**Behavioral Interventions to Improve Glycemic Control in African Americans with Type 2 Diabetes: A Systematic Review**

**Objective:** The use of behavioral interventions has been shown to improve glycemic control, however, the effectiveness of different behavioral interventions in one of the most high risk populations, African Americans, remains unclear. Our systematic review identified and examined findings of published behavioral interventions targeted at African Americans to improve glycemic control. The goal of our study was to distinguish which interventions were effective and identify areas for future research.

**Design:** Medline, PsychINFO, and CINAHL were searched for articles published from January 2000 through January 2012 using a reproducible strategy. Study eligibility criteria included interventions aimed at changing behavior in adult African Americans with type 2 diabetes and measured glycemic control.

**Results:** Ten studies met the inclusion criteria, of which five showed a statistically significant change in HbA1c in the intervention group when compared to the control group. Summary information and characteristics of the reviewed studies are provided.

**Conclusions:** Characteristics of successful interventions included using problem solving with the patient, culturally tailoring the intervention, and using a nurse educator. Limitations include the limited number of intervention studies available using glycemic control as the outcome measure. Clinical trials are needed to determine how best to tailor interventions to this largely underserved population and studies should describe details of cultural tailoring to provide information for future programs. (Ethn Dis. 2013;23[4]:401–408)

**Key Words:** Diabetes, Glucose Control, African Americans, Ethnic Groups, Lifestyle

---

Rebekah J. Walker, MS; Brittany L. Smalls, MHSA; Heather Shaw Bonilha, PhD, CCC-SLP; Jennifer A. Campbell, BS; Leonard E. Egede, MD, MS

**Introduction**

**Ethnic Differences in Burden of Diabetes**

Diabetes affects 25.8 million people, or 8.3% of the United States population, and is the seventh leading cause of death in the United States. It is the leading cause of kidney failure, non-traumatic lower-limb amputations, new cases of blindness among adults, heart disease and stroke. Ninety percent of all cases of diabetes are categorized as type 2 diabetes (T2DM). Overall estimated cost in the United States in 2007 was $174 billion and is predicted to increase to $192 billion by 2020. Prevalence rates are steadily increasing and it is estimated that globally, by 2030, 522 million people will be diagnosed.

Due to the prevalence and economic burden of diabetes, it is considered one of the most challenging health problems of the 21st century. While T2DM is a concern for all racial and ethnic groups, ethnic minorities show an increased prevalence, risks of complications, and mortality. Compared to non-Hispanic White (NHW) adults, the risk of diagnosed diabetes is 77% higher among non-Hispanic Blacks (NHB), 66% higher in Hispanic/Latinos, and 18% higher in Asian Americans. Once diagnosed, African Americans are 2.6 times more likely to develop end-stage renal disease and more likely to undergo a lower-limb amputation. Additionally, the average life years lost by diagnosis for NHB women is 12 years and NHB men is 9.3 years.

Evidence suggests that minority populations tend to have poorer self-management and outcomes as compared to NHWs, increasing the already disproportionate burden of disease and adding to the disparity in diabetes related complications. African Americans in particular tend to exhibit worse outcomes, including glycemic control, when compared to other minority populations and NHWs.

**Impact of Lifestyle Changes**

Lifestyle changes such as exercise, diet, and medication adherence have been shown to alter the course of disease progression through improving glycemic control. Reduced risk of diabetes-related complications, including nephropathy and myocardial infarction have been shown to be associated with HbA1c <7%. However, while a person’s cultural context has the potential to impact their self-management, studies have not adequately targeted minorities.

Previous reviews have shown that the most successful interventions are aimed at changing behavior rather than knowledge. Using behavioral interventions has been shown to improve glycemic control and quality of life in patients with T2DM. Nevertheless, there are still gaps in understanding the effectiveness of different behavioral interventions in African Americans and which aspects are most significant.

To our knowledge, no review exists providing information on interventions in African Americans; we, therefore, conducted a literature review to systematically
We conducted a literature review to systematically examine the results of published articles to answer whether behavioral interventions targeted at African Americans are effective at improving glycemic control.

Methods

Information Sources, Eligibility Criteria and Search

Three databases (Medline, PsychInfo, and CINAHL) were searched for articles published from January 2000 through January 2012 using a reproducible strategy. Three searches with broad search terms were performed in each database using MeSH headings search. The first search used the MeSH headings diabetes and ethnic groups, the second used diabetes and lifestyle, and the third used diabetes and community.

