The Effectiveness of a Community/Academic Health Center Partnership in Decreasing the Level of Blood Pressure in an Urban African-American Population

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This study investigated the effectiveness of a community-academic health center partnership, utilizing nurse-supervised indigenous community health workers, in decreasing the blood pressure in an urban African-American population. A four-year randomized clinical trial was conducted in the Sandtown-Winchester community, which has an excess prevalence of high blood pressure, in order to test the effectiveness of 2 different levels of intervention intensity on increasing the control of high blood pressure. Community health workers were trained and certified in blood pressure management, monitoring, education and counseling, social support mobilization, and community outreach and follow up.

The primary results were a significant decrease in mean systolic and diastolic pressures after both levels of intervention, and a significant increase in the percentage of individuals with controlled high blood pressure. Surprisingly, no differences in results were observed between the 2 levels of intervention intensity.

This study supports the use of community-based partnership efforts, and the utilization of indigenous health workers, to enhance the control of high blood pressure in a high-risk, African-American urban population. (*Ethn Dis*. 2003;13:354–361)

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Background

Hypertension is one of the most common chronic diseases in the African-American population, affecting approximately 6,315,000 adults in the United States.[1,2] The prevalence of hypertension is estimated to be 30% higher in African Americans compared to Caucasians (38% vs 29%), a difference that persists after controlling for age, adiposity, and socioeconomic status.[2,3] Hypertension-related mortality rates peak earlier among African Americans, and complications of uncontrolled hypertension, especially cerebrovascular accidents, left ventricular hypertrophy, congestive heart failure, and acute myocardial infarction, are also more common in African Americans than in White Americans. In addition, the risk for hypertensive end-stage disease has been reported to be 15–18 times greater among African Americans, compared to Whites.[4] In Maryland, as in the nation, heart disease and stroke were the 1st and 3rd leading causes of death for the total population, with African Americans bearing the greatest burden of mortality.[5] Age-specific and age-adjusted hypertensive heart disease mortality rates in Sandtown-Winchester, the inner-city African-American community in Baltimore examined in this study, are among the highest in Maryland, and in the United States. In 1991, the prevalence of high blood pressure (HBP) in this community was estimated to be 35%, with a control rate estimated at 15%.[6]

Prior research has indicated that, in order to be effective, interventions designed to enhance the accessibility, quality, and outcomes of care for urban African Americans with hypertension should be culturally specific, and should allow the indigenous population to participate in an intervention's development, implementation, and evaluation. Characteristics of such interventions include: 1) the formation of a partnership between the local community and an academic health center; 2) the training of indigenous community health workers to provide outreach, linkage, follow up, monitoring, and education; 3) a commitment to the long-term maintenance of effective programs; and 4) vigorous monitoring and evaluation from the outset.[7–9] Prior research has also indicated that appropriately developed educational/behavioral interventions are associated with significant improvement in the control of hypertension, and reductions in related morbidity and mortality.[10]

In order to test the generalizability of these earlier findings, we conducted a 4-year population-based study, funded by the National Heart, Lung, and Blood Institute, in the Sandtown-Winchester community of West Baltimore. In addition, in-kind support was provided by community and academic leaders, an advisory board was formed, and office space was provided in the community. The study was developed as a community-academic health center partnership to maximize the successful implementation and evaluation of the proposed interventions. The study was designed

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to compare the program effectiveness and intervention efficacy of 2 educational/behavioral interventions of different intensities, on the lowering and control of SBP. The 2 major hypotheses were: 1) that both interventions would result in a significant reduction of the overall blood pressure level in the community, and increased control of hypertension; and 2) that the more intensive intervention, utilizing nurse-supervised community health workers in a series of home visits over a 2.5-year period, would result in significantly better hypertension control, compared to the less intensive strategy. This paper presents the results of this community-based program designed to reduce hypertension.

