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To cite this article: Frances Feltner DNP, MSN, RN, FAAN, Sydney Thompson MS, William Baker RN, BA & Melissa Slone MSW, CSW (2016): Community health workers improving diabetes outcomes in a rural Appalachian population, Social Work in Health Care

To link to this article: http://dx.doi.org/10.1080/00981389.2016.1263269

Published online: 15 Dec 2016.
Community health workers improving diabetes outcomes in a rural Appalachian population

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ABSTRACT
Community health workers (CHWs) play a key role in the emerging health infrastructure. They are successful in identifying individual or family needs and matching resources to help overcome the social determinants of health, and the lack of trust in the health care system. This study captures the CHW experience as research assistants and evaluates the effectiveness of CHWs’ health coaching and support in improving diabetes health outcomes. By being immersed in the culture and values of the population, CHWs offer research support to assure more representative client samples, increased adherence to study protocols, and in reducing attrition rates.

Background and significance
The number of Americans diagnosed with diabetes has quadrupled during the past three and a half decades (1980–2014), from 5.5 to 22.0 million (Centers for Disease Control and Prevention, 2014a). The Centers for Disease Control and Prevention (CDC) reported in 2014 that 29.1 million people, or 9.3% of the U.S. population, has been diagnosed with diabetes, another 8.1 million people (27.8%) have been undiagnosed (CDC, 2014b).

Lifestyle choices (i.e., obesity, physical activity, diet, and stress) (Regensteiner, Reusch, Stewart, & Veves, 2009), environmental factors (i.e., unhealthy foods, barriers to physical activities, and social isolation) (Johnson et al., 2007), inadequate health insurance (Patel, Piette, Resnicow, Kowalski-Dobson, & Heisler, 2016), and general lack of understanding of the healthcare system (Ferguson et al., 2015) are often cited as contributing to the increase in diabetes. In 2012, almost half of the adults in the United States had one or more chronic health conditions, with ethnic minorities and the poor overwhelmingly represented (Brownstein et al., 2007; Ward, Schiller, & Goodman, 2014).
Kentucky ranks fifth in America’s poorest states, with the median household income $42,958 and a poverty rate of 19.1% (Mekouar, 2015). According to the United States Department of Agriculture Economic Research Service data, an average of 2,176 people live at least a mile away from a food access point. Furthermore, on average, 59 people live at least 10 miles away from food access (United States Department of Agriculture Economic Research Service, 2016). Exercise opportunities in Appalachia are also limited. Behavioral Risk Factor Surveillance System (BRFSS) data (University of Wisconsin Population Health Institute, 2016) reveals only 54% of people living in Appalachia have access to exercise opportunities (defined as a person residing within three miles of a recreational facility) and 70% of Kentuckians on average have access to a recreational area.

In Kentucky, one in eight adults have been diagnosed with diabetes nearly doubling the rate from 6.5% in 2000 to 12.5% in 2014 (KY Public Health, 2016). Sixty-eight of Kentucky’s 120 counties are located within the “diabetes belt.” According to the 2016 KY Health Rankings Data 14% of the population within “diabetes belt” counties have diabetes (University of Wisconsin Population Health Institute, 2016). Forty-five percent (54 out of 120) of Kentucky counties are considered to be part of Appalachia and 42% (50 out of 120) are part of the “diabetes belt.”

Community health workers (CHWs) have been cited as being a cost-effective strategy to help the underserved with managing chronic disease in the home and community setting (Institute of Medicine, 2003). CHWs cultivate connections with individuals suffering from chronic diseases in their own communities, which contributes to being able to communicate openly with patients about their needs and ultimately improving health outcomes and the ability to navigate the health care system (Laderman & Mate, 2015).

Kentucky was one of the first States to develop and implement a CHW program. More than 20 years ago, Kentucky Homeplace (KHP) was developed as a unique model utilizing CHWs to reach the most at-risk population. The well-established program employs CHWs from a multi-county region of Appalachia Kentucky to help clients identify risk factors and learn preventative measures to become a healthier population. As trusted and valued members of their own communities, CHWs facilitate communication between their clients and the clients’ primary care providers and help clients understand and effectively comply with medical care instructions. Through health coaching, CHWs support clients to improve their health behaviors, such as improved nutrition, increased physical activity, better weight management, smoking cessation, and improved diabetes self-management.

