Social Networks Help Control Hypertension

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Cardiovascular health disparities continue to pose a major public health problem. The authors evaluated the effect of education administered within social networks on the improvement of hypertension in 248 African Americans compared with historical controls. Patients formed clusters with peers and attended monthly hypertension education sessions. The authors assessed the likelihood of reaching goal below predefined systolic blood pressure (SBP) and diastolic blood pressure (DBP) thresholds as well as the absolute reduction in SBP and DBP, controlling for diabetes, smoking, baseline hypertension, and demographics. The intervention group was more likely to have ever reached treatment goal at 12-month follow-up (odds ratio, 1.72; P=.11). At 18-month follow-up, the Maryland Cardiovascular Disease Promotion Program group had a statistically significant larger drop in SBP (−4.82 mm Hg, $P<.0001$) and DBP (−3.37 mm Hg, P=.01) than the control group. The clustering of patients in social networks around hypertension education has a positive impact on the management of hypertension in minority populations and may help address cardiovascular health disparities. *J Clin Hypertens (Greenwich)*. 2013; 15:34–40. ©2012 Wiley Periodicals, Inc.

Cardiovascular disease is the leading cause of death for Americans,[1] and its effect on mortality and morbidity places an especially heavy burden on African Americans. A recent report by the Centers for Disease Control and Prevention (CDC) on health disparities and inequalities concludes that hypertension prevalence in non-Hispanic blacks is 45% higher than in non-Hispanic whites.[2] In addition, the report highlights persistent significant racial disparities in access to healthcare services. Given these statistics, it is not surprising that black men and women have the highest rates of cardiovascular-related mortality across all 10-year age strata spanning 45 to 84 years among all ethnic groups.[2] For example, black men younger than 75 had a 48% higher mortality rate due to coronary heart disease and a 95% higher mortality rate due to stroke than their white counterparts. In women younger than 75, cardiovascular-related racial disparities are even more pronounced, with a 95% higher mortality rate due coronary heart disease and a 125% higher mortality rate due to stroke among black women compared with white women.[3]

The need for a scientific exploration of these cardiovascular health issues among minorities is central to the national commitment to eliminate health disparities illustrated in the overarching goals of the Healthy People 2020 national framework.[4] Evaluating how racial disparities in health can be addressed, the authors of CDC's Health Disparities and Inequalities report underline that ''premature deaths attributable to CHD and stroke among black adults indicate the need for evidence-based interventions to reduce the prevalence of risk factors for cardiovascular disease.''[3] As well, they recommend increasing community awareness of disparities. In fact, a literature review recently identified community-based participatory research as one of the best practices to tackle health disparities in African American communities.[5]

One such interventional approach to reduce health disparities among blacks may be the leveraging of existing social networks. Built on the principles of trust and reciprocity, social networks facilitate the exchange of life-enhancing resources such as health-related information and social connections. They confirm the link between people's connectedness and their health. Studies have shown that decisions regarding health behavior are often made by groups of people connected to one another rather than by isolated persons.[6] Furthermore, social networks trigger support mechanisms resulting in increased levels of self-efficacy, which is instrumental in maintaining healthy lifestyles and adherence to treatment.[6–8] Further exploring the effect of social networks in minority populations is even more relevant given that black diabetic patients were found to rely more heavily on social networks to manage their disease than those who were white.[9] Additionally, in another study, African American men depended on family members as the most trusted health information source, despite health professionals' being the most common source of information.[10]

The beneficial effect of social network–based interventional programs has been well-documented in cardiovascular disease management. Little social support was found to be associated with a 50% to 100% higher risk of coronary heart disease events in both

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healthy patients and in those with established disease.[11] Additionally, participation in clubs and meetings, a larger number of siblings, and seeing friends more frequently were associated with lower systolic pressure[12] and higher awareness of hypertension.[13] Furthermore, social networks might have led to lower rates of cardiovascular-related events[14] and mortality.[15] A systematic review affiliated with the Mayo Clinic has even recommended considering the lack of social support network as a risk factor for subsequent morbidity and mortality after a myocardial infarction.[16]

