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The "10 Keys" to Healthy Aging: 24-Month Follow-Up Results From an Innovative Community-Based Prevention Program

Joseph F. Robare, DrPH, MS, RD, LDN[1], Constance M. Bayles, PhD[2], Anne B. Newman, MD, MPH[2], Kathy Williams, MHSA, RN[2], Carole Milas, MS, RD, LDN[2], Robert Boudreau, PhD[2], Kathleen McTigue, MD, MS, MPH[2], Steven M. Albert, PhD, MSPH, MA[2], Christopher Taylor, BS[2], and Lewis H. Kuller, MD, DrPH[2]

Abstract

The purpose of this report was to evaluate a prevention program to reduce risk factors for common diseases among older individuals in a lower income community. This randomized community-based study enrolled older adults into a Brief Education and Counseling Intervention or a Brief Education and Counseling Intervention plus a physical activity and (for those with hypertension) a dietary sodium intervention. Outcomes were collected on 389 adults with a mean age of 73.9 years over 24 months. Adherence to the "10 Keys" improved significantly in the proportion meeting goals for low-density lipoprotein cholesterol (+14%), bone mineral density testing (+11%), pneumonia vaccination (+11%), colonoscopy (+14%), and adherence to antihypertensive medication (+9%). This program resulted in significant reductions in key risk factors, increases in immunizations, and adherence to established prevention guidelines over 2 years. Further research is needed to refine the use of community health counselors for translating prevention knowledge into community settings. A major limitation of these studies is the low participation percentage.

Keywords

healthy aging, older adults, prevention program

Introduction

The "10 Keys" to Healthy Aging Demonstration Project was based on the principle that community-based prevention programs for older individuals should focus on long-term adherence to preventive therapies, screening, and immunizations. Since many older individuals have multiple chronic diseases, preventive programs focusing on a single condition/disease may be less effective for reducing overall disability when compared with programs focusing on multiple concurrent health concerns. Past research suggests that the substantial burden of clinical disease among older individuals requires fairly aggressive intervention efforts, such as medications for the reduction of blood pressure and blood lipids; medications for the control of diabetes, osteoporosis, and depression; and surgical therapy for osteoarthritis.

The "10 Keys" to Healthy Aging Demonstration Program focused on specific interventions with scientific evidence for effectiveness, targeting 10 major conditions/diseases in older adults living in a low-income community. We hypothesized that effective interventions could reduce morbidity, disability, and mortality among older individuals. In this article, we report on the 24-month evaluation of the program.

Method

Study Design

The Center for Healthy Aging (CHA) is a Centers for Disease Control and Prevention (CDC) research center. Its core demonstration program was a community-based randomized trial based on the "10 Keys" to Healthy Aging. The "10 Keys" were

[1]U.S. Department of Agriculture, Alexandria, VA, USA
[2]University of Pittsburgh, Pittsburgh, PA, USA

Corresponding Author:
Joseph F. Robare, DrPH, MS, RD, LDN, U.S. Department of Agriculture, Special Nutrition Evaluation Branch, Food and Nutrition Service, Alexandria, VA 22302, USA
Email: Joseph.Robare@fns.usda.gov

developed in 2001 and are based on epidemiological, clinical, and laboratory studies of the major diseases associated with morbidity and mortality (Cheng & Leiter, 2006; Chobanian et al., 2003; Fillit et al., 2002; Genuth et al., 2003; Hak et al., 2002; Kuller & Sutton-Tyrrell, 1999; Rimer, Orleans, Keintz, Cristinzio, & Fleisher, 1990; Smith, Cokkinides, & Eyre, 2005; U.S. Preventive Services Task Force, 2002). The interventions recommended were based on efficacy data demonstrating the potential for decreasing disability, morbidity, or mortality. Our study focused on the translation of these proven preventive approaches into the community. We employed no "untreated" control group for the interventions given the strong prior efficacy data and focused instead on how best to implement proven preventive approaches in a "real-world" setting. Support for the program was obtained from the local hospital, medical community, and voluntary health and social service agencies. The population of interest included men and women aged 65 years and older with no significant disability or difficulty with mobility and who were living in McKeesport, Allegheny County, Pennsylvania. Recruitment (discussed below) lasted 1 year, and participants were followed for an additional 24 months until 2005. A more detailed description of the program design has been published elsewhere (Newman et al., 2010).

Target Population

According to the 2008 U.S. Census Bureau, the city of McKeesport, Pennsylvania—the focus for CHA recruitment—had 21% of adults aged 65 years and older, with 47% reporting at least one type of disability. Approximately 64% were female, with only 60% graduating high school or beyond. The median per capita income in McKeesport was $15,698 compared with the U.S. average of $27,466, with 12.1% of those aged 65 years and older considered below the poverty level. Surrounding Allegheny County, Pennsylvania, had 18% of adults aged 65 years and older, the second highest proportion of older adults in a U.S. urban county (U.S. Census Bureau, 2008).

Recruitment

In 2001, 10,388 adults aged 65 years and older were identified from voter registration lists and were sent a letter describing the program. Recipients could return a detachable card, either refusing further contact or requesting a screening telephone call. The letter stated telephone follow-up would be forthcoming.