In the last 5 years, KHP CHWs have become much more involved in supporting community-based research, including studies of risk reduction for colorectal cancer, lung cancer, and cardiovascular disease, as well as studies for improving diabetes outcomes. CHWs have become skilled in
identifying and enrolling hard-to-reach study subjects according to Internal Review Board (IRB) provisions, collecting background and measurement data using computer database programs, and providing overall research support.

**Methods and design**

Seventeen CHWs were trained to administer the study measures, provide coordination for the nurse educator, and to answer questions and provide supporting educational materials after clients received the intervention. The project time line of the Improving Diabetes Outcomes Phase I (I DO) study was July 1, 2011 through June 30, 2012.

Data from the KHP web-based database was used to identify and describe potential study participants. The database includes client demographic information and responses to interview items based on the Behavioral Risk Factor Surveillance Survey (CDC, 2011) and special studies. CHWs collect and enter data at client intake and during updates on an ongoing basis.

The population included participants residing in 26 counties located in Southeastern Kentucky. The inclusion criteria for the study were KHP clients who were age 18–65 when completing their initial screening, were English speaking, and reported they had been diagnosed with diabetes by a health care professional. Kentucky Homeplace CHWs completed 3,217 initial assessments to screen clients to determine if they meet the inclusion criteria prior to the study starting date of July 1, 2011. Out of those screened, 983 (30.6%) clients had been told by a provider that they have diabetes. Women who were diagnosed with diabetes during pregnancy were not eligible.

Those clients, who met the inclusion criteria, were able to enroll on a first come basis up to the cutoff of the sample size of 495 (50%). These clients signed the IRB consent to participate in the study. After dropouts and disqualifications for failure to keep appointments, 215 clients were included in the study.

All participants completed each nurse education-screening visits. They all received the CHW health coaching home visits to repeat the nurse education materials and to preview the next nurse education materials on diabetes self-management education. All participants completed all pre- and post-test surveys and clinical outcome measures (height, weight, to calculate their BMI, blood pressure, random glucose level, foot check, medication review, and HbA1c). The CHWs collected demographic and background data including age gender, marital status, level of education, income, federal poverty level, health insurance status, visits to diabetes educators, and New Vital Sign (NVS) (Weiss et al., 2005) test of health literacy levels. The CHWs also administered the Diabetes Knowledge Test (DKT) (Fitzgerald et al., 1998), Diabetes Empowerment Scale-Short Form (DES-SF) (Anderson, Fitzgerald, Gruppen, Funnell, & Oh, 2003), and the Summary of Diabetes
Self-Care Activities (SDSCA) (Toobert, Hampson, & Glasgow, 2000) measures pre- and post-Diabetes Self-Management Education (DSME) (Funnell et al., 2008) intervention. To remove the barrier of transportation, participants received a $25 gas card to attend the nurse education group sessions and a $10 gift card to complete the health coaching session with the CHW.

At the end of one year, the 215 participants were invited to complete their 1-year follow-up. Of the 215 original participants, 137 (63.7%) returned to complete the nurse visit and post-test screenings.

Statistical analysis

A single-group pretest and post-test design was used to test the efficacy and outcome of the intervention. Frequencies, cross tabulations, and mean comparison tests were used to analyze demographic and background variables. Paired-means t-tests were used to examine the relationships between measures administered at baseline and post-test. Statistical Package for the Social Sciences (Version 23) was used for all statistical analysis.

Results

Demographics

CHWs successfully screened, enrolled, and obtained consent for 215 participants. The study group was predominately female (65.1%), middle-aged (M = 56.83 years old), married (60.9%), poorly educated (77% have a high school diploma or less education), 45.6% in poverty, 58.1% without health insurance, 68.8% report never having visited a diabetes educator, and 43.7% with the possibility of limited health literacy (see Table 1).

Community health workers outcomes

CHWs were effective members of the research team in a hard-to-reach, Appalachian population. As discussed in the methods section, CHWs approved 495 participants to be in the study. Of those 495, 215 participants completed the study. At the 1-year health measure follow-up, 137 of the original 215 participated, an attrition rate of 36.3%.

Diabetes Care Profile findings

Participants completed the Diabetes Care Profile before the DSME intervention. Out of the total 215 participants, 89.6% report testing their blood sugar, 71.9% report testing their blood sugar 7 days a week, 79.5% report testing 2–3 times a day, and 53.7% report keeping a record of their blood sugar test results.
When asked about receiving nurse-led education, 74.9% reported they had received education from a care provider about foot care, exercise programming (77.1%), and meal planning (76.5%). However, when asked the question “Have you ever received diabetes education?” 57.2% of participants reported “No.”

