (2.81, 8.19)	2.42 (1.79, 3.26)	7.62 (3.04, 9.11)	10.8 (3.18, 36.4)	1.14 (0.32, 4.08)	3.15 (0.52, 19.3)
Hospitalization for HF	1.06 (0.83, 1.35)	0.92 (0.69, 1.24)	1.17 (0.57, 2.42)	0.64 (0.24, 1.70)	1.27 (0.42, 3.89)	0.61 (0.13, 2.88)
Income						
<$20,000	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)
$20,000-$34,999	0.99 (0.48, 2.06)	1.36 (0.85, 2.17)	4.14 (1.13, 15.2)	3.71 (0.84, 16.3)	0.51 (0.10, 2.61)	0.26 (0.03, 2.20)
$35,000-$74,999	0.78 (0.39, 1.57)	1.00 (0.64, 1.57)	1.23 (0.37, 4.05)	0.89 (0.21, 3.69)	2.04 (0.30, 13.9)	1.32 (0.13, 13.8)
≥$75,000	0.51 (0.23, 1.11)	0.81 (0.47, 1.41)	0.95 (0.29, 3.16)	0.86 (0.18, 4.00)	0.64 (0.09, 4.89)	0.11 (0.01, 2.48)
Declined to report	0.58 (0.27, 1.27)	0.76 (0.45, 1.28)	0.40 (0.09, 1.80)	0.32 (0.05, 2.05)	0.43 (0.08, 2.22)	0.25 (0.03, 2.14)
Current/former smoker	1.04 (0.67, 1.62)	1.21 (0.93, 1.57)	1.13 (0.54, 2.38)	1.13 (0.39, 3.29)	2.02 (0.66, 6.17)	7.07 (1.21, 41.3)
HF type						
HFrEF/HFmEF	1 (ref)	1 (ref)	N/A	N/A	N/A	N/A
HFpEF	2.42 (1.27, 4.63)	1.70 (1.11, 2.62)				
Undetermined EF	1.38 (0.84, 2.25)	0.80 (0.56, 1.15)				

Abbreviations: CI = confidence interval; EF = ejection fraction; HF = heart failure; HFmEF = heart failure with midrange ejection fraction; HFpEF = heart failure with preserved ejection fraction; HFrEF = heart failure with reduced ejection fraction

Multivariable adjusted model includes all covariates listed in table.

use of BBs to treat hypertension, among other therapies, reduces ASCVD risk.[27] Whether using BBs specifically to control blood pressure in HFpEF can improve outcomes is unknown. For now, balancing the benefits of managing blood pressure with the potential side effects of BBs in HFpEF is critical.

There are several strengths to the present study. The REGARDS study enrolled a general population sample from across the continental US with approximately equal proportions of black and white participants. A large number of HF events were identified. There is limited research examining an individual's knowledge of their prescriptions, and we explored this in a high-risk population. We also acknowledge some limitations. The medication use survey was mailed a single time to participants, and the response rate was 46%. We observed differences between respondents and nonrespondents including by race and income. Identification of some survey recipients was based on Medicare claims for HF rather than adjudicated events. Sample sizes for HFrEF/HFmEF and HFpEF were small, and limited our power to identify covariates associated with responses to the BB survey. Etiology of HF was not available to account for differences in treatment recommendations. Types and doses of BBs used were not assessed. The medication survey was administered cross-sectionally, and does not account for changes in CVD risk which may impact treatment decisions. Finally, reasons for BB use are based on participant self-report, and we cannot infer the physician's intent for treatment.

In conclusion, despite the complex treatment regimens taken by adults with HF, many participants expressed high adherence to their medications and were willing to take additional medications to prevent healthcare encounters. Participant understanding of BB uses to treat HF is high. However, over half of participants with perceived BB symptoms did not discuss this with their healthcare providers. Better understanding of an individual's medication-taking behaviors and perceptions may facilitate optimization of HF treatments.

Acknowledgment

The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute of Neurological Disorders and Stroke or the National Institutes of Health. Representatives of the funding agency have been involved in the review of the manuscript but not directly involved in the collection, management, analysis or interpretation of the data. The authors thank the other investigators, the staff, and the participants of the REGARDS study for their valuable contributions. A full list of participating REGARDS investigators and institutions can be found at http://www.regardsstudy.org.

Disclosures

MTM and AS have no disclosures. MKVD is employed by GlaxoSmithKline. LC, RWD and TMB receive research support from Amgen, Inc. MF has no disclosures. JM was employed by Amgen, Inc. PG, MMS, and EBL receive research support from Amgen, Inc.

Supplementary materials

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.amjcard.2019.02.024.

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