The following inclusion criteria were used to identify eligible study characteristics: 1) published in English, 2) targeted African American adults, aged ≥18 years, 3) described an intervention, 4) the intervention was aimed at changing behavior, and 5) the intervention measured change in glycemic control as determined by HbA1c. For the purposes of this review, an article was considered to have targeted African Americans if at least 70% of the sample were Black or African American. Studies were classified as behavioral interventions if they focused on modifying one or more diabetes-relevant behaviors including diet, physical activity, self-monitoring, medication adherence, smoking, weight loss or stress/coping. Glycemic control was chosen as a required outcome measure because it is associated with successful self-care behaviors and lower rates of disease progression.¹

Study Selection and Data Collection

The process used to screen the citations is shown in Figure 1. Titles and abstracts were eliminated if they were obviously ineligible, for instance describing Type 2 diabetes, gestational diabetes, diabetes prevention studies or targeting ethnic groups other than African Americans. Full articles were read and reviewed using a standardized check-list by two independent reviewers (RW, BS). A senior topic expert (LE) acted as a third independent reviewer and made the final decision regarding eligibility in the case of disagreement.

Data collected from the eligible articles are shown in Tables 1–4. Since there were few intervention studies that targeted African Americans available, we included Randomized Controlled Trials (RCTs) and quasi-experimental studies, with and without a control arm. Data was extracted on the number of participants, sample population, duration of intervention, setting of intervention, study design, type of control, major findings, and limitations for the study (Table 1). An outcome table was created to include the mean baseline HbA1c, mean change (or baseline and post intervention if not reported), and statistical significance (Table 2). Details of the interventions are presented including theoretical basis, intervention description, and follow-up (Table 3). Each article was also analyzed for relevant intervention characteristics, including whether it was culturally tailored, included one-on-one counseling, group counseling, or telemedicine, involved nurse or diabetes educators, focused on nutrition or supervised exercise, and allowed for problem solving with the patient (Table 4). A narrative review was performed as the heterogeneous interventions and diverse study designs precluded conducting a meta-analysis. Though risk of bias exists, articles were not excluded due to the limited evidence available in the literature. The risk of bias across studies is discussed in the limitations.

Results

Study Selection

Figure 1 shows the results of the search. After duplicates were removed, the search resulted in 9,233 citations. Title review produced 1,362 abstracts to examine, after which 39 articles were determined eligible for full article review. Ten eligible studies were identified based upon the predetermined eligibility criteria.¹⁵⁻²⁴

Study Characteristics and Results of Individual Studies

Tables 1 and 2 provide a summary of the 10 studies that met eligibility criteria. Sample sizes ranged from 23 to 1,665, intervention duration ranged from 6 weeks to 5 years, and mean baseline HbA1c ranged from 7.58 to 10.8. Three of the studies focused on urban/inner-city population,¹⁵,¹⁷,²¹ and two focused on rural populations.¹⁶,¹⁹ Five included only African Americans,¹⁵⁻¹⁷,²²,²³ four included predominantly African Americans,¹⁸⁻²¹ and one analyzed the African American population separately from other ethnic/racial groups.²⁴ Six of the 10 were RCTs,¹⁵⁻²⁰,²²,²³ three were quasi-experimental,¹⁶,²¹,²³ and one was a time-series.²² Eight of the 10 studies used a control group.¹⁵⁻²⁰,²²,²⁻²⁶ Of these eight, four reported statistically significant improvements in HbA1c in the intervention
group compared with the control.\textsuperscript{17–19,22} Of the two studies without a control group, one reported statistically significant change in HbA1c.\textsuperscript{16}

Intervention characteristics of the 10 studies are provided in Tables 3 and 4. Three studies used an empowerment theoretical basis,\textsuperscript{15,20,22} one used motivational interviewing,\textsuperscript{19} one used health beliefs model,\textsuperscript{18} two used transtheoretical model,\textsuperscript{18,23} two used health promotion,\textsuperscript{21,23} one used nursing case-management\textsuperscript{16} and one used coordinated service delivery.\textsuperscript{17} Five of the 10 studies specifically stated being culturally tailored.\textsuperscript{15–18,20} Seven provided one-on-one counseling,\textsuperscript{17–20,22,23} five provided group counseling,\textsuperscript{15,16,18,20,21} and four were delivered through telemedicine.\textsuperscript{17–19,24} Nine of the 10 interventions involved problem solving with the patient, through development of action plans or question based discussion.\textsuperscript{15–19,21–24} Six used nurse educators,\textsuperscript{15–19,21} five used certified diabetes educators,\textsuperscript{15,18,21,22,24} four used dieticians,\textsuperscript{16,20,21,23} and four provided information to the patient’s provider.\textsuperscript{16,17,22,24}

