Effectiveness of a Community Health Worker Cardiovascular Risk Reduction Program in Public Health and Health Care Settings

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Objectives. We evaluated whether a program to prevent coronary heart disease (CHD) with community health workers (CHWs) would improve CHD risk in public health and health care settings.

Methods. The CHWs provided point-of-service screening, education, and care coordination to residents in 34 primarily rural Colorado counties. The CHWs utilized motivational interviewing and navigated those at risk for CHD into medical care and lifestyle resources. A software application generated a real-time 10-year Framingham Risk Score (FRS) and guideline-based health recommendations while supporting longitudinal caseload tracking. We used multiple linear regression analysis to determine factors associated with changes in FRS.

Results. From 2010 to 2011, among 4743 participants at risk for CHD, 53.5% received medical or lifestyle referrals and 698 were retested 3 or more months after screening. We observed statistically significant improvements in diet, weight, blood pressure, lipids, and FRS with the greatest effects among those with uncontrolled risk factors. Successful phone interaction by the CHW led to lower FRS at retests ($P = .04$).

Conclusions. A CHW-based program within public health and health care settings improved CHD risk. Further exploration of factors related to improved outcomes is needed. (*Am J Public Health.* 2013;103:e19–e27. doi:10.2105/AJPH.2012.301068)

The US Affordable Care Act specifies implementation of a national partnership for disease prevention and health promotion, with a focus on reducing health disparities.[1] Although the Affordable Care Act includes community outreach as a key component, it provides little detail on optimal methods for integrating community and health care silos. One potential linkage is the community health worker (CHW) who is a lay person trained to carry out specific health interventions. There is considerable evidence supporting the positive impact of CHWs on the health of diverse populations with hypertension and other chronic conditions.[2–6] However, systematic reviews of CHW effectiveness suggest important gaps in the evidence base,[7,8] and studies of coronary heart disease (CHD) risk factor interventions, in particular, were isolated within health care delivery settings. In addition, no studies to date have demonstrated a reduction in global CHD risk, the strongest predictor of long-term fatal and nonfatal cardiovascular events.[9]

Although the burden of CHD continues to decline,[10] it remains the leading cause of morbidity and mortality in the United States[11] where substantial health disparities persist among underserved populations, particularly geographically isolated residents.[12–14] In addition to limited access to primary care, rural medical centers have significantly fewer clinical capabilities, worse measured processes of care, and higher mortality rates among patients presenting with acute cardiovascular conditions.[15]

From 2006 to 2009, a previous statewide CHW-based network provided CHD screening to medically underserved populations including urban, rural, and frontier regions of Colorado.[16] The CHWs were deployed to provide point-of-service health screenings and education. In this population of 17 995 individuals, 82% were unaware of their risk for CHD, which suggested an important unmet public health need. This previous program was not designed to track health outcomes and focused primarily on the first step in the health improvement continuum by raising awareness among vulnerable individuals. Given this background, we enhanced the framework of the previous program by integrating best practices from multiple public health and health care models. This included:

1. creating a decision-support algorithm that would generate tailored health messages based upon national treatment guidelines,
2. assessing participant readiness to change,
3. utilizing motivational interviewing techniques to promote healthy behavior change,
4. incorporating longitudinal follow-up for at-risk participants,
5. improving navigation into medical care and community resources, and
6. integrating health care provider educational detailing.

These enhancements were incorporated into an electronic data collection system designed to assist the CHWs' workflow within the overall program framework. The program was adapted to the culture of the community to effectively link community outreach with local medical clinics. We sought to demonstrate whether a CHW-based program that integrated both public health and health care models would reduce CHD risk. We assessed outcomes from 2010 to 2011, and investigated factors associated with changes in Framingham Risk Score (FRS).