METHODS

Partnership

This intervention study was guided by the concepts and principles of community-based partnership research and programs.[11–13] At the outset, a community-based health advisory board was created. The board was chaired by a community leader, and included residents of the community; representatives from community-based organizations, the health department, social service agencies, and local healthcare providers; and faculty and staff from the Johns Hopkins University. The advisory board recruited more than 20 leaders from community-based organizations and the faith community, as well as health professionals and providers. The board: provided overall guidance, monitoring, and review; helped integrate the study into other ongoing community activities; planned for dissemination of research results and the maintenance of the partnership research program; and helped recruit, select, and monitor the community health workers. The training of the community health workers, taking place over a 3-month period, has been described in detail elsewhere.[14]

Community Sampling

The Sandtown-Winchester Community is urban, 98% African-American, 63% female, with an average age of 43 years. In this community, 42% of the residents have a high school diploma or GED, 31% are unemployed, and 51% have an annual income of $<$\$10,000.[15] Baseline data on this community's health status, and its high risk for cardiovascular disease, identified at baseline have been published previously.[15] In order to obtain a representative sample of the entire community for this study, the 72 census blocks were enumerated, using census maps. Blocks were than randomly assigned to one of 3 strata, with each strata representing the entire community.

Study Design

This research was conducted in 2 phrases: a community survey, followed by a randomized community trial. In the initial phase, household surveys were completed in each stratum, before data collection began in a new stratum. In order to ascertain whether a household was a functional residence, we assessed its physical condition, noting if it was boarded up, and whether it had a doorbell, broken or not. When a doorbell was present, the community health worker recorded that fact as evidence that a housing unit was a residence, and a study number was assigned to each household. Interviewers later returned (up to 5 times) to interview all household members ages 18 years and older. Interviewers entered a total of 1475 households, 2736 adults eligible for interview were identified, and after giving informed consent, 2196 completed the baseline interview. Baseline data included sociodemographic data and general health information; health and risk behaviors (eg, dietary, physical activity, alcohol consumption); access to, and utilization of, health care; and the practice of preventive health behaviors.[15–16]

After all baseline data were collected, census blocks were randomized to either a more or less intensive intervention arm. All African-American adults with hypertension, either those who reported prior history, or those newly detected during the baseline visit, were eligible, and were asked if they would agree to participate in the randomized intervention trial. For those with newly detected hypertension, blood pressures were measured again in the home within 2 weeks, to verify the initial evaluation. The average of the last 2 of 3 blood pressure readings was used to determine eligibility. If the systolic blood pressure was equal to, or exceeded, 140 mm Hg, and/or the diastolic was equal to, or exceeded, 90 mm Hg, the individual was considered hypertensive. Individuals with terminal conditions, mental impairment, or acute conditions precluding participation, were excluded from the study. Additional information collected from individuals with a prior history of hypertension included: time since diagnosis, type of treatment prescribed, adherence to care and treatment recommendations, satisfaction with care, and knowledge regarding hypertension. A follow-up household survey, repeating all baseline measures, was conducted 40 months after the initiation of the study.

The community health workers were trained in the blood pressure measure-

Less Intensive *N*=387	More Intensive *N*=402
Usual medical care	Usual medical care
Community HBP education	Community HBP education
HBP patient education materials	HBP patient education materials
	PLUS
	Education and counseling
	Outreach and follow up
	Social support mobilization

Fig 1. Intervention arms

ment standards of the American Heart Association, and certified by Johns Hopkins University and the Maryland State Department of Health. The major independent variables were the 2 levels of intensity of the intervention. The major outcome variables were blood pressure levels, and the percentage of individuals with controlled blood pressure. Intermediate outcome variables included the continuance of on-going care for hypertension, and adherence to treatment recommendations. The community-based intervention included the partnership approach, and the use of nurse-supervised indigenous community health workers,[14] as well as state-of-the-art educational/behavioral strategies to enhance participation in achieving on-going care, adherence to treatment recommendations, and control of hypertension.

Less Intensive Intervention

The less intensive intervention consisted of community health workers providing educational, counseling, and referral at a home visit. Participants received an explanation of hypertension and its treatment. Emphasis was placed on the importance of remaining in care, adhering to treatment, and achieving a goal BP. The community health workers also gave each participant a wallet-sized card to record dates and levels of BP, and an educational pamphlet entitled *High Blood Pressure in Blacks,* which emphasized self-care behaviors, such as controlling weight, moderating salt and alcohol intake, and increasing physical activity. For those participants with no source of care, or discontinued care, the health workers provided information on gaining access to free ongoing care in the community. In addition, the workers answered questions and discussed health concerns.