Five of the studies were statistically significant. Of these, five involved problem solving, three were culturally tailored,\textsuperscript{16–18} four used a nurse educator,\textsuperscript{16–19} two used a certified diabetes educator,\textsuperscript{18,22} one used a dietician,\textsuperscript{16} and three provided information to the provider.\textsuperscript{16,17,22} Statistically significant results were found in three of the four telemedicine interventions,\textsuperscript{17–19} two of the five group counseling interventions,\textsuperscript{16,18} and four of the seven one-on-one counseling interventions.\textsuperscript{17–19,22}

\textbf{DISCUSSION}

\textbf{Summary of Evidence}

This systematic review identified effective behavioral interventions in African Americans with T2DM based
<table>
<thead>
<tr>
<th>Study Author, Year</th>
<th>Participants (Completed)</th>
<th>Sample Population</th>
<th>Intervention Duration</th>
<th>Intervention Setting</th>
<th>Study Design</th>
<th>Type of Control</th>
<th>Major Findings</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson, 2005</td>
<td>239 Urban African American</td>
<td>6 weeks</td>
<td>Community based location</td>
<td>RCT pretest / posttest</td>
<td>Wait list (standard care)</td>
<td>No difference between control and intervention except diabetes understanding; positive pre/post changes in HbA1c</td>
<td>Volunteer bias; effects of providing study data to patients</td>
<td></td>
</tr>
<tr>
<td>Anderson-Loftin, 2002</td>
<td>23 (16) Rural African American</td>
<td>5 months</td>
<td>Rural SC</td>
<td>Longitudinal quasi-experimental</td>
<td>None</td>
<td>Intervention was effective in improving HbA1c, costs and dietary habits</td>
<td>Small sample size; no control</td>
<td></td>
</tr>
<tr>
<td>Carter, 2011</td>
<td>74 (47) Inner city African American</td>
<td>9 months</td>
<td>Online</td>
<td>RCT</td>
<td>Standard care</td>
<td>Effective telehealth intervention; increase in self-care, mental and physical well being</td>
<td>Access to internet; cost; small sample; ability to read</td>
<td></td>
</tr>
<tr>
<td>Davis, 2010</td>
<td>165 Low-income, overweight, predominantly African American</td>
<td>1 year</td>
<td>Telehealth, community health center</td>
<td>RCT</td>
<td>Standard care – 20-min education session</td>
<td>Effective multicomponent telehealth strategy to rural and underserved populations</td>
<td>Only federally qualified health care setting</td>
<td></td>
</tr>
<tr>
<td>Hawkins, 2010</td>
<td>77 (66) Rural, predominantly African American</td>
<td>6 months</td>
<td>Videophone</td>
<td>RCT</td>
<td>No reminder calls; good health handouts; 5-min monthly calls</td>
<td>Access to individualized diabetes education; all improved HbA1c</td>
<td>Sample size limited; technology needs to fit audience</td>
<td></td>
</tr>
<tr>
<td>Mayer-Davis, 2004</td>
<td>187 (152) Overweight, predominantly African American, ≥45</td>
<td>12 months</td>
<td>Rural health care center</td>
<td>RCT</td>
<td>Standard care, one individualized session</td>
<td>Weight loss was significant for intensive group; no difference for reimbursable level; weight loss not predictive of HbA1c</td>
<td>No self-care measure</td>
<td></td>
</tr>
<tr>
<td>Rimmer, 2002</td>
<td>30 Inner-city, predominantly African American</td>
<td>12 weeks</td>
<td>Local hospital and clinic</td>
<td>Quasi-experimental</td>
<td>None</td>
<td>Intensive and highly structured intervention was successful in underserved population</td>
<td>Barriers to participation</td>
<td></td>
</tr>
<tr>
<td>Tang, 2010</td>
<td>77 African American, ≥40</td>
<td>6 months</td>
<td>In person and mailings</td>
<td>Control-intervention time series (participants as own control)</td>
<td>Attention-control, weekly newsletters</td>
<td>Control served as low intensity intervention; flexible model is promising</td>
<td>No real control</td>
<td></td>
</tr>
<tr>
<td>Walker, 2010</td>
<td>195 African American, ≥40</td>
<td>6 months</td>
<td>In person and telephone</td>
<td>Quasi-experimental</td>
<td>Standard care</td>
<td>Increase in knowledge maintained for 6-mo; stages of change increased for exercise though no change in behavior</td>
<td>Group differences; small comparison group</td>
<td></td>
</tr>
<tr>
<td>Weinstock, 2011</td>
<td>1665 Underserved, ethnically diverse</td>
<td>5 years</td>
<td>Telemedicine</td>
<td>RCT</td>
<td>Standard care</td>
<td>Persistent benefit of telemedicine may reduce disparities</td>
<td>HbA1c not similar at baseline</td>
<td></td>
</tr>
</tbody>
</table>