Similar to the examples mentioned above, collective dynamics of social networks could play an important role in improving hypertension and in controlling other cardiovascular disease risk factors in minorities. Founded on the principles of social networking, this study aimed at providing preliminary findings for a full-fledged outreach, education, intervention, and research evaluation program. The target of the program, called the Maryland CVD Promotion Program (MVP), was to improve awareness, health-seeking behavior, and outcomes of cardiovascular disease in African American communities in the larger Baltimore metropolitan area, who have significantly higher rates of risk factors that contribute to heart disease when compared with whites in either city or state and 30% higher death rates for heart disease than the state and national rates.[17,18] In alignment with the Healthy People strategy and in addition to national initiatives, local public health agencies such as the Maryland Department of Health and Mental Hygiene[17] and the Baltimore City Health Department[18] have encouraged projects in health disparities research. Further, various community programs are ongoing.

METHODS

Study Design

The study was based on the "train the trainer" approach and the community health worker (CHW) model.[19] Each patient recruited to the intervention group (MVP) was asked to reach out and extend an invitation to two relatives or friends eligible to participate to enroll in the program. Subsequently, these two patients each recruited two patients of their own. This created a cluster of 7 patients in total, who were followed up as a team. These patients were referred to or were enrolled from the primary care practices at the University of Maryland (Figure). Patients presented to the research center with hypertension as indicated by current drug treatment for hypertension or a history of hypertension or severe risk factors for uncontrolled hypertension, eg, gastroenteritis, muscle spasm, allergy, backache, hernia, and otitis media. The control group was a retrospective cohort consisting of a random sample of a pool of patients who had previously enrolled in the control arm of a closely related randomized clinical trial from 2008 (Baltimore Partnership to Educate and Achieve Control of Hypertension [BPTEACH]) examining the effect of education to physicians and patients on improving blood pressure (BP) control in a mostly African American population in Baltimore.[20] Patients in the BPTEACH trial were enrolled individually and had been followed up as such.

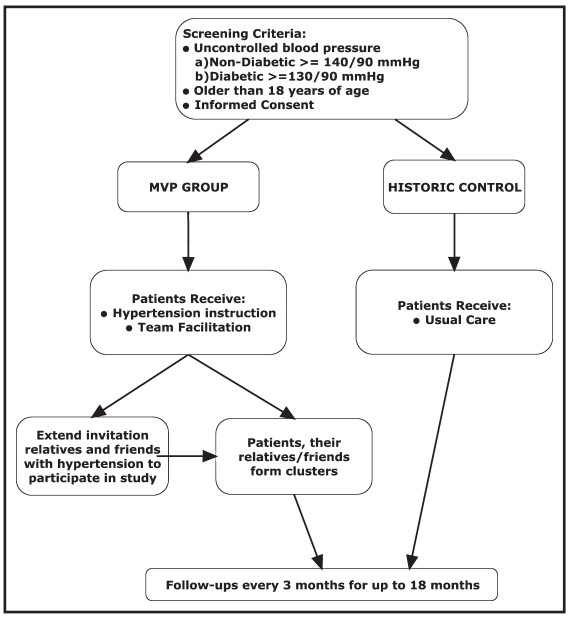

FIGURE. Study design.

The patients in the MVP group formed small groups or clusters and attended monthly education sessions focusing on disease education, prevention, and treatment of hypertension. They received comprehensive hypertension education instruction from the clinical research education nurse and were trained to effectively share the information among one another in their cluster. The premise is that this process of interaction and engagement could improve hypertension awareness, education, and treatment in individual patients and in their communities. In addition, patients also received a full 3-part hypertension education manual, which included additional inserts related to cholesterol, diabetes, medication, weight control, exercise, nutrition, and the Dietary Approach to Stop Hypertension (DASH) diet. The contents of the manual were discussed with the patients by the clinical research education nurse and were used as a reference guide for patients between education sessions. Patients in the retrospective cohort control group hadn't received hypertension counseling and had received usual care only. Written informed consent was obtained from all participating patients. The study was approved by the institutional review board of the University of Maryland, Baltimore. The study was conducted between May 2008 and August 2011 at the University of Maryland in Baltimore.

Inclusion and Exclusion Criteria

Patients were excluded if they had previously been admitted for hypertensive emergency, malignant hypertension, or severe uncontrolled hypertension and if they were younger than 18, were pregnant, or had no hypertension. Patients were considered to be hypertensive if any of the following conditions were met: patients without diabetes had systolic BP (SBP) $\geq$140 mm Hg or/and diastolic BP (DBP) $\geq$90 mm Hg and those with diabetes had SBP $\geq$130 mm Hg or/and DBP $\geq$80 mm Hg.