More Intensive Intervention

The more intensive intervention consisted of all the components of the less intensive intervention, and a series of 5 additional home visits by the community health workers, conducted over a 30-month period. Blood pressure was measured at each visit. The sessions focused on: helping individuals reduce barriers to controlling their hypertension; enhancing adherence to treatment; appropriate dietary practices and physical activity; and enhancing family and social support. The importance of patients keeping scheduled appointments, and expressing concerns and questions to their physicians, were emphasized. In addition, at each home visit, community health workers addressed issues of access to care, health insurance, and other system-related factors, as well as social/human service needs. Educational messages were tailored to the individual's hypertension status, and to their health and educational needs. The community health workers trained and rehearsed individuals in appropriate shopping and food preparation techniques designed to control caloric, salt and fat intake, in daily physical activity patterns, and in moderating alcohol intake. Family members or friends were taught how to provide daily support and assistance with appointment keeping, and with BP control related behaviors. The health workers and participants worked together to agree upon dietary, physical activity, and BP goals. See Figures 1 and 2.

Statistical Methods

Baseline measures were compared between individuals randomized to the more or less intensive interventions, using standard methods, including the *t* test, nonparametric tests, and the chi-square test for contingency tables, depending on the individual measure's characteristics. These same standard methods were employed to make the following comparisons: 1) baseline measurements between individuals who were successfully and unsuccessfully re-interviewed at the final follow up; and 2) final follow-up measures between individuals randomized to the 2 treatment arms. Some additional standard methods for paired comparison were used to analyze changes in measures collected at both baseline and final follow up between individuals randomized to the 2 treatment arms. All analyses were performed using the Statistical Analysis System (SAS), version 7 for Windows.[17]

In keeping with an intention-to-treat design, a random coefficient model was developed to assess the overall effectiveness of the intervention (ie,

change in blood pressure). The method of restricted maximum likelihood (REAL) was used to estimate the model parameters based on all available observations from both the baseline and final follow-up interviews. A significant advantage to using this model, as opposed to a standard linear model, is the retention of baseline observation from subjects who are subsequently lost to follow up.[18] Repeated ANOVA analysis is, in fact, a special case of the random effects linear model. Likewise, individuals for whom a baseline measurement was not obtained (persons reporting a prior history of SBP who refused to be measured), but for whom a final follow-up BP was obtained, can be retained. Thereby, the power is maximized to detect a significant difference in blood pressure change between treatment arms. The SAS procedure PROC MIXED was utilized for this purpose.

Individual shifts in JNC-VI blood pressure classes from baseline to follow up, stratified by treatment arm, were examined and tested using Bowker's test of symmetry for square tables.[19]

Home Visits	Theme
1	Adherence to HBP treatment and scheduled medical care visits
2	Adherence, social support, and double stethoscope
3	Review and reinforcement
4	Nutrition: reducing fats in diet
4b	Adherence to HBP treatment and care
5	Reinforcement: low fat diet
6	Provider-patient communication

Fig 2. Intensive intervention arm

RESULTS AND ANALYSIS

Baseline

In this random population survey, 817 individuals (37%) were identified as having hypertension. Eighty-six percent of these reported a prior diagnosis of hypertension, and 14% were newly detected during the household survey. The study population was 100% African-American, 62% female, with an average age of 54 years. Forty-two percent had a high school diploma or GED, 45% had less than a 9th-grade education, 32% were unemployed, 65% had an annual household income less than $10,000, 79% reported a usual source of care, and 20% had no health insurance.

Of the 817 eligible individuals, 97% agreed to participate in the study, with 387 being randomly assigned to the more intensive intervention group, and 402 to the less intensive group. The 3% who chose not to participate did not differ significantly from those who did participate, on any baseline measures. At baseline the 2 intervention arms were equivalent (Table 1), with no differences in the mean age, sex, marital status, education, employment status, insurance status, major co-morbidities, cardiovascular risk factors, access to care, or BP status.

Follow Up

Forty months after enrollment, of the 789 initially randomized, 53 (24 from the more intensive group, and 29 from the less intensive group) had died; 5 (3 and 2, from the more and less intensive groups, respectively) were incarcerated; 23 (13 and 10, from the more and less intensive groups, respectively) were too sick to be interviewed; and 191 (75 and 116, from the more and less intensive groups, respectively) had moved, leaving no follow-up address. Of the remaining 517 individuals potentially available for interview, 22 (12 and 10, from the more and less intensive groups, respectively) were never at home, despite numerous attempts being made to contact them; and 24, or 3%, (18 and 6, from the more and less intensive groups, respectively) refused to be interviewed. We were, therefore, able to re-interview 471 (87%) participants, evenly divided between the more and less intensive groups (240 more intensive, 231 less intensive). No significant differences were observed in any of the sociodemographic, healthcare utilization, risk factor, or initial BP level data, between the groups interviewed at baseline (N=708), and at the 40-month follow up (N=471).