METHODS

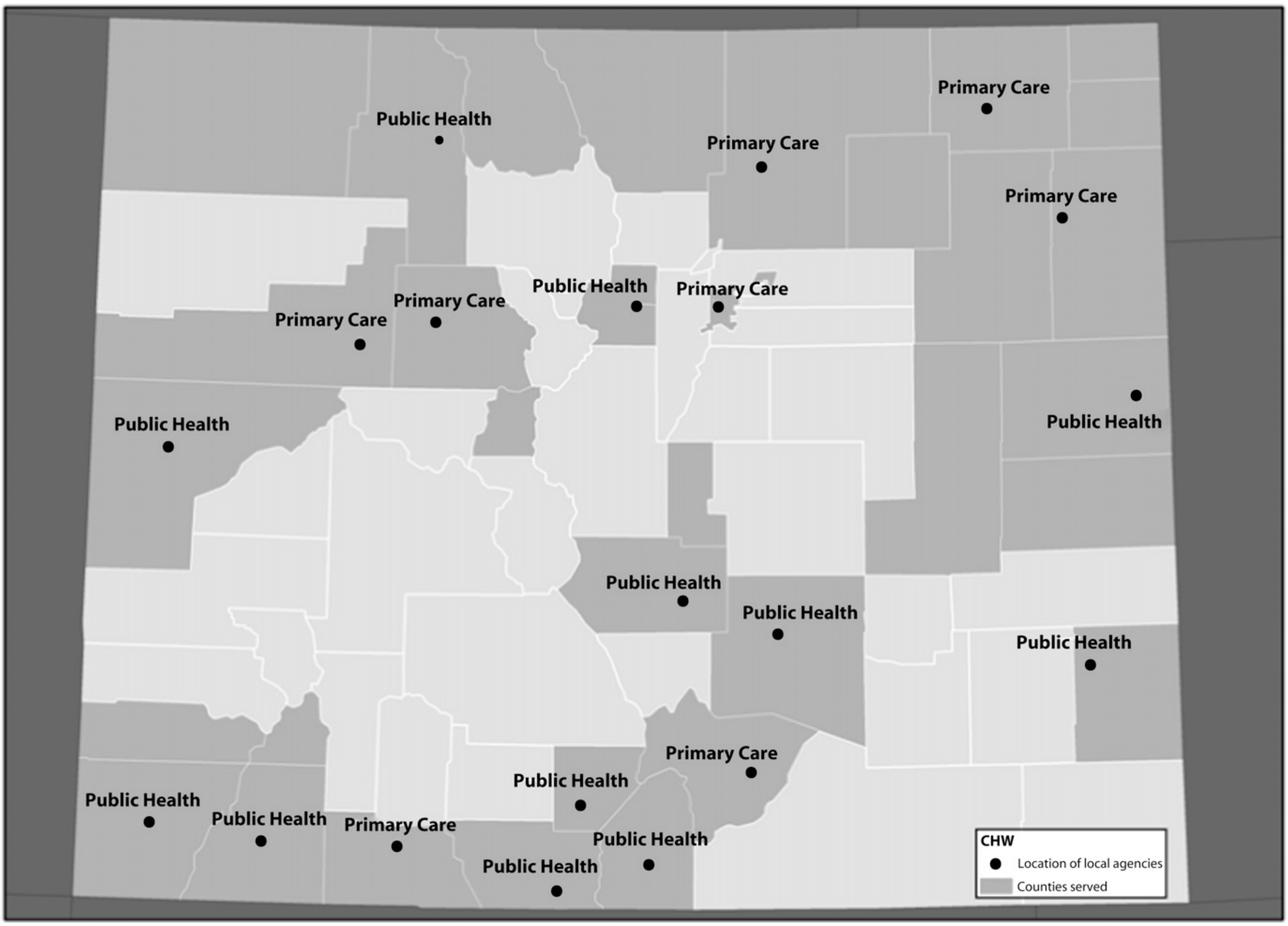
The Colorado Heart Healthy Solutions program (CHHS) is a statewide chronic disease prevention program primarily funded by the Cancer, Cardiovascular and Pulmonary Disease grants program of the Colorado Department of Public Health and Environment. The grants program is sustained through a constitutional amendment, which created a tobacco excise tax to enhance the early detection, prevention, and treatment of the leading chronic diseases in the state. The program and its evaluation were reviewed and exempted by the Colorado Multiple Institution Review Board.

The program was implemented by 22 CHWs who served 34 Colorado counties of which 8 were urban, 14 were rural, and 12 were designated as frontier. The CHWs were hired and placed locally within 20 centers: 12 public health agencies (including 1 visiting nurse association and 1 area health education center) as well as 8 health care delivery agencies (Figure 1). Health care agencies included 4 federally qualified community health centers and 4 rural hospitals. Program participants were recruited primarily via community outreach. Examples of outreach venues included churches, barbershops, local businesses, migrant farming areas, homeless shelters, grocery stores, and large-scale screening events in frontier counties because of the very low population density. Within health care agencies, CHWs were permitted to enroll individuals from the health care agencies for the purposes of providing enhanced chronic disease self-management.