Baseline Assessment

Prior to the start of the education sessions, all study-related data such as study consent, baseline or follow-up BPs, patient surveys, and demographic information of the patient were captured. BP was measured with patients in a sitting position, using electronically calibrated BP monitors. Baseline BP was obtained by the clinical research nurse. The average of two measurements was recorded. Patients completed a medical history form, a health assessment questionnaire (measured with the Patient-Reported Outcomes Measurement Information [PROMIS HAQ][21]), and a high BP survey. The information obtained from these forms included demographic variables (age, sex, and race), smoking status, and the diagnosis of diabetes. Patients' BP was captured at a variety of events including hypertension education sessions, patient consultation visits, health fairs, and various community functions throughout the Baltimore metropolitan area. Local organizations that MVP had partnered with, such as the Maryland Transit Authority (MTA), the League for People With Disabilities, Baltimore City Golf Association, Baltimore County Golfing, and various churches within the community, provided BP screenings and helped enroll patients.

Follow-Up and Assessment of Outcomes

The primary outcome of the study was reaching hypertension treatment goal. For patients with diabetes, the treatment goal was to achieve BP <130/80 mm Hg, and for patients without diabetes, the treatment goal was to achieve BP <140/90 mm Hg. Patients underwent follow-up every 3 months for up to 18 months and BP was measured during each follow-up.

Statistical Analysis

Descriptive analysis was performed to compare the characteristics of the patients in the intervention and control groups. Ordinary least squares analyses were conducted to assess the association between the intervention and absolute mean reduction in BP, controlling for group assignment, diabetes, smoking, baseline hypertension, and demographics. Binary logistic regression models at follow-up of up to 6, 12, and 18 months were built to assess the likelihood of ever reaching treatment goal after baseline. An alternative model with the same control variables assessed the likelihood of reaching goal more than once through follow-up after baseline. Furthermore, time-to-event analyses were carried out to allow for differential follow-up time between the control and the intervention groups. Given that the intervention group consisted of social clusters of participants by design, the models were further adjusted for cluster effects. All analyses were conducted using SAS version 9.2 (SAS Institute, Cary, NC).

RESULTS

The study participants were evenly distributed into 265 participants per study group. Since we were mostly interested in the effect of the social network intervention in African Americans, we restricted our analysis to that population and therefore excluded 25 patients of other race. Additionally, 9 and 55 patients were excluded from the MVP group and historic control group analyses, respectively, because they had dropped out immediately after their baseline measurement visit. In a sensitivity analysis, we modeled the African American patient population (N=505) where missing observations were imputed by substituting in the last observation carried forward. Overall, analyses in the nonimputed model gave more conservative results than those in the imputed model and we report results of the former.

Participants in the MVP group were younger and there were more men than in the control group (Table I). Furthermore, the MVP group had lower mean systolic and diastolic BP at baseline and had a longer follow-up period. Evaluating the endpoints of the study (Table II), the MVP group had lower systolic and diastolic BP at their last follow-up, on average, but showed a lower proportion of patients (not statistically significant) who had achieved goal at last follow-up (10.9% vs 15.0%, *P*=.19) than the control group. The MVP group had a greater proportion of patients who ever achieved goal (25.0% vs 18.7%, *P*=.19), but this was not statistically significant. Furthermore, tracking the repeated attainment of goal

TABLE I. Baseline Patient Characteristics in African Americans

	Control Group	MVP Group	
	N=193	N=248	*P* Value
Age, y (SD)	55.1 (13.9)	48.0 (13.1)	<.0001
Men, No. (%)	70 (36)	189 (76)	<.0001
Diabetes, No. (%)	67 (35)	72 (29)	.20
Smoking, No. (%)	37 (19)	63 (25)	.12
Baseline SBP, mm Hg (SD)	150.9 (18.7)	146.0 (10.5)	<.01
Baseline DBP, mm Hg (SD)	90.4 (11.3)	87.9 (8.2)	.01
Goal achieved at baseline, No. (%)	12 (6)	3 (1.2)	.01
Overall follow-up time, d (SD)	291 (143)	457 (279)	<.0001

Abbreviations: DBP, diastolic blood pressure; SBP, systolic blood pressure; SD, standard deviation.

