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Patient characteristics associated with greater blood pressure control in a randomized trial of home blood pressure telemonitoring and pharmacist management

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Abstract

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This paper reports subgroup analysis of a successful cluster-randomized trial to identify attributes of hypertensive patients who benefited more or less from an intervention combining BP telemonitoring and pharmacist management. The endpoint was BP <140/90 mm Hg at six-month follow-up. Fourteen baseline patient characteristics were selected a-priori as subgroup variables. Among the 351 trial participants, 44% were female, 84% non-Hispanic white, mean age was 60.9 years, and mean BP was 149/86 mm Hg. The overall adjusted odds ratio for BP control in the intervention vs. usual care group was 3.64 ($p<0.001$). The effect of the intervention was significantly larger in patients who were younger (interaction $p=0.02$), did not have diabetes ($p=0.005$), had high baseline DBP ($p=0.02$), added salt less than daily in food preparation ($p=0.007$), and took 0–2 (rather than 3–6) antihypertensive medication classes at baseline ($p=0.02$). These findings may help prioritize patients for whom the intervention is most effective.

Keywords

Blood pressure; hypertension; randomized trial; moderators; subgroups; telemonitoring; case management

Hypertension is the most common chronic condition for which patients see primary care physicians, affects about 80 million (about one in three) U.S. adults, and is a major risk factor for heart attacks, stroke, heart failure and kidney failure.¹ Compared with other modifiable cardiovascular (CV) risk factors, poorly controlled hypertension is the leading cause of death among women and the second leading cause of death among men after smoking.² Attaining recommended levels of blood pressure (BP) control has been shown to lower the risk of major cardiovascular events, the most common global cause of death and disability.¹ However, about half of patients with hypertension in the U.S. do not have their BP controlled to recommended levels.³

Although many types of interventions to improve BP control have been tested over the last several decades, the most potent methods reorganize clinical practice using a team-based approach to counsel patients, encourage self-management, promote timely adjustment of antihypertensive therapy, and conduct follow-up.^{4–6} In a 2006 meta-analysis of 28 studies, most of which included a nurse or a pharmacist team member as a care manager, average BP dropped by 10/4 mmHg, and the absolute proportion of patients achieving BP control improved by 20%.⁴ A recently updated meta-analysis of team-based care found smaller BP reductions (5/2 mmHg and proportion achieving BP control improved by 12%), but also documented better cholesterol and glucose levels, thus reducing long-term cardiovascular risk even further.⁷ In a recent systematic review, self-measured home BP monitoring was identified as a useful adjunct to hypertension management, particularly when additional support was part of the intervention.⁸

We recently reported the results of a cluster-randomized trial in patients with uncontrolled hypertension comparing usual care to an intervention that combined home BP telemonitoring and pharmacist management.⁹ The main outcome in the trial was blood pressure control at 6 and 12 months, defined as <130/80 mm Hg for those with diabetes or chronic kidney disease (CKD), and <140/90 mm Hg for all others. The trial showed a large effect on BP control at 6 months, with 72% of participants in the intervention group

achieving BP control, compared to 45% in usual care ($p<0.001$). The intervention group also achieved greater lowering of systolic BP (SBP) by 11 mm Hg and diastolic BP (DBP) by 5 mm Hg than usual care at the six-month follow-up. This paper reports on subgroups defined by patient characteristics at the start of the trial. The goal of the analyses was to detect moderating factors that identify patients who benefited more or less from the intervention.

Methods

Design, setting, and patients

This 2-group cluster randomized clinical trial was conducted at HealthPartners Medical Group, a multispecialty practice in the Minneapolis-St. Paul metropolitan area that is part of an integrated health system. Additional description of the study setting and design has previously been published.¹⁰ The study was designed as a cluster-randomized trial because in a study randomized at the level of the patient, physicians would be aware of the pharmacologic interventions in their patients randomized to the intervention group, and this could influence their usual care practice. The clinic randomized design minimized contamination and was administratively much more straightforward to implement in our practice setting.

Electronic medical records were used to identify adult patients who had BP $>140/90$ mm Hg at the two most recent primary care encounters in the previous year. Study participants were further required to have uncontrolled BP ($\geq 140/90$ mm Hg or $\geq 130/80$ mm Hg if diabetes or CKD was present) based on the average of three automated measurements taken using a standardized protocol in the research clinic. The 16 study clinics were randomly assigned to either the Telemonitoring Intervention (TI, $n = 8$) or Usual Care (UC, $n = 8$) group. A clinical practice agreement at each intervention clinic allowed medication therapy management (MTM) pharmacists to prescribe and change antihypertensive therapy within specified parameters.