Community Health Worker Intervention

We created the program as a multicomponent intervention that integrated best practices from public health and health care to bridge divisions between the 2 paradigms. This was based upon our recognition that programs grounded in more than 1 theory and containing multiple levels of intervention are more likely to be successful.[17] Our CHWs used the transtheoretical model to assess a participant's readiness to change, which informed the type of conversation the CHW had with the participant. For participants who were at least thinking about change, CHWs used motivational interviewing techniques to focus the interaction on identifying the participant's values and goals to stimulate behavior change. The process of creating goals, setting achievable action plans, and monitoring of action plans via follow up calls was based upon the social cognitive theory.[17]

Although the overall program management was coordinated centrally by program staff in Denver, Colorado, all CHWs were hired locally by the host agency and had a designated direct supervisor on site. The CHWs were trained with



Note. CHW = community health worker.

FIGURE 1—Distribution of the Colorado Heart Healthy Solutions program throughout Colorado.

our standardized curriculum as previously described.[18] Additional CHD-specific content expertise was provided along with the core training and supplemented via monthly conference calls and Webinars. The CHWs also received formalized training in motivational interviewing techniques, which equipped them with the skills necessary to encourage individual behavior change.

At program entry, CHWs obtained written permission for participation. The CHW then performed health screenings, which included automated blood pressure (BP), weight, height using a stadiometer, and point-of-service finger-stick serum testing (Cholestech LDX, Inverness Medical, Hayward CA). Single cartridges measured serum glucose, total cholesterol, high-density lipoprotein (HDL) cholesterol, and triglycerides, and calculated low-density lipoprotein (LDL) cholesterol via the Friedwald estimation.[19] Before program rollout we validated the performance of the point-of-service lipid testing system and found excellent correlations with a standardized, simultaneous laboratory venous sample.[20] The CHWs also assessed health care access, health history, dietary intake, physical activity patterns, and knowledge of CHD risk before the initial screening.

We defined at-risk participants as any individual with an uncontrolled risk factor per national guidelines[21–23] or having an FRS of 10% or greater. The CHWs assessed behavioral activation measures[24] and used motivational interviewing techniques to provide counseling and to develop an action plan with the participant to promote healthy behaviors. This technique focused on reflective listening and participant values related to behavior change. At-risk participants also received medical referrals as well as information about available community lifestyle resources.

After the screening interaction, CHWs conducted a follow-up call approximately 2 weeks later to check on the status of referrals and action plans, and assist participants with overcoming any barriers. The frequency and timing of additional follow-ups were decided by the CHW and participant. Finally, participants were encouraged to return within 3 to 12 months after the initial screening for a retest visit. During retest visits, CHWs reassessed all risk factors and health status in a manner identical to the initial screening episode.

Outreach Screening and Referral Data System

The Outreach Screening and Referral (OSCAR) system (CPC Clinical Research, Aurora CO) is a software system that guided the CHW through the program framework described previously. In addition to collecting individual and community data, it provided decision support to CHWs and incorporated educational tools for participants. The OSCAR system consisted of a tablet computer interface for the CHWs in the field, a Web service for automatic synchronization between tablets and the master relational database, and a Web application for program administration and producing reports.

The data collection component of the system captured participant demographics, health care information, health history, dietary practices, physical activity levels, health goals, participant activation measures, and risk factor values. The decision support component of the OSCAR system incorporated these values to calculate the participant's FRS and generate standardized health messages based on national guidelines.[22–24] Finally, the OSCAR system graphically displayed the participant's FRS and any changes from previous interactions for the CHW to use as an educational tool with the participant.

Other key features of OSCAR included generating cues to CHWs when to refer individuals into medical care, guiding CHWs in assessing readiness for change and creating appropriate action plans, incorporating a scheduling system that prompted CHWs to call participants, and generating referral letters to local health care providers. OSCAR also managed a dynamic inventory of local clinics and healthy living resources such as nutrition programs, exercise classes, and smoking cessation resources. Information available to the CHWs regarding local clinics included capacity for new patients, provision of indigent care, and bilingual (Spanish) capacity.

Because data from the various sites were synchronized with a master database, we were able to track temporal changes in standardized health metrics at the individual, community, and overall program level. Despite program implementation in numerous remote partner agencies across Colorado, these design features facilitated monitoring of each community's performance, which subsequently informed identification of communities that need additional support.

Health Care Provider Educational Detailing

We based the identification of a physician champion in each community upon diffusion of innovations theory.[25] Physician champions were felt to be important to the program by promoting use of evidence-based therapies and providing traction for access to care among at-risk participants identified by CHWs. All program sites, whether public health or health care, designated a physician champion to accept referrals from the CHW and handle alert screening values.