Participants report most of the help they receive in caring for their diabetes comes from spouses (35%), other family members (24.1%), health care provider (16.2%), and no one (19.9%).

A series of questions are used to assess how participants feel diabetes negatively affects their lives. The following percentages represent aspects of daily living affected by diabetes: Having enough money (57%), meeting school, work, household, and other responsibilities (42.1%), going out or traveling (48.1%), being active (53.2%), eating foods I like (81.4%), eating as much as I would like (74.7%), and keeping a schedule (64.08%). Participants also reported paying for diabetes treatment and supplies is a problem (71.3%) and 58% of participants report having diabetes makes life difficult.

Adherence to diet is assessed within the Diabetes Care Profile; 78% of participants report having been told to follow a meal plan by a health care provider; however, 82% of those participants report they sometimes or never follow a meal plan.

Changes in diabetes knowledge, self-care skills, and empowerment pre-/post-test results: Individuals took the pretest and 85 (45%) of those additionally took the post-test. In summary, during 2005 and 2006, a total of 173 individuals completed the individuals took the pretest and 85 (45%) of those additionally took the post-test. In 2006, 218 individuals took the pretest and 88 (40%) of those additionally took the post-test. A total of 215 individuals completed the DKT, Self-Care Diabetes Activities Scale, and the Diabetes Empowerment Scale pre- and post-DSME intervention provided by CHWs (see Table 2).

### Table 1. Demographic characteristics of study participants.

<table>
<thead>
<tr>
<th>Category</th>
<th>n   (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>76 (35.3%)</td>
</tr>
<tr>
<td>Female</td>
<td>139 (65%)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>&gt;30</td>
<td>4 (2%)</td>
</tr>
<tr>
<td>30–44</td>
<td>17 (8%)</td>
</tr>
<tr>
<td>45–60</td>
<td>115 (53.5%)</td>
</tr>
<tr>
<td>61+</td>
<td>79 (37%)</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
</tr>
<tr>
<td>Some high school or lower</td>
<td>37 (17%)</td>
</tr>
<tr>
<td>High school graduate</td>
<td>102 (47%)</td>
</tr>
<tr>
<td>Some college</td>
<td>38 (18%)</td>
</tr>
<tr>
<td>College graduate</td>
<td>11 (5.1%)</td>
</tr>
<tr>
<td><strong>Insured</strong></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>90 (42%)</td>
</tr>
<tr>
<td>No</td>
<td>125 (58%)</td>
</tr>
</tbody>
</table>

*Note. All categories do not total 215 because of missing data.*
Outcome 1: Change in feeling of empowerment concerning diabetes:

There was a significant increase on the item “In general, I believe that I can ask for support for having and caring for my diabetes when I need it” from pretest ($M = 4.00, SD = 1.071$) to post-test ($M = 4.19, SD = .870$); $t(169) = 1.99, p = 0.048$.

Outcome 2: Changes in self-care activities:

A significant increase from baseline ($M = 2.21, SD = 2.441$) to post-test ($M = 2.99, SD = 2.443$) was observed on the item “On how many of the last 7 days did you participate in at least 30 minutes of physical activity?” ($t(162) = 3.59, p = 0.000$).

Participants also increased significantly on the item “On how many of the last 7 days did you participate in a specific exercise session (such as swimming, walking, biking) other than what you do around the house or as part of your work?” from pretest ($M = 1.80, SD = 2.460$) to posttest ($M = 2.64, SD = 2.452$); $t(164) = 3.85, p = 0.000$.

An increase on the item “On how many of the last 7 days did you check your feet?” was significantly more from baseline ($M = 4.88, 2.658$) to follow-up ($M = 5.46, SD = 2.202$); $t(164) = 2.58, p = 0.011$.

Pretest ($M = 2.79, SD = 3.186$) to post-test ($M = 3.57, SD = 2.865$) on the item “On how many of the last 7 days did you inspect the inside of your shoes?” was significantly increased ($t(164) = 2.72, p = 0.007$).

Outcome 3: Changes in diabetes knowledge:

A significant increase from pretest diabetes knowledge ($M = 65.91, SD = 18.14$) to post-test diabetes knowledge ($M = 73.64, SD = 14.25$) significantly increased ($t(183) = 5.26, p = 0.000$).