Intervention

TI patients received home monitors (A&D Medical 767PC[®] automated oscillometric BP monitor, San Jose, CA) that stored and transmitted BP data to a secure website via modem (AMC Health, New York, NY). Pharmacists met with patients for a one-hour in-person visit, during which they reviewed the patient's relevant history, covered general teaching points about hypertension, instructed them on using the home BP telemonitor system and the individualized home BP goal. Patients were instructed to transmit at least 6 BP measurements each week. During the first 6 months of intervention, which is the time period covered in these analyses, patients and pharmacists met every two weeks via phone until BP control was sustained for 6 weeks, then frequency was reduced to monthly. During phone visits, pharmacists emphasized lifestyle changes and medication adherence. They assessed and adjusted antihypertensive drug therapy based on an algorithm using the percentage of home BP readings meeting goal. Pharmacists communicated with patients' primary care teams through the electronic medical record following each visit.

During the study period, UC patients worked with their primary care physicians as usual. This could include referral to an MTM pharmacist for consultation (1–2 visits without telephone follow-up or prolonged monitoring) and conventional home BP measurement.

Sample for subgroup analysis

The analytic sample for the subgroup analysis consists of 351 patients (177 TI, 174 UC) from the original randomized sample of 450 from the main study (228 TI, 222, UC). From the original 450 we excluded 41 participants with diabetes or CKD whose baseline BP was 130–139/80–89 mm Hg in order to use a common follow-up BP goal of <140/90 mm Hg and to assure that all patients at baseline were not at BP goal (n=409). The sample was further restricted to those who had a six month clinic visit (n=364) to ascertain the primary dependent variable of BP <140/90 and further to those who had full information on all of the subgroup variables considered (n=351).

Measures

The primary outcome in the main trial was blood pressure control of <130/80 mm Hg at both the six and twelve month clinic visit for those with diabetes or chronic kidney disease and <140/90 mm Hg for all others, reflecting the JNC 7 guidelines prevailing at that time¹¹. For this analysis the outcome was blood pressure control at the six month clinic visit, based on the average of three automated measurements taken using a standardized protocol in the research clinic. The endpoint used in this analysis was a common BP goal of <140/90 mm Hg for all patients, to reflect current JNC 8 guidelines for patients with diabetes and CKD¹² and to determine the effectiveness of the intervention in patients with diabetes and CKD independent of the lower BP goal that had previously been recommended. A sensitivity analysis was conducted to include the 41 participants with diabetes or CKD having baseline BP of 130–139/80–89 and defining the BP endpoint as BP <130/80 for those with diabetes or CKD and BP < 140/90 for all others.

A total of 14 baseline measurements defined the subgroups of interest. Binary variables included sex, white race, diabetes, CKD, reported a cardiovascular event at baseline (patient was ever told they had a heart attack, stroke, or ever had a heart bypass or stent), smoked in the past 30 days, consumed 2 or more alcoholic beverages per week (vs. none or a smaller amount), added salt daily or more when preparing food (vs. less frequently or not at all), and used a home BP monitor in the past 12 months. Age was coded a priori as 31–49, 50–59, 60–69, 70+ years. Body mass index (BMI), SBP, and DBP at baseline were all coded as continuous variables. The number of hypertension medications at baseline was coded post-hoc as 0–2 vs. 3–6 after plotting treatment effects within number of hypertension medications. A variable indicating prior hypertension care was considered, but dropped from consideration when it became apparent that patients were not able to interpret the survey item. These definitions of relevant subgroups have been used in prior hypertension research, and facilitate comparison of our results to those of others.

Plan of Analysis

Baseline attributes of TI and UC patients were summarized and differences by treatment group were examined in contingency tables and tested using Pearson's χ^2 or independent

samples t-tests. Generalized linear mixed models with a logit link and random intercept for clinic were used to test the interaction effect of each subgroup variable individually while accounting for clinic-level randomization. Each model predicted a binary endpoint of BP<140/90 mm Hg at 6 months from a binary indicator of treatment group (TI vs. UC), all 14 baseline variables, and a single treatment group by subgroup variable interaction. The p-value for the interaction term was used to draw a conclusion about whether there was evidence of differential effectiveness across patient characteristics (ie, a significant p-value suggests that the intervention was more or less effective in one or more subgroups).¹³ Simple effects odds ratios summarized the point estimate of the effect of treatment (TI vs. UC) within each category of a subgroup variable. The 95% confidence interval for the simple effects odds ratio is provided to understand the precision of the point estimate. Examining the overlap of this confidence interval with unity within each subgroup is not a strong approach for examining subgroup differences and can only yield suggestive conclusions.^{14,15} The study was not designed to draw conclusions about absolute treatment effectiveness within each patient characteristic subgroup. Some variables that are tested as continuous variables in interactions with treatment group (BMI, SBP, DBP) are classified into categories in tables to illustrate differential treatment effects. There is no adjustment for multiple testing of individual interaction terms.