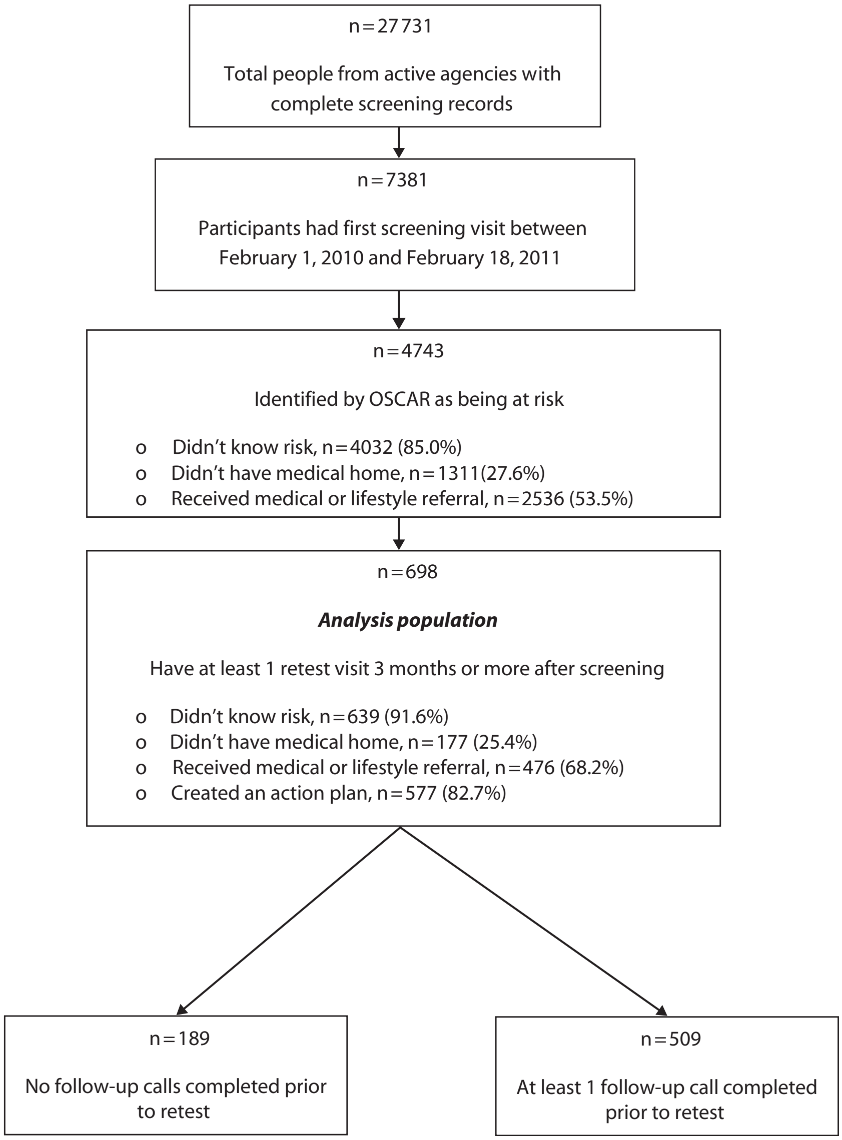
To ensure cohesion between CHWs and local health care providers, physician members of the program team performed periodic visits and education sessions with the 272 health care providers cataloged in the dynamic inventory. The first provider visit occurred shortly after a site joined the program. These visits included the following stakeholders: the local CHW(s), the CHW supervisor, office manager, agency executive director, and physician and midlevel providers. After completion of the initial visit we disseminated monthly electronic academic detailing given previous success utilizing this methodology to improve dyslipidemia care in Colorado.[26] Detailing included brief CHD case-based learning vignettes alternating with "fast facts" highlighting recent developments in CHD preventive care. Our detailing program derived some of its components from a public health detailing program used in primary care.[27] Components included education on CHD risk factor treatment, an action kit for site initiation visits including the Colorado State CHD guideline,[28] information on the validity of point-of-care lipid testing,[20] and reports on the numbers of participants navigated into care within their community.

Analysis

We estimated the 10-year risk of developing CHD by using the FRS,[29,30] which predicts cardiovascular events. The functions are based upon age, gender, total cholesterol and HDL cholesterol, systolic BP, treatment of hypertension, smoking, and diabetes status. When systolic BP measures were missing they were estimated from the participant's age and gender in the OSCAR system. When total or HDL cholesterol measurements were missing, an alternate function calculated FRS on the basis of body mass index (defined as weight in kilograms divided by the square of height in meters). If a participant reported a personal history of CHD, 10% was automatically added to the calculated FRS within the OSCAR system. For hypothesis testing, we considered 2-sided P values of $< .05$ to be significant. We used SAS version 9.2 (SAS Institute, Cary, NC) or higher for all analyses.