Effects of the Intervention

The overall program effects of the 2 interventions on lowering blood pressure from the baseline reading to the follow-up reading 40 months later, are displayed in Tables 2–5. The observed mean blood pressure by intervention arm (Table 2) indicates a mean systolic change of −2.7 mm Hg, and a mean diastolic change of −3 mm Hg, in the more intensive arm. The respective changes were −6.5 mm Hg, and −4.6 mm Hg, in the less intensive arm. While the differences from baseline to follow up within both treatment arms, and for both systolic and diastolic pressures, were significant ($P<.05$), the difference between the 2 groups at final follow up was not statistically significant ($P>.10$). The less intensive group ex-

Table 1. Comparison of baseline characteristics of the 2 intensive arms*

Characteristics	More Intensive *N*=387	Less Intensive *N*=402
Sociodemographics		
Mean age (yrs)	53.8	54.6
Female (%)	61.2	62.5
Marital status (%)		
Married	23.8	21.6
Divorced	13.7	12.7
Separated	15.5	14.5
Widowed	19.1	22.9
Never married	27.6	27.9
Education (%)		
Less than high school	57.1	58.5
HS/Some college	40.6	39.1
College graduate	2.3	2.5
Employment status (%)		
Full-time	21.2	15.7
Annual family income (%)		
None	5.7	9.2
<$10,000	58.4	59.2
$10,000–$14,999	9.8	9.4
$15,000 or more	10.6	9.5
Refused	7.2	8.2
Don't know	8.3	5.5
Having health insurance (%)	77.5	75.9
Access to care (%)		
Have a regular source of care	83.5	74.4
Last time received care (%)		
<3 months	70.5	67.9
3–6 months	10.2	14.6
6 months–1 year	9.6	10.7
>1 year	9.5	6.8
Don't know	1.1	0.3
Mean SBP (mm Hg)	147.7	148.6
Mean DBP (mm Hg)	89.2	89.3
Time since last BP check (%)		
Within last month	52.4	56.4
Within last 3 months	22.2	21.1
Within last 6 months	12.4	12.4
>6 months	8.8	9.4
Don't know	4.1	5.5
Risk factors (%)		
Ever smoked	61.5	61.2
Currently smoking	48.1	50.2
Elevated cholesterol	25.1	20.9
>5 drinks of alcohol/day in past month	39.2	39.5
Obesity	42.0	41.0
No regular exercise	78.0	79.0

* No statistically significant differences between arms for any of these variables.

perienced greater declines in both systolic and diastolic blood pressure, compared to the more intensive group, contrary to our initial second hypothesis. Table 3 presents the blood pressure changes by intervention arm, as derived from random coefficient models in accord with the study design. The unadjusted estimates indicate a change of −3.2 mm Hg (SBP), and −2.9 mm Hg (DBP) in the more intensive arm, with unadjusted estimates of −5.5 mm Hg, and −4.1 mm Hg, respectively, and adjusted estimates of −5.6 mm Hg and −3.8 mm Hg, respectively. The difference between changes in blood pressure for the more and less intensive arm are 2.3 mm Hg (SBP) and 1.2 mm Hg (DBP), unadjusted and adjusted, respectively.

Results from the random coefficient models, which retain data on all trial participants, indicate a significant decrease in both systolic and diastolic blood pressure for each group ($P<.05$), but not a significant difference between groups at the final follow up. These results are similar to those exhibited in Table 2, which reports findings only for those individuals for whom there were observed data, or baseline follow up; however, the findings are more robust. The improvement in the level of adequate control of SBP was significant in both groups (Table 4), with the control rate approximately doubling. No difference in the recidivism rate was observed between the groups.

