Effectiveness of Motivational Interviewing for Improving Self-Care Among Northern Plains Indians With Type 2 Diabetes

Darren Calhoun, PhD, Rod Brod, PhD, Kristin Kirlin, PhD, Barbara V. Howard, PhD, David Schuldberg, PhD, and Christine Fiore, PhD

Abstract

A study was conducted to assess the utility of motivational interviewing techniques to improve management of type 2 diabetes among residents of an American Indian reservation. A convenience sample of participants was recruited at an Indian Health Service diabetes clinic (n = 26). Random blood glucose, A1C, and demographic variables for the 6 months before baseline were collected via chart review; data on random blood glucose, A1C, demographic variables, health-related behaviors, and psychological self-report instruments were collected at baseline and 3 months after intervention. The intervention consisted of two individual, 30-minute sessions of motivational interviewing (MI) delivered over 3 weeks. Significant improvements in participants' self-reported depressive symptoms, genetic/racial fatalism, treatment satisfaction, and social/vocational worry were observed. Stepwise regression revealed seven predictors of change in A1C from baseline to study end: completion of the study, total blood quantum, change in A1C from 6 months before baseline to baseline, and change in provider trust, treatment acceptance, depression, and reported hours of exercise per week from baseline to study completion. The final analysis had an R^2 value of 0.896, accounting for 89.6% of the variance in A1C change. This pilot study provides preliminary support for the utility of MI techniques in diabetes care among American Indians.

An estimated 17 million people in the United States have been diagnosed with type 2 diabetes.[1] Prevalence rates are highest among ethnic minority populations. Among American Indians, type 2 diabetes has reached epidemic proportions, with occurrence rates more than three times that of the general U.S. population.[2] Diabetes is an expensive disease to treat and manage; in 2007, the annual estimated economic cost was $174 billion, with an estimated one in every five health care dollars being spent on this chronic condition.[1] Thus, studies that may lead to better prevention and treatment are needed.[2]

Obesity is the leading risk factor for type 2 diabetes, and improvements in health-related behaviors such as diet, exercise, smoking cessation or reduction, and self-monitoring of blood glucose (SMBG) have been shown to delay the onset of the disease and to minimize secondary complications. Studies have shown that lifestyle changes such as weight management and increased physical activity can prevent the development of type 2 diabetes and improve insulin sensitivity and glycemic control in those who already have the disease.[3]

The technique of motivational interviewing (MI), used in psychological counseling, can inspire behavioral changes such as patients' efforts to improve their diets and increase their level of exercise. MI was developed in the treatment of substance abuse.[4] This technique has been described as particularly useful for individuals who are reluctant to change and ambivalent about doing so.[5]

Daren Calhoun, PhD, Director, Phoenix Field Office, and Senior Research Fellow, MedStar Research Institute, 1616 E. Indian School Road, Suite 250, Phoenix, AZ 85016

MI techniques are well suited to assist patients with diabetes in changing the behaviors associated with increased risk of secondary complications. The available literature on the use of MI in patients with diabetes has demonstrated significantly enhanced adherence to treatment recommendations, increased weight loss, and improved glycemic control.[6,7] Even brief interventions using this technique have shown positive outcomes with regard to health-related behaviors, including those relevant to type 2 diabetes.[5]

This study is the first to assess the use of MI in American Indians diagnosed with diabetes and living in a reservation community. The aim of the MI sessions was to facilitate change in the participants' health-related behaviors and improve their psychological well-being. The investigators' previous experience has shown a relationship between these factors and diabetes management, and it was hypothesized that change on measures of diet, exercise, depression, locus of control, fatalism, and quality of life would be predictive of improvement in A1C from baseline to post-intervention.

Research Design and Methods

This project used a within-subjects pre-post design. Participants were tribal members who were ≥ 18 years of age, residing on a Northern Plains reservation in the western United States, diagnosed with type 2 diabetes, and receiving their diabetes medical treatment at their local Indian Health Service (IHS) clinic. Participants were selected through chart review and collaboration with the physicians and the diabetes coordinators employed at the local IHS clinics. The primary investigator (PI) as well as IHS staff (diabetes educators, behavioral health specialists, and medical staff) attended semimonthly clinics and met with participants to inform them of the study and invite them to participate. The study was approved by the institutional review boards of the University of Montana and the area IHS office and by the governing tribal councils.