Baseline sociodemographic variables collected in the OSCAR system included age, gender, race, insurance, education, and employment status. Health characteristics pertaining to CHD risk including medication use and family history were collected. Participants were asked if they previously knew their risk of developing CHD, to rate their overall health, and report their exercise and diet habits for fiber and fat intake. We summarized demographic and health characteristics by using means and standard deviations for continuous variables and frequency distributions for the categorical variables. We compared sociodemographic variables between the group with no retest and those with a retest by using the 2-sample t test for continuous variables and the χ^2 test for categorical variables. We assessed program implementation by quantifying participants with a successful follow-up phone call before retest, medical and lifestyle referrals performed by the CHW, and site (public health or health care agency). We compared baseline and retest values for FRS and its component risk factors—including systolic BP, total cholesterol, and HDL cholesterol—by using a paired t test.

We considered the change from baseline in 10-year FRS the primary outcome and incorporated it into a multiple linear regression model. We did not include variables used in calculating the FRS in the model unless they were considered as possible interactions with other covariates. Covariates considered for inclusion in the model were age, gender, race, education, employment, follow-up phone call, site (public health or health care agency), change in systolic and diastolic BP, change in cholesterol, change in exercise habits, change in fiber intake, change in fat intake, change in blood glucose, and having received medical or lifestyle referrals at the screening visit. We tested covariates for colinearity by using correlation coefficients before inclusion in the model. We sequentially eliminated covariates individually from the model until all parameter and interaction estimated P values were less than 0.25. We computed least squares means and 95% confidence intervals (CIs) for categorical factors. The Tukey-Kramer method of adjustment for multiple comparisons was used for the CI calculations. Covariates that remained in the final regression model included age, gender, follow-up phone call, site, and the change from baseline in total cholesterol, systolic BP, diastolic BP, exercise habits, fiber intake, and fat intake. Significant interactions in the final model were gender–site, gender–follow-up phone call, age–follow-up phone call, age–change in fiber intake, change in systolic BP–exercise, change in total cholesterol–exercise, and change in total cholesterol–site.



Note. OSCAR = Outreach Screening and Referral system.

FIGURE 2—Flow of program participants including those screened, determined to be at risk for coronary heart disease, and those who received retesting and follow-up phone calls: Colorado Heart Healthy Solutions Program, 2010–2011.

TABLE 1—Demographics and Health Characteristics of Individuals at Risk of Coronary Heart Disease: Colorado Heart Healthy Solutions Program, 2010–2011

	At Risk No Retest (n = 4045), No. % or Mean ±SD (No.)	At Risk Retested (n = 698), No. % or Mean ±SD (No.)
Male gender*	1729 (42.7)	343 (49.1)
Age, y*		
18–34	567 (14.0)	56 (8.0)
35–49	1141 (28.2)	176 (25.2)
50–64	1576 (39.0)	316 (45.3)
65–98	760 (18.8)	150 (21.5)
Race/ethnicity		
White	2756 (68.1)	448 (64.2)
Hispanic	1015 (25.1)	192 (27.5)
Other	274 (6.8)	58 (8.3)
Education		
< high school or refused to answer	606 (15.0)	117 (16.8)
High-school graduate or GED	1094 (27.0)	215 (30.8)
Some college or technical school	1175 (29.0)	182 (26.1)
≥ college graduate	1170 (28.9)	184 (26.4)
Employment*		
Employed for wages or self-employed	2598 (64.2)	414 (59.3)
Retired	683 (16.9)	152 (21.8)
Unemployed, student, homemaker, unable, refused, or missing	764 (18.9)	132 (18.9)
Health insurance: uninsured	1178 (29.1)	191 (27.4)
County*		
Urban	1118 (27.6)	249 (35.7)
Rural	2292 (56.7)	323 (46.3)
Frontier	635 (15.7)	126 (18.1)
Site*		
Clinic	2064 (51.0)	292 (41.8)
Public health	1981 (49.0)	406 (58.2)
CHD risk factors		
Hypercholesterolemia*	1349 (33.3)	303 (43.4)
Medications for high cholesterol*	440 (10.9)	97 (13.9)
Previous diagnosis of CHD*	206 (5.1)	53 (7.6)
Hypertension*	1140 (28.2)	249 (35.7)
Medications for hypertension*	690 (17.1)	153 (21.9)
Family history of heart disease*	1082 (26.7)	213 (30.5)
Diabetes*	290 (7.2)	82 (11.7)
Medications for diabetes*	162 (4.0)	40 (5.7)
Family history of diabetes	1183 (29.2)	218 (31.2)
Current smoker*	651 (16.1)	78 (11.2)
Overall health		
Excellent	385 (9.5)	65 (9.3)
Very good	1366 (33.8)	227 (32.5)
Good	1643 (40.6)	282 (40.4)
Fair	556 (13.7)	105 (15.0)
Poor	66 (1.6)	13 (1.9)