The percentages of levels of blood pressure among individuals in both groups at baseline and at follow up were also examined by JNC VI stages as noted in Table 5. The percentages of individuals with normal BP increased by 12% and 14%, in the more and less intensive groups, respectively. The percentages of individuals in Stage I decreased by 8% and 12%, in the more and less intensive groups, respectively; while the percentage of those in Stages II, III, and IV decreased by 4%, in the more intensive intervention group, with no change observed in the less intensive arm. There were no significant changes between either arm.

We were surprised by the finding that the more intensive intervention group had less favorable results in lowering blood pressure, compared to the less intensive group. To attempt to explain this seeming anomaly, we examined trends in systolic and diastolic blood pressure levels in the more intensive treatment group, as observed at the 6 home visits over the 40-month intervention period, and compared these trends to those of the less intensive group, for which there were only the

Table 2. Observed mean blood pressures by intervention arm

	N	Baseline Mean (95% CI)	*N*	Final Follow-Up Mean (95% CI)
Systolic blood pressure (mm Hg)				
More intensive	371	147.7 (145.5, 149.9)	241	145.0 (142.3, 147.7)
Less intensive	391	148.6 (146.4, 150.7)	228	142.1 (138.8, 145.4)
Diastolic blood pressure (mm Hg)				
More intensive	371	89.2 (87.8, 90.6)	241	86.2 (84.2, 88.2)
Less intensive	391	89.3 (87.8, 90.8)	228	84.7 (82.7, 86.7)

P>.10 between more and less intensive groups at both baseline and final follow-up.

initial and final follow-up data points. It is noteworthy that the improvements in the more intensive group were highly significant, with decreases at 27 months in mean systolic pressure (from 148 mm Hg to 138 mm Hg, a 10 mm Hg decrease), and in mean diastolic pressure (from 89 mm Hg to 82 mm Hg, a 7 mm Hg decrease). However, between the 27-month and final follow-up visit (at 40 months), the mean systolic and diastolic pressures rose to 145 mm Hg, and 86 mm Hg, respectively. These findings were similar for all individuals assigned to this arm, as well as for those who participated in all 6 home visits.

DISCUSSION

Utilizing an intention-to-treat model, this study demonstrated a significant post-intervention improvement in the blood pressure level of the community, and in the percent of the individuals with controlled blood pressures. The program effectiveness in improving hypertension control was impressive, although, surprisingly, the more intensive arm did not experience any greater improvement than the less intensive arm. This result appears to be due to a strong reversal of both systolic and diastolic blood pressures in this group during the last 13 months of the study, suggesting that further input of a reinforced new intervention may have been necessary. This study provides further evidence to support the use of community-based hypertension control programs.

The findings complement the work of other studies.[20–23] Moreover, study results indicate that the aforementioned results can be achieved though a partnership effort between a community and an academic health center. It was important for the partnership that the results be disseminated to the community. The advisory board took the lead in presenting the findings, and, based on this, requested that the investigators continue their research with the community, including determining how to address other health problems. The partnership established at the initial planning for this study continues. Community members view this study as an aid to individuals with high blood pressure, but also as an opportunity for employment and skill building for residents.

Several other programs have been launched in the community, and a free clinic has been created under the partnership's auspices. Currently, we are tar-

Table 3. Blood pressure changes by intervention arm derived from random coefficient models

	Systolic Blood Pressure mm Hg		Diastolic Blood Pressure mm Hg	
	Unadjusted* (Est (se)	Adjusted†‡ Est (se)	Unadjusted* Est (se)	Adjusted† Est (se)
Baseline BP for all individuals	148.0 (1.4)	156.1 (4.2)	86.4 (0.9)	94.9 (2.7)
Change in BP for less intensive intervention individuals	−5.5 (1.5)	−5.6 (1.5)	−4.1 (0.9)	−3.8 (1.0)
Change in BP for more intensive intervention individuals	−3.2 (1.5)	−3.3 (1.5)	−2.9 (1.0)	−2.6 (1.4)
Difference between changes in BP for more and less intensive intervention individuals	2.3 (2.0)	2.3 (2.0)	1.2 (1.3)	1.2 (1.3)

Note: Inclusion of covariate set is statistically significant based on change in log likelihoods between models based on 1172 observations (χ^2 = 95.0 [16 *df*]; *P*<.005). Covariate set included in these models is as follows: Sampling stratum (1, 2, 3), Gender (female, male), Prior history of HPB reported (yes, no), Employment status (full-time, part-time, or student; never employed or housewife, retired or other; unemployed), Co-morbidities (among heart disease, diabetes, kidney disease, high cholesterol, stroke), Preventive health care in past 2 years [among eye exam, dental exam, prostate exam (males >50), mammogram (females >50) or pap smear (females)], Lifestyle risk factors (among cigarette smoking, alcohol problem, lack of exercise), Insurance (medical only, prescription only, both), Body mass index (≥30.0, >30.0, unattained).