Volunteers underwent a prescreening telephone interview; if eligible, informed consent was obtained and three successive health assessment visits were scheduled, each expected to last 0.5 to 1.5 hours in length. On the first visit, health counselors traveled to the individuals' homes to conduct health assessments. Subsequently, two "Center" visits were scheduled at the CHA office in McKeesport, no more than 1 month apart. If needed, transportation was arranged; otherwise, parking was validated. Following the completion of all health assessments, individuals were randomized by household into either a Brief Education and Counseling Intervention (BECI) or a BECI along with interventions for physical activity (all intervention participants) and nutrition program (volunteers with hypertension) to reduce salt consumption (BECI-plus).

Data Collection

At baseline, 12 months, and 24 months, health counselors collected self-reported questionnaire data on current health issues and preventive practices, including cancer screening status (Key 3), smoking history (Key 2), immunization histories (Key 4), and bone mineral density (BMD) screening (Key 8). Medication names, dosage, and adherence were assessed. Blood pressure (BP) was measured twice using a standard mercury sphygmomanometer, and the average value was recorded (Key 1). Weight and height were measured in light clothing without shoes. Physical activity level was assessed using the Modified Activity Questionnaire (Pereira et al., 1997); physical function was assessed with standard questionnaires on activities of daily living (Fried et al., 1991; Katz, Ford, Moskowitz, Jackson, & Jaffe, 1963) and mobility (Simonsick et al., 2001). Gait speed (average), standing balance, and chair stand time were evaluated using the Short Physical Performance Battery (Guralnik, Ferrucci, Simonsick, Salive, & Wallace, 1995) (Key 7). Long-distance walking was assessed with a 400-meter walk test (Newman, Haggerty, Kritchevsky, Nevitt, & Simonsick, 2003). Fasting serum glucose (Key 5) and low-density lipoprotein (LDL) cholesterol (Key 6) were assessed by a local Quest Diagnostics clinical laboratory. Depression symptoms were assessed using the Center for Epidemiologic Studies Depression (CES-D) questionnaire (Orme, Reis, & Herz, 1986) (Key 10). Social contact was measured by the number of contacts a participant had per week (Heitzmann & Kaplan, 1988) (Key 9). For those participants with hypertension who were randomized to the BECI-plus group, urinary sodium was collected.

Interventions

Adherence to effective long-term preventive therapies is a major limiting factor in the success of these interventions. We based our approach to improving adherence on the previous successes in clinical trials such, as the Hypertension Detection and Follow-up Program (Hypertension Detection and Follow-up Program Cooperative Group, 1979), the Systolic Hypertension in the Elderly Program (SHEP Cooperative Group, 1991), and the Multiple Risk Factor Intervention Trial (Caggiula et al., 1981), and recent trials of multiple risk factor interventions and cardiovascular disease, such as the Bypass Angioplasty Revascularization Investigation 2 Diabetes (BARI 2D Study Group, 2009), as well as long-term behavioral, exercise, and weight loss programs, such as in the Diabetes Prevention Program (Diabetes Prevention Program Research Group, 2002). All these trials had used health counselors as advisors

to carefully follow participants so that they do not repeat measurements and to provide health education and behavioral counseling. Unfortunately, there have been very few successful attempts to transfer the success of these clinical trials in modifying risk factors and maintaining long-term follow-up to effectiveness studies in the community, especially with defined measurable outcomes.

Behavioral counseling, that is, nutrition and exercise, was firmly grounded in behavior theory, specifically behavior modification and social learning theory (Bandura, Adams, & Beyer, 1977; Botelho & Skinner, 1995). Participants were introduced to numerous self-management approaches such as self-monitoring, food label reading, goal setting, budgeting, and problem solving. After 10 initial weekly sessions, monthly follow-up sessions focused on maintaining motivation and adherence.

All participants received a BECI designed to educate about the "10 Keys" to encourage adherence to age-appropriate screening procedures and vaccinations and to work toward the reduction of specific health risk factors identified in a one-page report that reflected all 10 key risk factors, titled the *Prevention in Practice Report* (PIP). Each participant was given a PIP, which summarized the participant's status regarding each of the "10 Keys" goals. The PIP report uses risk factor assessment as a simple and useful tool to help individuals learn about their overall health. The report has been designed to involve adults in learning about their personal risk factors and identifying keys that require action.

As the study progressed, the "10 Keys" goals were modified slightly to reflect changing preventive standards for serum glucose or lipid levels (Genuth et al., 2003; National Cholesterol Education Program Expert Panel, 2002). All information was provided to the participants' physician, including "10 Keys" recommendations.

Participants met individually with their health counselor every 6 months to review the PIP report. Health counselors facilitated the behavior modification changes that included action plan development, knowledge acquisition strategies, skills development, social support, self-monitoring, and relapse prevention. Each participant indicated the key to be addressed, and with light prompting from the counselor, specific goals/action steps were identified. The counselor prompted the participant to identify local community resources for additional support. This plan was discussed and modified via telephone follow-up calls with participants' counselors at least every 3 months. Participants were encouraged to take the PIP report to their physicians and solicit their support in addressing these goals. Monthly calls were made to participants with concerning (but nonemergent) findings such as elevated BP (systolic BP [SBP] > 160 mmHg; Chobanian et al., 2003), blood glucose (>130 mg/dL), a positive depression screening score (CES-D score >16; "The American Geriatrics Society and American Association for Geriatric Psychiatry Recommendations," 2003), an absence of physical activity (Nelson et al., 2007), or any current smoking behavior. These calls helped ensure that appropriate medical follow-up was sought and provided community resources/support for behavior change. Participants without a primary care physician were given physician names and contact information from the local medical society and hospital and encouraged to make an appointment. Participants with difficulty obtaining or adhering to prescribed medications were provided information on prescription medication benefits and adherence strategies. Counseling calls continued on a monthly basis until active issues were resolved and then reduced to approximately every 3 months for the remainder of the program.