TABLE II. Endpoints Evaluation (N=441)

	Control Group N=193	MVP Group N=248	*P* Value
Systolic BP at last follow-up, mm Hg (SD)	150.2 (19.9)	143.8 (7.2)	<.0001
Diastolic BP at last follow-up, mm Hg (SD)	87.5 (14.2)	84.2 (6.5)	.001
Reached goal at last follow-up, No. (%)	29 (15.0)	27 (10.9)	.19
Ever achieved goal, No. (%)	36 (18.7)	62 (25.0)	.11
By 6 months, No. (%)	11 (5.7)	24 (9.7)	.13
By 12 months, No. (%)	25 (13.0)	47 (19.0)	.09
By 18 months, No. (%)	36 (18.7)	56 (22.6)	.31
By 24 months, No. (%)	36 (18.7)	60 (24.2)	.16
Reached goal more than once, No (%)	1 (0.5)	22 (8.9)	<.0001
By 6 months, No. (%)	0 (0)	0 (0)	–
By 12 months, No. (%)	1 (0.5)	5 (2.1)	.18
By 18 months, No. (%)	1 (0.5)	16 (6.5)	.001
By 24 months, No. (%)	1 (0.5)	19 (7.7)	.001

over time, the MVP group had a significantly higher proportion of patients who had achieved goal more than once (8.9% vs 0.5%, $P<.0001$).

Unadjusted time-to-event curves of ever achieving goal after baseline showed differences in the probability of ever achieving goal during the course of the study. The MVP group had a higher likelihood of achieving goal at up to about 400 days of follow-up, after which the probability curves crossed, leading to a nonsignificant difference between the time-to-event curves (log-rank $P=.85$). Unadjusted time-to-event curves of achieving goal more than once after baseline, however, highlighted the finding that the MVP group reached second goal more frequently than did the control group ($P=.04$).

Examining the absolute mean change in SBP between the two groups in African Americans (Table III), controlling for baseline BP measurements and patient characteristics, we found that the MVP group had an increasingly higher mean drop in DBP over time compared with baseline, with −1.70 mm Hg ($P=.16$) at 6 months, −4.47 mm Hg ($P=.001$) at 12 months, and −4.82 mm Hg ($P=.001$) at 18 months of follow-up compared with the control group. Higher baseline SBP was associated with a significant reduction in mean SBP over time within the range of −0.43 to −0.58 mm Hg for every 1-mm Hg increase in baseline SBP ($P<.0001$).

Decreases in DBP were also greater among African Americans in the MVP cohort compared with the control group (Table III). The relative change in DBP from baseline in the MVP compared with the control group was −1.42 mm Hg ($P=.11$) at 6 months, −3.02 mm Hg ($P=.01$) at 12 months, and −3.37 mm Hg ($P=.01$) at 18 months of follow-up. Higher baseline DBP was associated with a significant

TABLE III. Regression Model for Absolute Mean Drop in SBP and DBP (mm Hg) Over Time in African Americans (N=441)

	At 6 Months		At 12 Months		At 18 Months	
	Change, mm Hg	*P* Value	Change, mm Hg	*P* Value	Change, mm Hg	*P* Value
Mean reduction in SBP						
MVP Group	−1.70	.16	−4.47[a]	.001	−4.82[a]	.001
Baseline SBP	−0.43[a]	<.0001	−0.52[a]	<.0001	−0.58[a]	<.0001
Baseline DBP	0.06	.36	−0.11	.18	−0.08	.30
Men	−0.02	.98	0.77	.54	0.91	.48
Age <39 y			Reference			
Age 40–64 y	0.27	.79	1.16	.31	0.66	.57
Age 65+ y	1.86	.27	0.43	.84	1.30	.54
Diabetes	−1.48	.24	−1.77	.21	−0.39	.80
Smoker	−0.74	.58	−2.22	.16	−0.29	.87
Mean reduction in DBP						
MVP Group	−1.42	.11	−3.02[a]	.01	−3.37[a]	.01
Baseline SBP	0.03	.37	0.10[a]	.03	0.13[a]	.01
Baseline DBP	−0.33[a]	<.0001	−0.66[a]	<.0001	−0.70[a]	<.0001
Men	0.35	.66	1.09	.37	0.90	.48
Age <39 y			Reference			
Age 40–64 y	1.01	.20	0.07	0.95	−0.63	.59
Age 65+ y	−0.61	.62	−4.28[a]	0.01	−5.79[a]	.001
Diabetes	−0.09	.89	−0.36	0.69	−0.40	.66
Smoker	−0.34	.70	−0.81	0.40	−0.28	.80

[a]Statistically significant at .05 level.