Continued

RESULTS

The flow of screened participants and derivation of the analysis population is presented in Figure 2. A total of 27 731 individuals had complete screening records in the OSCAR database as of May 18, 2011. Iterative site initiation, OSCAR training, and compliance with protocols was felt to be accomplished across sites as of February 1, 2010, leaving 7381 participants who completed their screening between February 1, 2010, and February 18, 2011, representing the cohort evaluated after full program implementation. Among those, 4743 individuals were identified by the OSCAR system as being at risk for CHD. Participants who had a retest visit 3 months or more after screening were analyzed to assess changes in health outcomes, which yielded an analysis population of 698 at-risk individuals. We applied the missing data schemes for BP and cholesterol in the calculation of FRS to 6.4% of the analysis population. We applied the 10% upward adjustment on the basis of self-reported CHD history to 7.6% of the analysis population.

Table 1 shows the demographic and health characteristics for at-risk individuals with no retest (n = 4045) as well as at-risk individuals who were retested (n = 698). More than 25% of patients in both groups had no health insurance. Less than 10% of participants in both groups rated their health as excellent. Individuals retested were less likely (8.5% vs 16.1%) to know their risk of CHD. It is notable that there was a higher percentage of those in the retest group reporting that they were in the "action" stage of change (19.8% vs 15.5%). The retested group had a higher percentage of participants overweight or obese and was significantly more likely to receive a medical referral from the CHW at screening (60.9% vs 39.9%). The mean ±SD FRS for the retested group was 12.3% ±11.3% (minimum = 0.25%; maximum = 65.7%) whereas it was 9.4% ±9.8% (minimum = 0.13%; maximum = 65.4%) in the no-retest group ($P < .05$).

Univariate Results

Table 2 shows the changes in health characteristics after a mean ±SD follow-up of 8.3 ±2.9 months (range = 3.1–15.2 months). For the primary outcome, we observed modest, statistically significant reductions in FRS: –0.8% ±6.2% in the analysis population and

TABLE 1—*Continued*

Stage of change*		
Precontemplative	988 (24.4)	79 (11.3)
Contemplative	1308 (32.3)	241 (34.5)
Preparation	813 (20.1)	166 (23.8)
Action	627 (15.5)	138 (19.8)
Maintenance	309 (7.6)	74 (10.6)
Has knowledge of risk*	652 (16.1)	59 (8.5)
Serving of fiber (daily)		
≥ 5	645 (15.9)	101 (14.5)
1–4	2991 (73.9)	518 (74.2)
< 1	348 (8.6)	70 (10.0)
Servings of high-fat food		
Rarely or never	218 (5.4)	37 (5.3)
Once/wk	485 (12.0)	103 (14.8)
Few times/wk	1804 (44.6)	309 (44.3)
Once/d	1114 (27.5)	183 (26.2)
Several times/d	376 (9.3)	60 (8.6)
≥ 3 times/d	1323 (32.7)	213 (30.5)
Frequency of aerobic exercise, weekly		
1 or 2 times	800 (19.8)	165 (23.6)
Occasionally	726 (17.9)	128 (18.3)
Other	365 (9.0)	60 (8.6)
None	699 (17.3)	111 (15.9)
Unable	63 (1.6)	12 (1.7)
Body mass index,* kg/m^2		
Normal	1095 (27.1)	158 (22.6)
Overweight	1469 (36.3)	279 (40.0)
Obese	1252 (31.0)	244 (35.0)
Screening visit data		
Received medical referral*	1614 (39.9)	425 (60.9)
Received lifestyle referral	841 (20.8)	166 (23.8)
Systolic BP, mm Hg	129.0 ±17.4 (3908)	132.7 ±18.4 (677)
Diastolic BP, mm Hg	82.8 ±11.7 (3906)	83.6 ±11.1 (676)
HDL cholesterol, mg/dL	46.3 ±17.6 (3972)	44.3 ±17.2 (675)
LDL cholesterol, mg/dL	127.5 ±36.5 (3706)	131.5 ±36.1 (606)
Blood glucose,* mg/dL	108.6 ±38.6 (3981)	113.1 ±41.0 (681)
Framingham Risk Score,* %	9.4 ±9.8 (4045)	12.3 ±11.3 (698)

Note. BP = blood pressure; CHD = coronary heart disease; GED = general equivalency diploma; HDL = high-density lipoprotein; LDL = low-density lipoprotein.
*$P < .05$. Determined by t test or χ^2 test comparing groups.