RCT, randomized controlled trial.
on the impact on glycemic control. Using a reproducible search strategy, 9,233 articles were reviewed. Ten articles met inclusion criteria and five showed a statistically significant change in HbA1c in the intervention group, compared to the control group. Five of the 10 studies specifically noted cultural tailoring, three of which were significant. All studies with statistically significant results used problem solving with the patient, four used a nurse educator, three provided information to the provider, three were delivered via telemedicine, four provided one-on-one counseling, and two provided group counseling sessions.

A noteworthy aspect of the studies reviewed was problem solving - defined as both a cognitive and behavioral process to find solutions. Self-management behaviors have been associated with positive problem solving skills, however, not all studies have found this association significant. In the studies reviewed, some interventions addressed problem solving through structured processes such as action plans and goal setting, while others used open-ended questions and time for discussion of patient concerns. Few studies have looked specifically at the impact of problem solving in patients with diabetes on glycemic control. Our review found that of the interventions that allowed for problem solving, half improved glycemic control, indicating it may be a critical aspect when engaging African Americans with T2DM.

Cultural tailoring of interventions has been shown to improve outcomes, and was evidenced in this review. Of the five studies that specifically noted cultural tailoring, three found statistically significant changes in HbA1c, however, few gave details regarding how interventions were tailored. Among studies that detailed culturally appropriate interventions, techniques included modifying dietary suggestions for practical and cultural acceptance, providing demonstrations, discussing food choices at social events, and using local healthcare providers.

All studies reviewed used either nurse educators, certified diabetes educators, or dieticians, and four noted providing information to the healthcare provider, as recommended by national standards for diabetes self-management education (DSME). Nurse educators seemed to be most effective, being used in four of the five statistically significant interventions. Table 2. Outcomes of interventions

<table>
<thead>
<tr>
<th>Study Author, Year</th>
<th>Mean Baseline A1C, %</th>
<th>Intervention Mean Change in A1C, %</th>
<th>Control Mean Change in A1C, %</th>
<th>Statistical Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson, 2005</td>
<td>8.6</td>
<td>8.74 baseline; 8.34 post intervention</td>
<td>8.41 baseline; 8.13 post intervention</td>
<td>No sign difference; sign pre/post decrease in HbA1c (P&lt;.001)</td>
</tr>
<tr>
<td>Anderson-Loftin, 2002</td>
<td>50% elevated levels</td>
<td>Decreased 1.18 post intervention</td>
<td>No control</td>
<td>P&lt;.0106</td>
</tr>
<tr>
<td>Carter, 2011</td>
<td>8.9</td>
<td>9.0 baseline; 6.82 post intervention</td>
<td>8.8 baseline; 7.9 post intervention</td>
<td>P&lt;.05 OR=4.58 to reach A1c&lt;7 if in intervention</td>
</tr>
<tr>
<td>Davis, 2010</td>
<td>9.3 (intervention); 8.9 (control)</td>
<td>9.4 baseline; 8.3 6-mo post; 8.2 12-mo post</td>
<td>8.8 baseline; 8.6 6-mo post intervention; 8.6 12-mo post</td>
<td>P=.003 6-mo</td>
</tr>
<tr>
<td>Hawkins, 2010</td>
<td>8.95</td>
<td>Decreased 1.7</td>
<td>Decreased 0.6</td>
<td>P=.015</td>
</tr>
<tr>
<td>Carter, 2011</td>
<td>8.95</td>
<td>Decreased 0.8</td>
<td>Decreased 1.1</td>
<td>Not significant</td>
</tr>
<tr>
<td>Mayer-Davis, 2004</td>
<td>9.6 (usual care); 9.7 (reimbursable care); 10.2 (intensive care)</td>
<td>10.8 baseline; 10.3 post intervention</td>
<td>No control</td>
<td>No significant difference</td>
</tr>
<tr>
<td>Rimmer, 2002</td>
<td>10.8</td>
<td>Decreased 0.68</td>
<td>Increased 0.32</td>
<td>P=.008</td>
</tr>
<tr>
<td>Tang, 2010</td>
<td>8.2 (intervention); 7.9 (control)</td>
<td>39% elevated levels</td>
<td>Not reported</td>
<td>Treatment effect not significant (Black, White)Treatment effect .50 (95%CI .22-.78)</td>
</tr>
<tr>
<td>Walker, 2010</td>
<td>8.2 (intervention); 7.9 (control)</td>
<td>7.10 baseline; 6.87 5-yr post (White); 7.61 baseline; 6.95 5-yr post (Black); 7.69 baseline, 7.32 5-yr post (Hispanic)</td>
<td>Not reported</td>
<td>(Hispanic)</td>
</tr>
<tr>
<td>Weinstock, 2011</td>
<td>7.02 (White); 7.58 (Black); 7.79 (Hispanic)</td>
<td>6.97 baseline; 6.93 5-yr post (White); 7.56 baseline; 7.20 5-yr post (Black); 7.94 baseline, 7.82 5-yr post (Hispanic)</td>
<td>Not reported</td>
<td>(Hispanic)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Treatment effect not significant (Black, White)Treatment effect .50 (95%CI .22-.78)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Our review found that of the interventions that allowed for problem solving, half improved glycemic control, indicating it may be a critical aspect when engaging African Americans with T2DM.
studies. Since African Americans have been shown to have lower levels of trust in health care providers, the specific type of education provider may be important in intervention effectiveness. Benkert et al found significantly higher trust in African American patients with hypertension seen by nurse practitioners than those seen by medical doctors. Considering the large number of behavioral intervention studies, few studies targeting African Americans and measuring the impact on glycemic control were found. African Americans
are more likely to be diagnosed with diabetes, and have been shown to have greater disability from diabetes complications than NHWs.\textsuperscript{9} In addition, patients with diabetes in the United States have been shown to have twice the medical costs of those without the disease.\textsuperscript{1} Only 10 studies were found in this review and of those that were statistically significant only three had a separate control group. This is an insufficient level of evidence to inform wide-scale behavior interventions and suggests more work is needed to develop effective behavioral interventions for African Americans with T2DM. Additionally, while cultural tailoring of interventions has been shown to be effective,\textsuperscript{10,30,31} only half of the studies reviewed noted use of this technique. Our review provides a summary of the evidence, which can serve as a starting point for development of clinical trials in the future.