Individuals randomized to BECI-plus received a physical activity intervention (the *Key to Life Exercise Intervention*) and, for those with a history of hypertension, a dietary sodium nutritional intervention (the *Key to Life Nutrition Program*). The *Key to Life Exercise Intervention* aimed to increase or maintain physical activity and consisted of a walking program and an instructional weight training program, each delivered via small-group (18 per group) exercise sessions. The program included stretching, chair exercises, and recreational activities such as basketball and shuffleboard. Participants were encouraged to attend 24 one-hour sessions over 12 weeks and to exercise on their own at least one other day of the week. Intervention resources were provided, including exercise fact sheets, pedometers, exercise logs, and handheld weights.

The *Key to Life Nutrition Program* was a voluntary 10-week intervention based on the Dietary Patterns, Sodium Intake and Blood Pressure trials (Appel et al., 1997; Sacks et al., 2001), which aimed to translate proven sodium reduction approaches into a community setting. This intervention focused on educating individuals to reduce dietary sodium by increasing the intake of fruits and vegetables, low-fat dairy products, and whole grains and decreasing the intake of processed foods and sodium chloride. Education was delivered in group sessions, facilitated by a registered dietitian. Weight loss was recommended only when body mass index was ≥30. A more detailed description of the sodium reduction intervention has been published elsewhere (Robare et al., 2009).

Data Analysis

Data analysis was completed using SAS Version 9.1 (SAS Institute, Cary, NC). We calculated descriptive statistics for the sample and then assessed the proportion of participants that achieved each of the "10 Keys" goals at baseline and at 24 months. Because the BECI and BECI-plus interventions were identical with regard to the "10 Keys" goals, we describe analyses for those outcomes pooled across intervention arms. However, as the two arms differed in terms of physical activity and sodium reduction counseling, it is important to examine how physical activity changed in each group and whether the more intensive intervention led to larger effect sizes.

To assess for "10 Keys" goals adherence change over time, we used *t* tests for continuous variables and chi-square test for categorical variables. We also assessed for change in continuous measures of several cardiovascular risk factors over the 24 months of the study, using matched paired *t* tests. To determine whether outcomes relevant to physical activity changed over time and to assess for an intervention effect (BECI vs. BECI-plus), we used matched paired *t* tests and McNemar's test.

Results

Recruitment

We identified 10,388 adults, and 951 households responded (8.2%). Of the 951 households that responded, a total of 389 (3.4%) households had identified at least one eligible person for the program. We attempted to determine the reasons for the apparently low response to our mailings. From the first approximately 292 letters sampled, we attempted further contact of the individuals. Multiple telephone contacts were then followed by attempts to go to the homes of those who did not respond in order to determine their eligibility and willingness to participate. Of the 292 that were contacted, 156 (53%) were actually reached by telephone contact and subsequently 74 of these individuals were evaluated by telephone. After completion of the telephone contact, 34 (12%) individuals were determined to be eligible and 9 (3%) were then scheduled for a further home visit. Of these 9, only 6 (2%) were later randomized into the program. We randomly selected 25 homes from the 136 that did not respond to the telephone contact and went to their homes. We found that only 1 of these 25 was potentially eligible for the demonstration project. Many of the residents had either moved to another residence or a skilled nursing facility, the house no longer existed, or the individual at the home was deceased or did not answer the door. Thus, more intensive recruitment effort did not increase the yield for this study.

Of the 417 participants recruited, 93% were still in the study at 24 months. Only 28 individuals did not complete any follow-up health assessments. This left 389 (93%) individuals for evaluation through 24 months. Of the 28 individuals who did not complete a follow-up health assessment, 8 individuals died from non-study-related causes, 5 from the BECI group and 3 from the BECI-plus group. Our sample was predominantly White; 59.4% were female, and the average baseline age was 73.9 years (Table 1). Less than 50.0% had an education level higher than high school. Approximately half reported hypertension, 22.6% with coronary heart disease, 11.6% with diabetes, and 7.2% a prior stroke.

The most commonly achieved prevention keys were having the ability to complete 5 chair stands (100%) and maintenance of social contact (99%; see Table 2). A total of 88% of the sample had CES-D scores that were not suggestive of depressive symptoms, while 73% had controlled SBP (although only 59% of those with a history of hypertension had values <140 mmHg). Cancer screening rates ranged from 72% to 79%, with a colonoscopy alone rate of 50%. Influenza and pneumonia vaccine adherence was 71% and 66%, respectively. Only 4% were current cigarette smokers at baseline, probably due, in part, to "selection" for the study as smokers are less likely to participate in intervention studies. There was no difference in the baseline characteristics between the two intervention groups.