–2.0% ±8.5% among those with an FRS greater than 10% at baseline. We also observed statistically significant improvements in total cholesterol, LDL cholesterol, systolic BP, and weight. In addition, we observed small, but significant increases in HDL cholesterol.

For all health parameters tested, those individuals considered uncontrolled in that parameter realized greater absolute improvements in clinical outcomes. Fat intake was reduced among 27% and increased in 13%. Similarly, fiber intake increased among 17.3% of the cohort and decreased in 5.8%. However, exercise frequency increased in only 14.1%, whereas 28.1% reported a decrease in frequency (data not shown).

Multivariate Results

Results from the multiple linear regression model revealed that participants receiving the follow-up phone call from a CHW before the retest had lower FRS scores at retest than those who did not receive a phone call ($P = .04$). Furthermore, we observed an interaction between receiving a CHW follow-up call and gender and age. Men without a follow-up call demonstrated an estimated mean increase in FRS of 1.7% (95% CI = 0.04, 3.35) whereas those older than 50 years (categories of 50–64 years and 65–98 years) who received a follow-up call had an observed decrease in FRS of –1.25% (95% CI = –2.28, –0.22) and –1.52% (95% CI = –3.00, –0.04), respectively.

Overall reductions in FRS did not differ significantly among participants enrolled in health care delivery facilities compared with local public health agencies ($P = .9$). Parameter estimates and least squares means resulting from the model are included in Table A (available as a supplement to this article at http://www.ajph.org).

DISCUSSION

To our knowledge, this program is the first to demonstrate that a CHW-based initiative can reduce 10-year CHD risk as measured by FRS. In addition to long-term CHD risk, this program also demonstrated statistically significant univariate improvements in dietary patterns, weight, BP, and cholesterol levels for those who returned for a follow-up visit. This extends the evidence that CHWs can improve individual CHD risk factors such as BP and glycemic control.[4,5] In a multiple linear regression model, change in FRS was similar regardless of geographic region and regardless of health care or public health setting. Furthermore, we observed that receipt of a phone call from the CHW following screening was associated with improvements in FRS at the follow-up visit. Among older men this phone call was associated with even greater improvements in FRS. As this demographic is generally at greatest absolute risk for developing atherosclerosis[29,30] this demonstrates the CHWs' ability to motivate behavior changes in high-risk populations. Overall, the proportion of participants with underlying hypertension, dyslipidemia, and diabetes was higher than the averages

TABLE 2—Change from Screening to Retest Among Individuals at Risk of Coronary Heart Disease: Colorado Heart Healthy Solutions Program, 2010–2011

Clinical Values	Participants Retested		Participants Retested With Abnormal Risk Factor[a]	
	Mean ±SD (No.)	P[b]	Mean ±SD (No.)	P[b]
Framingham Risk Score, %	−0.8 ±6.2 (691)	< .001	−2.0 ±8.5 (326)	< .001
Body mass index, kg/m^2	−0.1 ±2.0 (626)	.12	−0.3 ±2.1 (478)	.008
Weight, kg	−1.1 ±10.9 (631)	.01	−2.0 ±10.3 (479)	< .001
Systolic BP, mm Hg	−3.8 ±17.2 (652)	< .001	−14.7 ±20.6 (196)	< .001
Diastolic BP, mm Hg	−2.3 ±10.7 (649)	< .001	−9.3 ±11.7 (174)	< .001
Total cholesterol, mg/dL	−7.5 ±34.1 (679)	< .001	−15.3 ±34.9 (421)	< .001
HDL cholesterol, mg/dL	1.9 ±12.1 (653)	< .001	5.4 ±11.2 (358)	< .001
LDL cholesterol, mg/dL	−7.4 ±33.7 (561)	< .001	−18.3 ±34.2 (300)	< .001

Note. BP = blood pressure; HDL = high-density lipoprotein; LDL = low-density lipoprotein.
[a]Abnormal or uncontrolled risk factors: Framingham Risk Score > 10%; body mass index > 25 kg/m^2; systolic BP > 140 mm Hg; diastolic BP > 90 mm Hg; total cholesterol > 200 mg/dL; HDL for men < 40 mg/dL; HDL for women < 50 mg/dL; LDL > 130 mg/dL.
[b]*P* values from paired *t* test testing the null hypothesis that the change from screening to retest value is equal to zero.

for the State of Colorado Survey,[31] suggesting that this intervention appropriately targeted a population in need of services.