* Unadjusted models based on *N*=1229 observations at baseline and final follow-up among 776 individuals.

† Adjusted models based on *N*=1172 observations at baseline and final follow-up among 739 individuals.

‡ Inclusion of covariate set is statistically significant based on change in log likelihoods between models based on 1172 observations (χ^2=140.9 [16 *df*]; *P*<.005).

Table 4. Percent of individuals under adequate control (BP<140/90) by treatment arm*

	More Intensive	Less Intensive
Baseline	16%	18%
Final follow-up	36%	34%

* $P<.01$ in both groups between baseline and follow-up, no difference between groups.

Table 5. JNC VI blood pressure classes by intervention arm

	More Intensive N=233*		Less Intensive N=221*	
	Baseline	Final Follow Up	Baseline	Final Follow Up
SBP <130 mm Hg and DBP <85 mm Hg (normal)	13%	22%	13%	15%
SBP 130–139 mm Hg and DBP 85–89 mm Hg (high normal)	17%	12%	21%	12%
SBP 140–159 mm Hg and/or DBP 90–99 mm Hg (Stage I)	41%	29%	40%	32%
SBP 160–179 mm Hg and/or DBP 100–109 mm Hg (Stage II)	23%	21%	20%	19%
SBP ≥180 mm Hg and/or DBP ≥110 mm Hg (Stage III)	14%	13%	11%	13%

* Paired measurements for individuals measured at both baseline and final follow-up. Shifts in BP classes between baseline and final follow-up were not statistically significant ($P>.05$) within intervention arms based on Bowker's test of symmetry or between arms based on a test for equality of the Kappa coefficients.

geting arthritis education to test this outreach model for use with other chronic diseases, and we are planning other programs focusing on obesity and substance abuse. Although there was a significant improvement in the BP level of this community, the majority of individuals with hypertension continued to have uncontrolled blood pressures.

The findings from this study suggest that it is feasible to:

- Assess hypertension and cardiovascular health status in an urban African-American community, and, based on the assessment, to develop community-based intervention strategies to enhance the identification, care, and control of hypertension in this population;
- Develop a structure that allows for community control and ownership of programs, such as a hypertension control program, which forms a working partnership between an academic institution and the community itself;
- Educate and train community health workers to function as interventionists in a high-risk population;
- Incorporate economic development and job opportunities for community residents as an important component of a research study; and
- Achieve a significant improvement in the control of SBP in the target community.

Limitations

This study had several limitations. First, only one community was investigated. Involving a second community would have been informative, and increased generalizability, as it would have allowed for comparison of results. The loss of participants to follow up, which was mostly due to geographic movement from the area, is a concern. However, there was no evidence that this loss was different in either arm of the study, or that those seen at follow up differed from those who were not followed. In addition, the lack of information about hypertension care in the less intensive intervention group prevents us from understanding factors that might have contributed to this group's improved pressure control.

Implications

Enhancing the effectiveness of these approaches further will require additional research, both to extend the positive effect of improved blood pressure control to more of the community, as well as to maintain the initial improvements over time.

This study has demonstrated that it is feasible to plan, implement, and evaluate a community-based intervention trial conducted by nurse-supervised community health workers. A true partnership approach with the community was essential to achieving this. The health workers were highly valued by the population, as indicated by a corollary study, assessing the community's perceptions.[24] Community health worker/nurse teams were effective in outreach, patient education, linking individuals to care, monitoring, and coordinating other important services necessary for adequate blood pressure control (eg, obtaining appropriate insurance, accessing transportation).

This model appears to be of value in the continued investigation of methods for reducing the continuing gap in health status between various minority communities, and the majority of the US population.

This study provides further evidence to support the use of community-based hypertension control programs.