Table 1. Baseline Characteristics of the Center for Healthy Aging Demonstration Program Participants (*N* = 389)

Characteristics	
Age (years), mean (*SD*)	73.9 (5.4)
Gender, *n* (%)	
Men	158 (40.6)
Women	231 (59.4)
Race, *n* (%)	
White	369 (94.9)
Black	20 (5.1)
Educational attainment, *n* (%)	
Less than high school	31 (8.2)
High school	184 (48.5)
Greater than high school	164 (43.3)
Marital status, *n* (%)	
Single	21 (5.4)
Married	233 (59.9)
Separated	5 (1.3)
Divorced	14 (3.6)
Widowed	116 (29.8)
Self reported health status, *n* (%)	
Excellent/very good/good	351 (90.2)
Fair/poor	38 (9.8)
Hypertension, *n* (%)	209 (53.7)
Coronary heart disease[a], *n* (%)	88 (22.6)
Diabetes, *n* (%)	43 (11.1)
Stroke, *n* (%)	28 (7.2)

a. Defined as a reported diagnosis of myocardial infarction, angina, coronary artery bypass graft, cardiac stent, or angioplasty.

Twenty-Four-Month Results

At 24 months, vaccination rates showed the largest improvement of the "10 Keys" under examination (Table 2). Among participants without prior influenza or pneumonia vaccination at baseline (refer Table 2, no influenza or pneumonia immunization at baseline but subsequent vaccine), 49% had obtained an influenza vaccination and 31% a pneumonia vaccination by the 2-year follow-up. The goal of reducing LDL cholesterol below 100 mg/dL was met by 14% of all participants and 22% of those with a prior CHD diagnosis. There was a 9% increase in the percentage of individuals with SBP to less than 140 mmHg among those with diagnosed hypertension at baseline (SBP 140 or greater, diagnosed by physician, and/or is on medication

Table 2. Proportion of Participants Achieving the Goals of the "10 Keys" to Healthy Aging at Baseline, 24-Month Follow-Up, and Change

Key and Goals	*n*	Total (*N* = 389)		
		Baseline	Follow-Up	Difference
1. Control systolic blood pressure to <140 mmHg	313	73%	76%	3%
Hypertensive at baseline	209	59%	68%	9%*
Prescribed medications for hypertension	313	45%	49%	4%
2. Stop smoking (% indicates smokers)	363	4%	4%	0%
3. Participate in cancer screenings				
Mammogram	222	79%	79%	0%
Prostate cancer screening	134	72%	70%	–2%
Colon cancer screening	340	79%	79%	0%
Colonoscopy alone	349	50%	64%	14%***
4. Get regular immunizations				
Influenza	363	71%	54%	–17%***
No influenza immunization at baseline but subsequent shot	104	0%	49%	49%
Pneumonia				
No pneumonia immunization at baseline but subsequent shot	119	0%	31%	31%
5. Regulate blood glucose to <110 mg/dL	309	86%	81%	–5%
Diabetic at baseline	43	26%	23%	–3%
Prescribed medications for diabetes	309	10%	11%	1%
6. Lower LDLc to <100 mg/dL	306	31%	45%	14%***
History of CHD at baseline	75	51%	73%	22%***
Baseline LDLc >130 mg/dL	102	0%	16%	16%
7. Be physically active at least 2.5 hours per week	338	64%	61%	–3%
8. Prevent bone loss and muscle weakness				
Bone mineral density test	358	61%	72%	11%***
Muscle weakness (chair stands)	297	100%	100%	0%
9. Maintain social contact at least once per week	363	99%	100%	1%
10. Combat depression (CES-D score <16)	356	88%	88%	0%

Note: LDLc = low-density lipoprotein cholesterol; CHD = coronary heart disease; CES-D = Center for Epidemiologic Studies Depression scale.
*$p \le .05$. **$p \le .01$. ***$p \le .001$.

for elevated BP). There was little change in the overall percentage of the sample with blood glucose less than 110 mg/dL (among participants with diabetes or among those with prescribed antiglycemic agents). The number of participants who met the Diabetes Key at the 24-month period was less than those who originally met the Key at baseline. At baseline, 256 of 309 met the key; at follow-up the number dropped to 249 of 309. This results in a drop from 86% to 81% at baseline and at 24-month follow-up, respectively. Meeting the Diabetes Key was defined as having a glucose value less than 110 mg/dL.

Likewise, there was no significant change in the prevalence of depression symptoms. Colonoscopy screening increased 14%. We found an 11% increase in adherence in dual-energy X-ray absorptiometry BMD screenings.

The average level of cardiovascular risk factors at baseline and at 24 months and changes in these values are reported in Table 3. Overall, the baseline average SBP was 131.9 mmHg and diastolic BP was 71.3 mmHg. Average BP was slightly higher among participants with diagnosed hypertension. Fasting blood glucose was 97.6 mg/dL for the total sample and 138.8 mg/dL for participants with a history of diabetes. Average LDL cholesterol was 116.3 mg/dL, whereas among participants with a baseline history of CHD, it was 102.8 mg/dL.