### Table 2. Pre post DSME intervention outcomes.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Baseline $M$ (SD)</th>
<th>Follow-up $M$ (SD)</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empowerment ($n = 170$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“In general, I believe that I can ask for support for having and caring for my diabetes when I need it”</td>
<td>4.00 (1.07)</td>
<td>4.14 (.87)</td>
<td>0.048</td>
</tr>
<tr>
<td>Self-care ($n = 165$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“On how many of the last 7 days did you participate in at least 30 minutes of physical activity?”</td>
<td>2.21 (2.44)</td>
<td>2.99 (2.44)</td>
<td>0.00</td>
</tr>
<tr>
<td>“On how many of the last 7 days did you participate in a specific exercise session?”</td>
<td>1.80 (2.46)</td>
<td>2.46 (2.45)</td>
<td>0.00</td>
</tr>
<tr>
<td>“On how many of the last 7 days did you check your feet?”</td>
<td>4.88 (2.66)</td>
<td>5.45 (2.20)</td>
<td>0.011</td>
</tr>
<tr>
<td>“On how many of the last 7 days did you inspect the inside of your shoes?”</td>
<td>2.79 (3.19)</td>
<td>3.57 (2.87)</td>
<td>0.00</td>
</tr>
<tr>
<td>Diabetes knowledge ($n = 184$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total score on DKT</td>
<td>65.91 (18.14)</td>
<td>73.64 (14.25)</td>
<td>0.000</td>
</tr>
<tr>
<td>A1 C ($n = 214$)</td>
<td>7.76 (1.90)</td>
<td>7.42 (1.65)</td>
<td>0.000</td>
</tr>
</tbody>
</table>
**Health outcomes**

Participants’ BMI, weight, and A1 C were measured at baseline and at the six-month follow-up. No differences were observed in BMI or weight from pre- to post-test. However, there was a significant decrease in A1 C from pretest \(M = 7.76, \text{SD} = 1.90\) to post-test \(M = 7.42, \text{SD} = 1.65\), \(t(214) = -4.059, p = 0.000\).

**Discussion**

Completing a study in rural Appalachian counties can be challenging due to many different barriers. These barriers can include a lack of telephone or internet service to maintain contact, inadequate transportation or the ability to pay someone to bring them to the appointment, and sometimes just an overall reluctance to keep appointments.

By being immersed in the culture of clients whom they serve and being aware of their values and special needs, CHWs offer research support that helps assure more representative client samples for health studies, increased adherence to study protocols, and less likelihood of withdrawal from studies. CHWs also help clients benefit directly from participating in health studies by giving the time required for successful health coaching and they are pivotal in aiding clients who often are characterized by low levels of education and health literacy by reinforcing health education concepts.

Notably, the study’s population was comprised of individuals with diabetes and low health literacy levels. Most participants reported they had received education on following foot care, exercise, and meal planning but reported they had not received any sort of diabetes education from a health care provider. Although clients receive diabetic education, low health literacy seems to negate perceiving it as being education. Scores on the DKT increased significantly from time of pretest to post-test suggesting the CHW DSME intervention was effective and received by the study population as “diabetes education.” The significant decrease on A1 C at the 6-month health measures follow-up suggest CHWs providing the DSME education made a lasting impression on the participant.

With a workforce shortage of Certified Diabetes Educators and an overwhelming need for diabetes education, the health care system must adopt more cost-effective and coordinated efforts that will enable the health care team to reach these vulnerable clients. CHWs may be the answer to bridging the gap in delivering diabetes self-management education. Using people from the communities they serve will give the advantage of cultural competency and appropriate literacy education for their communities (Rosenthal et al., 2010). CHWs have demonstrated success in providing outreach and serving as advocates for their communities. “Community health workers offer
important contributions that have the potential to enhance the quality of care and health status of the U.S. population and to eliminate heart disease and stroke disparities” (Brownstein et al., 2005).

Acknowledgments

The authors would like to thank Elmer Whitler for his service to KHP and his guidance and dedication to the community health workers. Also, the authors would like to recognize the community health workers for their commitment to the project, KHP, and for bettering the lives of the people of Appalachia.

Funding

This effort was in partnership with the University of Kentucky Center of Excellence in Rural Health, the Kentucky Cabinet for Health and Family Services Department of Public Health and the Anthem Foundation.

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