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REFERENCES

1. The Subcommittee on Definition and Prevalence of the 1984 Joint National Committee. Hypertension prevalence and the status of awareness, treatment, and control in the United States. *Hypertension.* 1985;7(3):457–468.
2. Sixth Report of the Joint National Committee on the Detection, Evaluation and Treatment of High Blood Pressure: (JNC VI). *Arch Intern Med.* 1997;157:2413–2446.
3. Heckler MM. *Cardiovascular Disease and Cerebrovascular Disease (Parts 1 and 2).* Vol 4. *Report of the Secretary's Task Force on Black and Minority Health.* Washington, DC: USDHHS; 1985.
4. Keil JE, Saunders E. Urban and rural differences in cardiovascular disease in Blacks. In: Saunders E, ed. *Cardiovascular Disease in Blacks.* Philadelphia, Pa: Doris Co; 1991:17–28.
5. Maryland Governor's Commission on Black and Minority Health. *Now Is the Time: An Action Agenda for Improving Black and Minority Health in Maryland.* Baltimore, Md: Maryland Department of Health and Mental Hygiene; 1987.
6. Henderson L, Lerner M. *Mortality in the Johns Hopkins Hospital Catchment Area: Selected Causes of Death in Baltimore City, 1982–88.* Baltimore, Md: Johns Hopkins University, School of Hygiene and Public Health; 1991.
7. Levine DM, Bone LR. The impact of a planned health education approach on the control of hypertension in a high-risk population. *J Hum Hypertens.* 1990;4:317–321.
8. Bowker AH. Bowker's test for symmetry. *J Am Stat Assoc.* 1948;43:572–574.
9. Hill MN, Bone LR, Kim MT, Miller DJ, Dennison CR, Levine DM. Barriers to hypertension care and control. *Am J Hypertens.* 1999;12:951–958.
10. Krieger D, Collier C, Martin D. Linking community-based blood pressure measurement to clinical core: a randomized trial of outreach and tracking by community health workers. *Am J Public Health.* 2000;89:859–861.
11. Ward MJ, Morisky D, Gees M. A clinical and community-based approach to hypertension control in an underserved minority population. *Am J Med.* 2000;13:177–183.
12. Brownson R, Riley P, Bruce T. Demonstration projects in community-based presentation. *J Public Health Manage Pract.* 1998;2:66–77.
13. Felix-Aaron HL. Young Black males satisfaction with care in a randomized controlled trial of high blood pressure care. Presented at: Society of General Internal Medicine; May 2000; Boston, Massachusetts.
14. Strogatz DS, James SA. Social support and hypertension among Blacks and Whites in a rural, southern community. *Am J Epidemiol.* 1986;124(6):949–956.
15. Gillum Rf, Neutra RR, Stason WB, et al. Determinants of dropout rate among hypertensive patients in an urban clinic. *J Community Health.* 1979;5(2):94–100.
16. Morisky DM, Levine DM, Green LW, Shapiro S, Russell P, Smith C. Five-year blood pressure control and mortality following health education for hypertensive patients. *Am J Public Health.* 1983;73:153–162.
17. Israel B, Schulz AJ, Parker EA, Becker AB. Review of community-based research: assessing partnership approaches to improve public health. *Annu Rev Public Health.* 1998;19:173–202.
18. Maurana CA, Beck B, Newton GL. How principles of partnership are applied to the development of a community campus partnership. *Community-Campus Partnership for Health: Partnership Perspectives.* 1998;1:47–53.
19. Levine D, Becker D, Bone L, Hill M, Tuggle MB, Zeger SL. Community-academic health center partnerships for underserved minority population: one solution to a national crisis. *JAMA.* 1994;272:309–311.
20. Hill MN, Bone LR, Butz AM. Enhancing the role of community health workers in research. *Image J Nurs School.* 1996;28(3):221–226.
21. Bone LR, Levine DM, Hill MN, et al. Community health survey in an urban African-American neighborhood: distribution and correlates of elevated blood pressure. *Ethn Dis.* 2000;10(1).
22. Enterprise Foundation. *The Transformation of the Sandtown-Winchester Neighborhood.* Baltimore, Md: Enterprise Foundation; 1995;2.
23. SAS Institute Inc. *SAS/STAT Software: Changes and Enhancements Through Release 6.11.* Cary, NC: SAS Institute Inc; 1996.
24. Zeger SL, Karim M. Generalized linear models with random effects: a Gibb's sampling approach. *J Am Stat Assoc.* 1991;86(413):79–86.

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