There was a significant decrease in the BP of the total sample (–3.2/–1.9 mmHg) at 24 months; among participants with diagnosed hypertension, an average of –5.1/–2.4 mmHg reduction was found. Blood glucose decreased by 11.2 mg/dL among participants with diabetes. LDL cholesterol decreased –11.7mg/dL overall, including a –15.7 mg/dL reduction for those individuals with a history of CHD. An even greater reduction (–26.6 mg/dL) was observed for those individuals whose baseline LDL cholesterol was >130 mg/dL.

Results of the Physical Activity Intervention

Table 4 reports mean differences within and between intervention groups using specific physical activity performance–based measures. For both groups, levels of physical activity generally declined. Within each intervention group, the only physical activity parameters that changed over 24 months were seen in the BECI-plus participants, in whom total physical activity dropped by 1.6 hours per week and occupational activity decreased by 1.1 hours per week. No statistically significant

Table 3. Means of the "10 Keys" Selected Measures for Baseline and 24-Month Follow-Up Assessment (Mean Clinical Levels)

		Total (N = 389)		
	n	Baseline	Follow-Up	Difference
Systolic BP	313	130.9	127.7	–3.2***
Persons with hypertension	209	136.7	131.6	–5.1***
On BP-controlling medication	140	134.7	131.3	–3.4*
No BP-controlling medication	173	127.9	124.8	–3.1*
Diastolic BP	313	71.3	69.4	–1.9**
Persons with hypertension	209	72.7	70.3	–2.4***
On BP-controlling medication	140	71.4	69.9	–1.5
No BP-controlling medication	173	71.2	68.9	–2.2*
Glucose	309	97.9	98.8	0.9
Diabetic at baseline	43	138.8	127.6	–11.2
On diabetic medication	30	140.3	127.8	–12.4
LDL cholesterol	306	117.2	105.5	–11.7***
History of CHD at baseline	75	102.8	87.1	–15.7***
Baseline LDL >130 mg/dL	102	155.3	128.7	–26.6***
On cholesterol-lowering medication	123	101.0	94.8	–6.2**
No cholesterol-lowering medication	183	128.1	112.7	–15.4***
HDL cholesterol	308	54.8	54.3	–0.5
History of CHD at baseline	75	48.1	46.9	–1.2
On cholesterol-lowering medication	125	50.9	49.8	–1.1
No cholesterol-lowering medication	183	57.4	57.3	–0.2
Combat depression (CES-D score <16)	356	6.7	7.6	0.95

Note: BP = blood pressure; LDL = low-density lipoprotein; CHD = coronary heart disease; CES-D = Center for Epidemiologic Studies Depression scale.
*$p \leq .05$. **$p \leq .01$. ***$p \leq .001$.

differences in the mean 24-month change in multiple physical activity–related outcomes were observed between the two intervention groups.

Results of the Sodium Reduction Intervention

Among participants with hypertension, baseline mean sodium excretion was 3128 mg/day (136 mmol/day). When we compared baseline results with 12-month data, we found a statistically significant sodium reduction, –299 mg (–13 mmol; 95% confidence interval = 1.16, 25.40), with a final average urinary sodium of 2875 mg/day (125 mmol; Robare et al., 2009).

Discussion

This project demonstrates that older adults in a lower income community can improve their adherence to prevention goals through an evidence-based education and counseling program. Our participants successfully improved their adherence to the "10 Keys" goals in areas such as controlling SBP (especially those persons with hypertension at baseline), decreasing LDL cholesterol, obtaining colonoscopy for cancer screening, BMD measurement as osteoporosis screening, and influenza and pneumonia vaccinations. A relatively intensive program to promote physical activity was no more effective than brief counseling in minimizing a loss of physical activity and muscle strength over 2 years, whereas counseling to reduce sodium intake in a subset of the sample resulted in modest but significant change in urine sodium excretion over the first year of the study. The overall rates for influenza vaccine decreased by 17% from baseline to 24-month follow-up. We would like to bring to attention that the 24-month follow-up health assessment was conducted in 2005, the same year the United States had a shortage of influenza vaccinations, which could be a major factor as to why we observed such a decrease.

To promote sustainability, this intervention complemented existing community resources. Despite relatively low-cost intervention approaches, we achieved considerable success in controlling cardiovascular risk factors. For example, BP control, especially among persons with hypertension, which was better than in the general U.S. population (Chobanian et al., 2003). Control of serum glucose levels was also better than usually seen in population studies, and the proportion controlling LDL cholesterol to <100 mg/dL (especially for participants with coronary artery disease) was better than typical community values.

There are several possible reasons why the BECI-plus intervention had no significant effect on physical activity compared with the brief intervention alone. First, the level of physical activity reported was higher than in other elderly samples (Brach, Simonsick, Kritchevsky, Yaffe, & Newman, 2004). Since the participants were well functioning and active at

Table 4. Means of Physical Activity Performance Based Measures by Intervention Group for Baseline and 24-Month Follow-Up Assessment