Protection of Research Subjects

All participants provided informed consent and the study protocol was reviewed, approved in advance, and monitored by the HealthPartners Institutional Review Board.

Results

Among the 351 trial participants included in subgroup analysis, 44% were female, 84% non-Hispanic white (Table 1). Among 56 not in the non-Hispanic white category, 35 were Black, 5 Asian, 3 American Indian, 11 mixed, 2 “other,” and 6 additionally identified as Hispanic. At baseline mean age was 60.9 years (SD=11.9), mean BP was 149/86 mm Hg, 12% of patients had diabetes, 15% had CKD, and 9% had a prior cardiovascular event. Roughly 11% smoked tobacco in the past 30 days, 44% had 2 or more alcoholic drinks per week on average, 26% added salt daily or more in the preparation of food, and 45% had used a home BP monitor in the past 12 months. The only statistically significant difference at baseline by treatment group was a higher mean number of antihypertensive medications in the TI group (mean 1.6, SD=1.4) compared with the UC group (mean 1.3, SD=1.1). This difference was also present in the full trial of 450 patients.

The overall unadjusted odds ratio for achieving the primary outcome of BP control to <140/90 mm Hg at six months of follow-up in the TI compared with the UC group was 3.43 (95% CI: 2.25, 5.22, $p < 0.001$). The overall odds ratio for BP control at 6 months in the TI vs. UC group with adjustment for the 14 covariates was 3.64 (95% CI: 2.27 to 5.84, $p < 0.001$). Table 2 shows the multivariable model-predicted proportion of BP control at 6 months overall (0.79 in the TI group and 0.50 in the UC group) and in each subgroup for the TI and UC groups. The interaction p-values indicated that the magnitude of the treatment effect varied for 5 of the 14 subgroup variables examined (Table 2). For example, the p-value

of 0.02 for the patient characteristic of baseline diastolic BP indicates that the treatment effect was larger in one group (patients with DBP ≥ 90) than the other (patients with DBP < 90). For patients with DBP < 90 , BP control was 56% in usual care and 75% in the TI group. For patients with DBP ≥ 90 , BP control was 41% in usual care and 84% in the TI group. The effect of the intervention was significantly larger in younger patients, those without diabetes, those with high DBP at baseline, those adding salt less than daily in food preparation, and those taking 0–2 (rather than 3–6) antihypertensive medication classes at baseline. There was no strong evidence of differential treatment effectiveness by race/ethnicity, BMI, other co-morbidities, SBP, smoking, alcohol use, or previous use of a home BP monitor. The results were qualitatively similar in the unadjusted and multivariable adjusted models, although the unadjusted analysis showed a marginally significant interaction with sex and number of antihypertensive medication classes (Table 3), while there was no evidence of a differential treatment effect by sex in the multivariable adjusted analysis (Table 2).

Examination of the model-predicted BP control proportions in Table 2 shows that the UC group BP control was progressively better in each age category (0.25, 0.36, 0.69, 0.69), while there was less difference by age group in the TI group (0.59, 0.86, 0.84, 0.78). The treatment effect was much greater in patients age 30–59 because older patients in the TI and UC groups generally did about equally well. Thus, the odds ratio was closer to unity for older patients although they had the highest BP control rates. Similarly, patients with diabetes had high rates of BP control at 6 months in both the TI and UC groups, but patients without diabetes achieved high rates of BP control in the TI group but not in the UC group. Patients with high self-reported salt intake had similar BP control at 6 months in both the TI and UC group, while patients with low salt intake had higher BP control in the TI than in the UC group. Patients on three or more antihypertensive medications had lower BP control in both the TI and UC group, while patients on fewer medications had higher BP control in the TI than in the UC group. In the sensitivity analysis defining BP control as BP $< 130/80$ for those with diabetes or CKD and BP $< 140/90$ for all others, the resulting interaction p-values yielded the same decisions concerning statistically significant subgroup variables as found in Table 2.