**Limitations**

There are four limitations of our study worth addressing. First, the search was limited to articles published in English between 2000 and 2012. Second, the review was limited to studies using glycemic control as an outcome. While this is an important risk factor for disease progression, it limited the number of interventions examined. Future studies should investigate the impact of behavioral interventions on other outcomes, such as quality of life. Third, since studies with positive results are more likely to be published, the studies in this review may reflect publication bias. Lastly, the small number of RCTs and heterogeneous methodology prevented a meta-analysis from being performed. Conclusions from this review are therefore qualitative and meant to guide future research rather than serve as conclusive answers.

**CONCLUSIONS**

Based on our review, future research should continue testing the effectiveness of behavioral interventions in African Americans. Studies should investigate whether incorporating problem solving improves glycemic control over providing information without efforts to improve problem solving. Studies should be clear in their description of methods used, such as how to encourage problem solving or details of cultural tailoring. Future studies should also investigate the possible link between trust and DSME effectiveness, specifically investigating the association between outcomes and the type of professional delivering an intervention. Additionally, studies on the impact of feedback to providers and changes in patient trust levels or patient-provider interactions would be informative. A recent review on the effectiveness of provider reminders showed that modest improvements are seen in provider behavior when interventions use reminders;\textsuperscript{34} the review was not specific to diabetes, but it indicates reminders could be an important contributor to effectiveness.

In conclusion, an extensive search of the literature resulted in only 10 studies being identified as targeting African Americans with T2DM for behavioral interventions to improve glycemic control as measured by HbA1c. Based on these studies, those that include problem solving with patients, culturally tailored information, and nurse educators are effective. Clinical trials are needed to determine how best to tailor interventions to this largely underserved population and studies should describe details of cultural tailoring to provide information for future programs.

**REFERENCES**

INTERVENTIONS FOR GLYCEMIC CONTROL AMONG AFRICAN AMERICANS - Walker et al


AUTHOR CONTRIBUTIONS

Design and concept of study: Walker, Smalls, Shaw Bonilha, Egede

Acquisition of data: Walker, Smalls, Egede

Data analysis and interpretation: Walker, Smalls, Shaw Bonilha, Campbell, Egede

Manuscript draft: Walker, Smalls, Shaw Bonilha, Campbell, Egede

Statistical expertise: Egede

Acquisition of funding: Egede

Administrative: Walker, Smalls, Campbell

Supervision: Shaw Bonilha, Egede