	Lifestyle Plus ($N = 188$)				Education and Counseling ($N = 201$)				Intervention Comparison
	n	Baseline	Follow-Up	Difference	*n*	Baseline	Follow-Up	Difference	*p* Value
Modified Activity Questionnaire—total score	164	7.5	5.9	−1.6*	174	6.5	5.7	−0.8	.37
Modified Activity Questionnaire—Leisure	164	5.2	4.6	−0.6	174	4.8	4.6	−0.2	.35
Modified Activity Questionnaire—Occupational	164	2.4	1.3	−1.1*	174	1.7	1.1	−0.6	.58
Heart rate									
Prewalk heart rate	120	76.6	74.9	−1.68	135	75.8	74.5	−1.30	.79
Postwalk heart rate	120	102.4	100.6	−1.82	135	101.6	101.4	−0.28	.35
Total time to complete 400-m walk (min)	120	5.73	5.81	0.08	135	5.80	5.91	0.11	.67
Gait speed (m/s)	149	1.05	1.03	−0.02	164	1.04	1.02	−0.02	.72
Lower extremity battery score	146	10.3	10.3	0.06	164	10.4	10.3	−0.10	.36

*$p \leq .05$.

baseline, there may have been little room for improvement. Second, budget and staffing restrictions resulted in a less-intensive intervention than employed by many physical activity efficacy studies conducted over a relatively short timeframe. Intervention intensity was likely insufficient to increase subjective measures of physical performance. Despite the provision of transportation many participants reported already participating in community-based activity programs. Health counselors encouraged both groups to increase their physical activity on a regular basis. This contact from the health counselors may be sufficient to encourage an increase or maintenance of physical activity in healthy older individuals.

The fact that our program may have lacked enough intensity is particularly concerning as the program was more intensive than typical community programs for promoting physical activity.

Although the observed reduction of urinary sodium was significant, it did not approach the recommended goal level of 1,500 mg/day. The level of urine sodium reduction was similar to that in other studies of individuals with hypertension; it is very unlikely that more substantial reduction in sodium is feasible without decreasing the amount of sodium in processed foods.

Study Limitations

The major limitation of this study is the very low response rate to the mailings, that is, only about 4%. The approach was successful in obtaining enough participants for the study but obviously is a highly selected, motivated population similar to those who are often recruited for clinical trials. In our previous Rural Health Promotion Project (RHPP) among Medicare participants age 65-79, we recruited under the auspices of Medicare again by mailing and telephone follow-up and had a higher response rate (Ives, Kuller, Schulz, Traven, & Lave, 1992; Ives, Traven, Kuller, & Schulz, 1994). We mailed 22,796 participants, all Medicare Part B recipients in rural areas of western Pennsylvania. The overall response rate was 17%. However, in the communities where we combined both mailing with telephone and home visits, participation increased to 37%. We then compared the characteristics of the participants by these different recruitment strategies. There were relatively little differences in the characteristics of those recruited primarily by the mailings and the more intensive recruitment strategy nor between those who were recruited and those who did not participate.

Recruitment of a higher percentage of older participants has been accomplished in the United Kingdom using the general practitioners lists, approximately 78%. However, there was a substantial drop out of practices from the study over time (Fletcher et al., 2004).

Recruitment of a high percentage of potentially eligible participants from these high-risk communities remains a challenge and has not been successfully implemented in the aging populations in the United States. Thus, even the successful interventions can only reach a small percentage of the population who are willing to participate and remain in the study over time. Clearly the major challenge in future studies for older individuals will be to improve the recruitment of participants in a defined population and demonstrate the effectiveness of the program on changes in objective risk factors and outcomes.

These analyses were limited by a lack of control data. However, given the well-established importance of the "10 Keys" goals, it would have been unethical to demonstrate that these goals were unmet in control participants without intervening over this 2-year study.

Since the inception of this project, several major initiatives have underscored the importance of the "10 Keys" goals and

have suggested possible new "keys" (U.S. Department of Health and Human Services, 2006). For example, the CDC has identified the reduction of disparities in risk factors for chronic disease among older individuals as a priority issue and recognizes influenza and pneumonia vaccinations, mammography and colorectal screening, cholesterol measurement, and an increase in physical activity as important indicators of preventive health care quality for older individuals (U.S. Department of Health and Human Services, 2006). Efforts to reduce hip fracture hospitalizations, via screening and treatment of osteoporosis and fall prevention, are also high priorities. Furthermore, the "10 Keys" overlap with most of the older adult prevention priorities that were identified by the Partnership for Prevention (Partnership for Prevention, 2008).

Implications for Practice

We have shown that it may be possible to use health counselors to work in the community to enhance adherence to a multifaceted prevention program. Unlike some of the health advisor programs that use such individuals only to provide information, our health counselors in this study were trained to provide counseling, take specific measurements, and monitor pharmacological and nonpharmacological therapies. It is very important, we believe, that such health counselors be trained in both the measurement of the risk factors as well as in behavioral skills and adherence methodologies. They also must be able to work in their communities. Effectiveness studies of how best to train and use health counselors and the measurement of their effectiveness, including hard outcomes, are important next steps. The ability to reach a high percentage of older individuals within any community remains a major challenge. Prevention is proposed as a method to reduce or slow health care costs. Restructuring of physicians practices, for example, "medical home," to include better coordination and follow-up are proposed (Stange et al., 2010).

We have used Medicare patient lists, physicians' offices and specialized clinics in the RHPP, and community sampling. Neither approach reached a high percentage of the eligible population. A major issue is how to reach the highest risk individuals, successfully implement proven preventive strategies, and maintain long-term adherence and follow-up and provide "proof of reduction of adverse health outcomes" (Scott & Guyatt, 2010; Strandberg, Pitkala, Berglind, Nieminen, & Tilvis, 2006).