Discussion

The intervention strategy that we evaluated was highly effective overall as previously reported and intervention effectiveness did not vary in most of the subgroups we examined for this analysis.⁹ These results extend the prior analysis and demonstrate that there were some significant differences in intervention effect across demographically and clinically defined subgroups. In particular, it is apparent that those who benefited the most from the intervention were those who were younger, those who did not have diabetes, those who had uncontrolled DBP at baseline, those who reported low salt intake, and those on fewer antihypertensive medications. However, the results should not be taken to indicate that the intervention should be withheld from some patient subgroups. The only subgroups of patients having a directionally negative effect of the intervention are those with diabetes. All other patient subgroups have intervention effects that are at least in the direction of benefit.

Some of these subgroup findings seem easy to understand in the context of the care delivery system in which the study was conducted. Since 1995 there have been sustained and systematic efforts to improve control of BP and other major risk factors in adults with diabetes. These patients continued to receive additional attention to their elevated BP during the study as a result of quality improvement efforts, while patients without diabetes did not. This may account for the greater treatment effect in patients without diabetes. In contrast, patients with and without CKD both had higher BP control in the TI group vs. UC group. For this study we carefully classified patients as having CKD by repeated measures of estimated glomerular filtration rates and urine albumin levels. Although we informed the patients and primary care physicians of the results and assigned patients with CKD to a lower BP goal, there was no system-wide effort targeting BP control in patients with CKD. Therefore, this group likely did not receive the same additional attention that patients with diabetes received.

The observed differences by age group are harder to interpret. It may be that working age patients have less access to clinic-based care due to work obligations and time constraints, and that the telephonic nature of pharmacist care provided more regular access to care including needed medication adjustments. It may also be that younger patients need further persuasion by multiple home BP measurements to be willing to accept the diagnosis of hypertension and need for treatment. The finding of greater effect on those with elevated DBP could relate to meticulous focus by the intervention MTM pharmacists on both SBP and DBP when considering further treatments. Another possibility is some residual confounding by age despite adjustment, since younger patients are more likely to have elevated DBP.

Patients who reported lower salt intake may have been more physiologically responsive to treatment with diuretics, a mainstay of treatment. Alternatively, this may have been a marker for patients who were generally more adherent to treatment and more willing to accept treatment intensification. Conversely, patients who were treated with three or more classes of antihypertensive medication classes and had persistently elevated BP were more likely to have resistant hypertension or other management challenges. Our results suggest that additional study is needed to test interventions to achieve BP control in this group of patients, who represented 21% of the study population.

Our overall results are congruent with beneficial effects of nurse- and pharmacist-led hypertension control interventions conducted in other care settings.^{4-6,17} A recent systematic review pointed out that relatively few studies have analyzed outcomes by patient baseline variables.⁷ In a similar interventions in managed care settings, Green, et al found a greater treatment effect in patients with baseline SBP ≥ 160 mm Hg and Magid, et al found greater treatment effects in patients with diabetes or CKD but did not perform a statistical interaction test.^{18,19} In a nurse-managed intervention in the VA setting, Jackson, et al reported that the intervention effect was confined to African American patients.²⁰ Although we did not observe significant interactions by baseline SBP level or race, our results extend these previous reports and provide useful information on subgroups that also suggests likely mechanisms by which our intervention, and perhaps similar interventions designed by others, may exert their beneficial effects.

Our study thus contributes new knowledge, and has several strengths. We carefully designed our subgroups for analysis a priori, and had sufficient data to accurately assign study subjects to subgroups with confidence, minimizing the likelihood of bias related to misclassification. Moreover, we performed formal interaction testing. This study also has some limitations. We tested more subgroups than typical according to a review of subgroup analysis practices, which found a median of 4 variables selected for subgroup analysis.²¹ With 14 subgroup interaction tests, some of our findings may represent chance findings, so our results should be interpreted cautiously and considered hypothesis-generating. On the other hand, the number of subjects in some of our subgroups (non-white race, had CVD event, smokers) was limited, raising the possibility that we may not have identified some clinically meaningful subgroup differences as statistically significant. We lacked detailed information on occupation and socioeconomic status, but exploratory analyses did not reveal any differences in intervention effect by educational attainment. The analytic approach was reasonable for assessing patient characteristic subgroup in which the treatment effect was larger or smaller than in other subgroups (“differential effectiveness”). However, the approach allows only suggestive conclusions of whether or not the intervention was effective or not within each subgroup (“absolute effectiveness”). Finally, generalization of our observed single-site results to other care settings and patient populations should be done with caution.