Although the results reported herein are preliminary, these findings suggest that a CHW operating within both public health and clinical sites has the potential to improve CHD risk factor control. Although further exploration of causal factors related to differential health outcomes within these 2 settings is needed, implementation of a statewide CHW-led intervention with centralized management seems clearly feasible. The program is innovative in operating within a community yet emphasizing close ties to the health care delivery system. By integrating a process of physician buy-in from inception and fostering inclusion through academic detailing, physicians become part of a stakeholder group necessary for ongoing community–clinic linkages.

The OSCAR software system was designed to integrate public health and primary care by incorporating several essential public health services with evidence-based clinical care. At the participant level, OSCAR enabled monitoring of health status by tracking individuals' risk factors and facilitating CHW counseling by providing risk-appropriate health recommendations based upon national guidelines. Most tools that assess FRS have been designed specifically for use in the clinic setting.[32] By creating algorithms that translated FRS and the individual's risk factors into customized health messages, the FRS was successfully utilized by CHWs outside the clinic setting to identify those at risk and refer them for medical care. On the community level, the OSCAR system fostered evaluation of overall program effectiveness and allowed for ongoing updates of individual community resource inventories. Finally, the design of the overall program was informed by a team that consisted of both public health and health care professionals who engaged local stakeholders to tailor the program to the culture and needs of the community. This type of blended infrastructure including centralized and local leadership may provide a template for improving population health in the era of health care reform.

Limitations

A number of factors should be considered when one is interpreting the results of this program. The current evaluation represents a pilot investigation into a complex multicomponent public health intervention. Because the program has many embedded elements it is difficult to discern the contribution of each program component to the observed improvement in outcomes. This limitation was partially addressed in the regression model by including the follow-up phone call, site type, and receipt of medical or lifestyle referrals as surrogates for the program components. Nonetheless, most successful health improvement programs are effective precisely because they have multiple components that have an adequate impact on the determinants of health.[33] Another important issue relates to dissemination and adoption of the program outside Colorado. Full adoption by CHWs of the software system required ongoing training and technical support and was not well suited to large-scale screening events in frontier counties, which required data input after completion of the event.

We acknowledge that the 698 participants in the analysis group consist of only 15% of the 4743 participants identified as at risk for CHD and are a self-selected population. Therefore, results of this study cannot simply be extended to a larger population. The program was voluntary and resources to aggressively pursue participants not retested were limited. Moreover, many individuals were referred into medical care and lifestyle resources potentially limiting their enthusiasm for duplicating services via a subsequent retest visit. However, we are encouraged that those who returned for retesting had a higher baseline FRS and were less likely to know their risk of CHD at baseline. This suggests that our program was successful at reaching those individuals most vulnerable to developing CHD.

One final consideration was utilization of the traditional FRS[29] that assessed a standard 10-year risk of developing CHD. We also utilized a broader cardiovascular disease risk profile (including death, myocardial infarction, angina, stroke, transient ischemic attack, peripheral arterial disease, and heart failure) for imputation,[30] which may be more applicable to ethnic minorities and the poor who are at greater risk of developing noncoronary atherosclerosis.[11] However, we did not employ this formula for final calculation of global risk because of the much greater proportion of individuals it would have identified as being at risk for developing cardiovascular events.

Conclusions

A CHW-based program that integrates both public health and primary care practices across urban, rural, and frontier counties has the potential to improve CHD risk factor control.

The program highlighted herein was tailored to meet the needs of the individual community by the locally hired CHW; however, core components of the intervention were consistent across all sites and geographic regions in the state of Colorado. Frieden et al. have emphasized the importance of public health programs gaining strength in 3 key functional areas: information systems, communications, and policy.[34] Our OSCAR system provided point-of-service decision support and administrative functions that were scalable and potentially applicable to other community-based health improvement programs in the United States. There is also a growing need to provide longitudinal follow-up to demonstrate the effectiveness of public health programs. The outreach component of our program raised awareness within local communities and fulfilled the need for public communication. This also dovetails with the current, constitutionally directed funding mechanism in Colorado and highlights the importance of public will building for policies that promote integrated disease prevention programs. Next steps include linking the OSCAR data system with existing electronic medical records systems at clinic sites to promote integration between public health and health care delivery systems. In addition, increasingly utilizing CHWs to provide self-management training to existing patients with chronic diseases will facilitate accreditation of community health centers as patient-centered medical homes. ■

About the Authors

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M. J. Krantz and E. M. Whitley conceptualized and designed the program and drafted the original article. M. J. Krantz performed multiple article revisions. R. O. Estacio, S. M. Coronel, and J. Yost provided substantial input to analysis and writing. R. Dale performed all statistical analyses, participated in editing the article, and assisted with the article's multiple revisions.

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Human Participant Protection

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