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References

The American Geriatrics Society and American Association for Geriatric Psychiatry Recommendations for Policies in Support of Quality Mental Health Care in U.S. Nursing Homes. (2003). *Journal of the American Geriatrics Society*, *51*, 1299-1304.

Appel, L. J., Moore, T. J., Obarzanek, E., Vollmer, W. M., Svetkey, L. P., Sacks, F. M., . . . Karanja, N. (1997). A clinical trial of the effects of dietary patterns on blood pressure. DASH Collaborative Research Group. *New England Journal of Medicine*, *336*, 1117-1124.

Bandura, A., Adams, N. E., & Beyer, J. (1977). Cognitive processes mediating behavioral change. *Journal of Personality & Social Psychology*, *35*, 125-139.

The BARI 2D Study Group. (2009). A randomized trial of therapies for type 2 diabetes and coronary artery disease. *New England Journal of Medicine*, *360*, 2503-2515.

Botelho, R. J., & Skinner, H. (1995). Motivating change in health behavior. Implications for health promotion and disease prevention. *Primary Care*, *22*, 565-589.

Brach, J. S., Simonsick, E. M., Kritchevsky, S., Yaffe, K., & Newman, A. B. (2004). The association between physical function and lifestyle activity and exercise in the health, aging and body composition study. *Journal of the American Geriatrics Society*, *52*, 502-509.

Caggiula, A. W., Christakis, G., Farrand, M., Hulley, S. B., Johnson, R., Lassier, N. L., . . . Widdowson, G. (1981). The Multiple Risk Factor Intervention Trial (MRFIT) IV. Intervention on blood lipids. *Journal of Preventative Medicine*, *10*, 443-475.

Cheng, A. Y., & Leiter, L. A. (2006). Implications of recent clinical trials for the National Cholesterol Education Program Adult Treatment Panel III guidelines. *Current Opinion in Cardiology*, *21*, 400-404.

Chobanian, A. V., Bakris, G. L., Black, H. R., Cushman, W. C., Green, L. A., Izzo, J. L., Jr., . . . Roccella, E. J. (2003). Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. *Hypertension*, *42*, 1206-1252.

Diabetes Prevention Program Research Group. (2002). Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *New England Journal of Medicine*, *346*, 393-403.

Fillit, H. M., Butler, R. N., O'Connell, A. W., Albert, M. S., Birren, J. E., Cotman, C. W., . . . Tully, T. (2002). Achieving and maintaining cognitive vitality with aging. *Mayo Clinic Proceedings*, *77*, 681-696.

Fletcher, A. E., Ng, E. S. W., Stirling, S. L., Bulpitt, C. J., Breeze, E., Nunes, M., . . . Tulloch, A. J. (2004). Population-based

multidimensional assessment of older people in UK general practice: A cluster-randomized trial. *Lancet*, *364*, 1667-1677.

Fried, L. P., Borhani, N. O., Enright, P., Furberg, C. D., Gardin, J. M., Kronmal, R. A., . . . Newman, A. (1991). The Cardiovascular Health Study: Design and rationale. *Annals of Epidemiology*, *1*, 263-276.

Genuth, S., Alberti, K. G., Bennett, P., Buse, J., Defronzo, R., Kahn, R., . . . Zimmet, P. (2003). Follow-up report on the diagnosis of diabetes mellitus. *Diabetes Care*, *26*, 3160-3167.

Guralnik, J. M., Ferrucci, L., Simonsick, E. M., Salive, M. E., & Wallace, R. B. (1995). Lower-extremity function in persons over the age of 70 years as a predictor of subsequent disability. *New England Journal of Medicine*, *332*, 556-561.

Hak, E., Nordin, J., Wei, F., Mullooly, J., Poblete, S., Strikas, R., & Nichol, K. L. (2002). Influence of high-risk medical conditions on the effectiveness of influenza vaccination among elderly members of 3 large managed-care organizations. *Clinical Infectious Diseases*, *35*, 370-377.

Heitzmann, C. A., & Kaplan, R. M. (1988). Assessment of methods for measuring social support. *Health Psychology*, *7*, 75-109.

Hypertension Detection and Follow-up Program Cooperative Group. (1979). Five-year findings of the Hypertension Detection and Follow-up Program, II: Mortality by race-sex and age. *Journal of the American Medical Association*, *242*, 2572-2576.

Ives, D. G., Kuller, L. H., Schulz, R., Traven, N. D., & Lave, J. R. (1992). Comparison of recruitment strategies and associated disease prevalence for health promotion in rural elderly. *American Journal of Preventative Medicine*, *21*, 582-591.

Ives, D. G., Traven, N. D., Kuller, L. H., & Schulz, R. (1994). Selection bias and nonresponse to health promotion in older adults. *Epidemiology*, *5*, 456-461.

Katz, S., Ford, A. B., Moskowitz, R. W., Jackson, B. A., & Jaffe, M. W. (1963). Studies of illness in the aged. The index of ADA: A standardized measure of biological and psychosocial function. *Journal of the American Medical Association*, *185*, 914-919.