TABLE IV. Binary Logit Model for Ever Attaining Joint SBP/DBP Goal up to 6, 12, and 18 Months After Baseline in African Americans (N=441)

	6 Months		12 Months		18 Months	
	OR	*P* Value	OR	*P* Value	OR	*P* Value
MVP Group	1.51	.45	1.72	.11	1.42	.20
Baseline SBP	0.95[a]	.04	0.97[a]	.04	0.96[a]	.01
Baseline DBP	0.96[a]	.02	1.00	.84	1.02	.35
Men	0.68	.38	0.68	.19	0.70	.16
Age <39 y			Reference			
Age 40–64 y	0.62	.31	0.53[b]	.08	0.50[a]	.04
Age, 65+ y	0.31	.16	0.93	.89	1.12	.81
Diabetes	0.05[a]	.01	0.20[a]	.01	0.18[a]	<.0001
Smoker	0.65	.35	0.64	.24	0.73	.34

Abbreviations: BP, blood pressure; DBP, diastolic blood pressure; MVP, Maryland Cardiovascular Disease Promotion Program; OR, odds ratio; SBP, systolic blood pressure. [a]Significant at .05 level. [b]Significant at .10 level.

reduction in mean DBP over time within the range of −0.33 to −0.70 mm Hg for every 1-mm Hg increase in baseline DBP ($P<.001$). Patients in the 65-year-old group had a significant reduction in DBP, with −4.28 mm Hg ($P=.01$) and −5.79 mm Hg ($P<.01$) at 12 and 18 months, respectively.

We constructed binary logistic models for ever reaching the joint SBP/DBP therapeutic goal and more than once for up to 6, 12, and 18 months of follow-up (Table IV). After controlling for confounders, the MVP group had 1.51 higher odds ($P=.45$) of ever reaching the joint therapeutic goal at up to 6 months after baseline, 1.72 higher odds ($P=.11$) at up to 12 months, and 1.42 higher odds ($P=.20$) at up to 18 months. Consistently during the follow-up, we found that every 1-mm Hg increase in baseline SBP was associated with about 3% to 5% lower odds of ever achieving goal. Likewise, participants with diabetes, compared with those without diabetes, had 80% to 95% lower odds of ever achieving goal. Participants aged 40 to 64 years had about 50% lower odds of achieving goal at 12 months (odds ratio [OR], 0.53; $P=.08$) and 18 months (OR,0.50; $P=.04$) of follow-up than participants in the 18- to 39-year-old group. Binary logistic models pointed to a significantly higher likelihood for reaching goal more than once for the MVP group at up to 18 months (OR, 13.2; $P=.03$) (not shown). Due to decreasing observations with increased length of follow-up, the estimates of the models for more than one goal achieved (which is correlated with length of follow-up) should, however, be interpreted with caution.

In Cox proportional hazard time-to-event analyses accounting for differential follow-up time, the MVP group was as likely to ever achieve goal as the control group (hazard ratio [HR], 1.01; $P=.96$). Patients with higher baseline SBP (HR, 0.97; $P=.01$) in the 40- to 64-year-old group (HR, 0.59; $P=.05$, compared with the 18- to 39-year-old group), those with diabetes (HR, 0.19; $P<.0001$), and smokers (HR=0.56, $P=.03$) had a lower likelihood of achieving goal.

DISCUSSION

Since the study used a random sample pool of patients from a previous trial to create its control group, it is subject to several limitations. Although we controlled for important demographics and clinical characteristics, the fact that the MVP group was generally younger might have biased our results away from the null. On the other hand, having more men in the MVP group might have biased our results toward the null. Even though this was not statistically significantly, men were consistently less likely to reach goal than women in our study. This finding supports the general literature showing sex disparities in health primary and secondary prevention.[22,23] Another possible limitation is that we did not control for medication use in patients. The possibility of bias away from the null due to a change in prescribing patterns, in view of the retrospective cohort design, however, should be deemed minimal as the observation windows of the two groups were less than a year apart and that no major practice guidelines had changed in between.