In conclusion, we found that in our setting an intervention with home BP telemonitoring and pharmacist management improved BP control and lowered BP overall, but was particularly effective in younger patients, those without diabetes, those with elevated diastolic BP, and patients treated with fewer than three medication classes. These findings may help clinicians or health systems prioritize patients for whom the intervention is most effective.

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Highlights

- This paper reports subgroup analysis of a successful cluster-randomized trial
- The intervention involved BP telemonitoring and pharmacist management
- Intervention effect on BP control was similar for 9 of 14 patient characteristics
- Intervention effect varied by age, diabetes, DBP, salt use, number of medications
- Findings may help prioritize patients for whom the intervention is most effective

Table 1

Patient characteristics at baseline, n=351.

	Total N=351	TI group N=177	UC group N=174	p
Female, %	44.2	43.5	44.8	0.80
White, %	84.1	85.3	82.8	0.51
Age, mean (SD)	60.9 (11.9)	61.8 (11.5)	59.9 (12.3)	0.13
30–49 (%)	19.1	15.3	23.0	0.18
50–59	29.6	28.8	30.5	
60–69	25.6	29.4	21.8	
70+	25.6	26.6	24.7	
BMI, kg/m ² , mean (SD)	31.4 (6.3)	31.0 (6.3)	31.8 (6.3)	0.22
Diabetes, %	11.7	12.4	10.9	0.66
CKD, %	15.4	18.1	12.6	0.16
CVD event (ever told had a heart attack, stroke, or ever had a bypass or stent), %	9.4	10.2	8.6	0.62
Systolic BP	148.8 (11.8)	149.7 (11.6)	148.0 (11.9)	0.18
Diastolic BP	85.7 (10.7)	85.5 (10.8)	85.9 (10.7)	0.70
Smoked in past 30 days	10.8	9.6	12.1	0.46
Alcohol use 2+ days or more per week	43.9	43.5	44.3	0.89
Salt use daily or more in preparation of food, %	25.6	27.1	24.1	0.52
Count of antihypertensive medication classes, mean (SD)	1.4 (1.3)	1.6 (1.4)	1.3 (1.1)	0.01
0–2 (%)	79.5	84.5	74.6	0.02
3–6	20.5	15.5	25.4	
Prior use of home BP monitor, %	44.7	49.2	40.2	0.09

Analytic denominator: N=351 with 6 month data, with BP $\geq$ 140/90 mm Hg at baseline, and non-missing on all covariates.

Table 2

BP goal met (<140/90 mm Hg) at six-month visit, and differences in effects of treatment on BP<140/90 mm Hg across subgroups, multivariable adjusted model.

	Proportion with BP <140/90, TI group ^a	Proportion with BP<140/90 UC group ^a	Simple effects OR (95% CI)	Inter-action p
Overall	0.79	0.50	3.64 (2.27 – 5.84)	-
Female	0.75	0.53	2.64 (1.29 – 5.39)	0.16 ^b
Male	0.82	0.49	4.79 (2.81 – 8.17)	
White	0.79	0.48	4.04 (2.50 – 6.51)	0.27
Other	0.79	0.64	2.13 (0.70 – 6.46)	
Age 30–49	0.59	0.25	4.02 (1.02 – 15.95)	0.02
50–59	0.86	0.36	11.05 (4.07 – 30.01)	
60–69	0.84	0.69	2.34 (0.91 – 6.04)	
70+	0.78	0.69	1.56 (0.72 – 3.40)	
BMI (continuous)				0.99
BMI <25	0.81	0.48	4.72 (1.19 – 18.77)	0.57
25–<30	0.66	0.44	2.47 (0.93 – 6.57)	
>=30	0.85	0.54	4.79 (2.34 – 9.80)	
Diabetes	0.73	0.76	0.82 (0.28 – 2.45)	0.005
No diabetes	0.79	0.47	4.20 (2.51 – 7.04)	
CKD	0.77	0.36	6.02 (2.28 – 15.87)	0.19
No CKD	0.79	0.53	3.30 (2.09 – 5.18)	
CVD event	0.76	0.67	1.57 (0.50 – 5.00)	0.15
No CVD event	0.79	0.49	3.97 (2.38 – 6.61)	
Systolic BP (continuous)				0.48
SBP < 150	0.80	0.51	3.73 (1.88 – 7.40)	0.89
SBP >=150	0.77	0.49	3.46 (1.71 – 6.99)	
Diastolic BP (continuous)				0.006
DBP < 90	0.75	0.56	2.34 (1.44 – 3.81)	0.02
DBP >= 90	0.84	0.41	7.59 (3.04 – 18.97)	
Smoked in past 30 days	0.57	0.47	1.52 (0.41 – 5.57)	0.20
Did not smoke	0.81	0.51	4.16 (2.31 – 7.49)	
Alcohol use 2+ days or more per week	0.83	0.52	4.52 (2.31 – 8.84)	0.16
Less or no alcohol use	0.75	0.49	3.10 (2.03 – 4.73)	
Salt use daily or more in food prep	0.67	0.61	1.33 (0.60 – 2.94)	0.007