Kuller, L. H., & Sutton-Tyrrell, K. (1999). Aging and cardiovascular disease. Use of subclinical measurements. *Cardiology Clinics*, *17*, 51-65.

National Cholesterol Education Program Expert Panel. (2002). Third report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report. *Circulation*, *106*, 3143-3421.

Nelson, M. E., Rejeski, W. J., Blair, S. N., Duncan, P. W., Judge, J. O., King, A. C., . . . Castaneda-Sceppa, C. (2007). Physical activity and public health in older adults: Recommendation from the American College of Sports Medicine and the American Heart Association. *Circulation*, *116*, 1094-1105.

Newman, A. B., Bayles, C. M., Milas, C. N., McTigue, K., Williams, K., Robare, J. F., . . . Kuller, L. H. (2010). The 10 keys to healthy aging: Findings from an innovative prevention program in the community. *Journal of Aging and Health*, *22*, 547-566.

Newman, A. B., Haggerty, C. L., Kritchevsky, S. B., Nevitt, M. C., & Simonsick, E. M. (2003). Walking performance and cardiovascular response: Associations with age and morbidity—The Health, Aging and Body Composition Study. *Journals of Gerontology Series A—Biological Sciences & Medical Sciences*, *58*, 715-720.

Orme, J. G., Reis, J., & Herz, E. J. (1986). Factorial and discriminant validity of the Center for Epidemiological Studies Depression (CES-D) scale. *Journal of Clinical Psychology*, *42*, 28-33.

Partnership for Prevention. (2008). *Community preventive services*. Retrieved from http://www.prevent.org

Pereira, M. A., FitzerGerald, S. J., Gregg, E. W., Joswiak, M. L., Ryan, W. J., Suminski, R. R., . . . Zmuda, J. M. (1997). A collection of physical activity questionnaires for health-related research. *Medicine & Science in Sports & Exercise*, *29*(6, Suppl.), S1-S205.

Rimer, B. K., Orleans, C. T., Keintz, M. K., Cristinzio, S., & Fleisher, L. (1990). The older smoker. Status, challenges and opportunities for intervention. *Chest*, *97*, 547-553.

Robare, J. F., Milas, N. C., Bayles, C. M., Williams, K., Newman, A. B., Lovalekar, M. T., . . . Kuller, L. H. (2009). The Key to Life Nutrition Program: Results from a community-based dietary sodium reduction trial. *Public Health Nutrition*, *13*, 606-614.

Sacks, F. M., Svetkey, L. P., Vollmer, W. M., Appel, L. J., Bray, G. A., Harsha, D., . . . Lin, P. H. (2001). Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. DASH-Sodium Collaborative Research Group. *New England Journal of Medicine*, *344*, 3-10.

Scott, I. A., & Guyatt, G. H. (2010). Cautionary tales in the interpretation of clinical studies involving older persons. *Archives of Internal Medicine*, *170*, 587-595.

SHEP Cooperative Group. (1991). Prevention of stroke by antihypertensive drug treatment in older persons with isolated systolic hypertension. *Journal of the American Medical Association*, *265*, 3255-3264.

Simonsick, E. M., Newman, A. B., Nevitt, M. C., Kritchevsky, S. B., Ferrucci, L., Guralnik, J. M., & Harris, T. (2001). Measuring higher level physical function in well-functioning older adults: Expanding familiar approaches in the Health ABC study. *Journals of Gerontology Series A—Biological Sciences & Medical Sciences*, *56*, M644-M649.

Smith, R. A., Cokkinides, V., & Eyre, H. J. (2005). American Cancer Society guidelines for the early detection of cancer, 2005. *CA: A Cancer Journal for Clinicians*, *55*, 31-44.

Stange, K. C., Nutting, P. A., Miller, W. L., Jaen, C. R., Crabtree, B. F., Flocke, S. A., & Gill, J. M. (2010). Defining and measuring the patient-centered medical home. *Journal of General Internal Medicine*, *25*, 601-612.

Strandberg, T. E., Pitkala, K. H., Berglind, S., Nieminen, M. S., & Tilvis, R. S. (2006). Multifactorial intervention to prevent recurrent cardiovascular events in patients 75 years or older: The Drugs and Evidence-Based Medicine in the Elderly (DEBATE) study: A randomized, controlled trial. *American Heart Journal*, *152*, 585-592.

U.S. Census Bureau. (2008). *American Community Survey. Fact sheet: McKeesport City, Pennsylvania*. Retrieved from http://factfinder.census.gov/servlet/ACSSAFFFacts?_event=Search&geo_id=04000US42&_geoContext=01000US|04000US42

&_street=&_county=mckeesport+city&_cityTown=mckeesport+city&_state=04000US42&_zip=&_lang=en&_sse=on&ActiveGeoDiv=geoSelect&_useEV=&pctxt=fph&pgsl=040&_submenuId=factsheet_1&ds_name=ACS_2008_3YR_SAFF&_ci_nbr=null&qr_name=null&reg=null%3Anull&_keyword=&_industry=

U.S. Department of Health and Human Services. (2006). *Advancing the nation's health: A guide to public health research needs, 2006-2015*. Washington, DC: Author.

U.S. Preventive Services Task Force. (2002). Screening for depression: Recommendations and rationale. *Annals of Internal Medicine*, *136*, 760-764.