The use of a complex observational design employing a retrospective control group was driven by the authors' goal to efficiently generate a hypothesis, the testing of which could be implemented in a future major trial. Despite the biases accruing from utilizing a historical cohort and not recording possibly important covariates such as socioeconomic status or education, it should be noted that the patients in the MVP arm and in the control group come from a relatively homogeneous African American population pool from urban Baltimore and it could be a safe assumption to make that they share similar demographic and clinical characteristics. Moreover, more than half of the patients in the retrospective control group, as part of the BPTEACH trial, had been randomized to a study arm in which their treating physicians had attended a series of in-depth physician educational lectures on hypertension management. Patients in the BPTEACH trial who received usual care had an average reduction in SBP of 4.1 mm Hg or 2.6 mm Hg at 6 months of

follow-up, depending on whether their physicians attended physician education seminars or not, respectively.[20] For comparison, the arm in which patients but not physicians received hypertension education, not in social networks, had an average reduction in SBP of 4.6 mm Hg at 6 months of follow-up, which is a greater SBP reduction compared with the usual care arm. We could extrapolate the findings from this study (a difference of 1.70 mm Hg in the average reduction in SBP at 6 months between patients who received hypertension education clustered around social networks and those who had received only usual care but whose physicians might also have received continuing hypertension education) and compare them with those from BPTEACH. A hypothesis could be formed that the individual effect of social networks on top of hypertension education alone was about 1 mm Hg of additional SBP reduction by month 6, although not statistically significantly. As evidenced by our findings, however, the effect of social networks on hypertension management could be increasing over the following 12 months.

Given that high BP varies over time in individuals due to nonclinical reasons such as environmental or physical or other stressors, it is possible that patients might have reached goal between follow-up visits. The study was not designed to capture those BP fluctuations. Measuring reduction in BP against a clinical threshold as specified in our study could possibly be better analyzed by taking into account the frequency of meeting that threshold. Although the robustness of our models for measuring goal attainment more than once could be improved, it brings to light the possibility that the MVP program could be considered effective in mediating cardiovascular health-changing behavior by capitalizing on the positive dynamics of interactions within social networks.

Although the MVP group was as likely to ever achieve goal as the control group overall, the results of the binary logistic models highlight a trend for participants in the MVP group to be more likely to achieve goal, especially for up to 12 months of follow-up. This may suggest that the effect of the social network intervention may wear off over time when not sustained with enabling factors, such as improved access to care, eg, through health insurance coverage. This idea is further supported by evidence from the regression models analyzing absolute mean change in SBP, which indicate that the MVP group had sustained mean drop in systolic pressure over time compared with the control group, accounting for the confounding effect of age and sex distributions, baseline BP measurement, and presence of diabetes and smoking status. The MVP group achieved highest reduction in SBP (−4.82 mm Hg) and DBP (−3.37 mm Hg) at 18 months from baseline. The magnitude of such reduction could be deemed clinically relevant as pointed out by previous studies. A meta-analysis of 147 prospective studies found that 10 mm Hg in SBP and 5 mm Hg in DBP were associated with 22% reduction in coronary heart disease and 41% reduction in stroke.[24] Other studies have shown that a 1-mm Hg decrease in SBP decreased the risk of stroke by 5% even though many of the included studies had baseline SBP >160 mm Hg, while the mean SBP at baseline in the MVP study was 143.7 mm Hg.[25]

CONCLUSIONS

The MVP program consolidated the efforts of health providers, payers, academic research institutions, as well as faith and community organizations in addressing cardiovascular health disparities in the Baltimore community. In this study, we report findings generally supportive of the positive impact structuring hypertension education around naturally existing social networks in a population of African Americans in the greater Baltimore metropolitan area. Further studies should capitalize on these findings and explore ways to reinforce ties within social networks, assess their impact on mediating factors such as health knowledge, self-efficacy, and social network indices, and finally measure their impact on intermediate, and if possible, long-term health outcomes such as developing heart disease.

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