	Proportion with BP <140/90, TI group ^a	Proportion with BP<140/90 UC group ^a	Simple effects OR (95% CI)	Inter- action p
Less salt use	0.83	0.47	5.36 (2.90 – 9.90)	
0–2 antihypertensive medications	0.82	0.50	4.64 (2.64 – 8.18)	0.02
3–6 antihypertensive medications	0.67	0.56	1.55 (0.70 – 3.44)	
Home BP monitor use in past 12 mos	0.73	0.56	2.10 (1.07 – 4.13)	0.10
None	0.84	0.47	5.87 (2.55 – 13.52)	

Generalized linear mixed model with random intercept for clinic. Each subgroup analysis includes the 14 subgroup predictors listed in the table and coded as described in the text, treatment group, and one interaction of treatment group and a subgroup variable.

^aModel-predicted proportion of patients with BP < 140/90 at six months.

^bThe p-value is the treatment group by subgroup interaction test.

Table 3

BP goal met (<140/90) at six-month visit, and differences in effects of treatment on BP<140/90 across subgroups, unadjusted results.

	Simple effects OR (95% CI)	Interaction p
Overall	3.43 (2.25 – 5.22)	-
Female	2.29 (1.24 – 4.23)	0.05 ^a
Male	4.83 (2.99 – 7.81)	
White	3.68 (2.37 – 5.70)	0.42
Other	2.38 (0.86 – 6.60)	
Age 30–49	3.53 (0.92 – 13.63)	0.01
50–59	8.86 (3.57 – 21.96)	
60–69	2.48 (1.10 – 5.62)	
70+	1.40 (0.65 – 2.99)	
BMI (continuous)		0.99
BMI <25	3.67 (0.97 – 13.9)	0.75
25–<30	2.84 (1.35 – 5.97)	
>=30	4.29 (2.23 – 8.26)	
Diabetes	0.95 (0.35 – 2.58)	0.01
No diabetes	4.00 (2.51 – 6.38)	
CKD	6.25 (2.13 – 18.33)	0.21
No CKD	3.14 (2.07 – 4.76)	
CVD event	1.73 (0.53 – 5.70)	0.22
No CVD event	3.68 (2.41 – 5.62)	
Systolic BP (continuous)		0.51
SBP < 150	3.60 (1.87 – 6.92)	0.79
SBP >=150	3.14 (1.58 – 6.23)	
Diastolic BP (continuous)		0.01
DBP < 90	2.32 (1.45 – 3.69)	0.04
DBP >= 90	6.48 (2.84 – 14.80)	
Smoked in past 30 days	1.21 (0.33 – 4.52)	0.10
Did not smoke	4.00 (2.37 – 6.74)	
Alcohol use 2+ days or more per week	3.82 (2.22 – 6.58)	0.58
Less or no alcohol use	3.19 (1.94 – 5.26)	
Salt use daily or more in food preparation	1.36 (0.75 – 2.47)	<0.001
Less salt use	4.95 (2.82 – 8.70)	

	Simple effects OR (95% CI)	Interaction p
0–2 antihypertensive meds	4.25 (2.46 – 7.34)	0.07
3–6 antihypertensive meds	1.77 (0.86 – 3.66)	
Home BP monitor use in past 12 mos	2.21 (1.19 – 4.11)	0.12
None	5.01 (2.52 – 9.95)	

Generalized linear mixed model with random intercept for clinic. Each subgroup analysis includes one subgroup predictor listed in the table and coded as described in the text, treatment group, and one interaction of treatment group and a subgroup variable.

^aThe p-value is the treatment group by subgroup interaction test.