Approximately 96 individuals were invited in person to participate in the study. Of these, 83 (86%) expressed an interest in participating and scheduled initial appointments. Of those who expressed interest, 26 (31%) attended the initial appointment for baseline assessment. Those who had expressed interest but did not attend their scheduled initial appointment were contacted and rescheduled a minimum of two and a maximum of three times; a fourth missed appointment resulted in no further contact. Twenty-six participants completed the baseline measures, and 20 of those individuals (77%) returned for their first session of counseling. Every participant (100%) who completed the initial session of counseling completed the entire study, including the 3-month follow-up appointment.

Participants met with the PI a total of four times. They attended an initial baseline appointment to complete a demographic questionnaire, physiological measures (random glucose testing and A1C), psychological self-report instruments, and exercise and dietary intake questionnaires. The psychological measures included the following:

- **DC Fatalism Questionnaire,** which measures fatalistic thinking regarding the inevitability of the onset of diabetes and its complications. This test was developed among American Indian participants and has shown acceptable factor structure.[8] It yields scores ranging in value from 36 to 180, with higher scores indicating increased levels of fatalism.
- **Diabetes Locus of Control**, which measures individual perception regarding control over health issues specifically related to diabetes.[9]
- **Diabetes Quality of Life**, which measures five domains of quality of life related to living with diabetes.[10]
- **Beck Depression Inventory–II,** which measures depressive symptoms.[11]
- **5-Item Stage of Change**, which measures an individual's assessment of his or her readiness to change behaviors that are related specifically to diabetes management. This five-item measure uses a Likert scale and is based on the Transtheoretical Model Stage of Change.[12]

Additionally, exercise/physical activity was recorded using a nonstandardized self-report questionnaire. Participants were asked to estimate the amount of time (in 30-minute increments) they spent during the previous 7 days engaging in exercise/physical activity, including culturally specific forms of activity such as pow-wow dancing. The data were expressed as total hours for the 7-day period, and change scores were derived by comparing baseline and end-of-study totals.

The dietary intake questionnaire was a self-reported tally of the number of food servings consumed during the previous 24 hours from a list of healthy and unhealthy food choices. This questionnaire yielded scores ranging from 0 to 16; higher scores reflected greater consumption of that type of food (either healthy or unhealthy). The change score on this measure was computed by comparing the number of servings of foods quantified as healthy versus nonhealthy in the previous 24-hour period at baseline and at study completion.

The next two meetings consisted of 30-minute sessions of MI occurring within 3 weeks of the participants' baseline appointments. The aim of the counseling sessions was to address type 2 diabetes management at the individual level and elicit behavioral change by helping individuals resolve ambivalence regarding their lifestyle habits (e.g., diet, amount of exercise, and adherence to treatment regimens). Three months after the intervention, participants returned to again complete the physiological and psychological measures.

The interventionist in this study was trained in MI, was supervised by a member of the Motivational Interviewing Network of Trainers, and attended training in MI skill coding to strengthen working knowledge of MI.

Sessions of MI began with a brief discussion of how the management of diabetes may differ for each individual. A standardized introductory script was followed. Participants were told, "I would like to learn what it has been like for you to have diabetes and what if anything you would like to do to address your overall management of diabetes." Use of this open-ended question frequently led to personal histories and stories from the participants.

The goal of the intervention was to address behaviors raised by the participant and then follow up with further directive open-ended questions. An example from one such encounter is, "You mention walking as something that is often helpful for improved blood sugar management. What would it be like for you to use walking in your management of diabetes?"

The intervention focused on behaviors raised either through participant responses or from direct questions the participant asked the interventionist. Behaviors targeted were primarily those associated with improved overall health and diabetes management: exercise, diet, smoking cessation, SMBG, adherence to medication/diabetes treatment plan, and management of mood. Through the continued use of directive open-ended questions, issues explored were those the participants chose to discuss in relation to their management of diabetes. Additionally, individual participants' level of readiness for considering behavior change, confidence in their ability to initiate or maintain behavior change, and rating of the importance of behavioral change in improving individual diabetes management were elicited and discussed.[13] This type of conversation regularly led to exploration of the pros and cons of the behavior change under discussion.

The development of discrepancies technique was used when appropriate, as well. Information exchange was used in cases where participants would ask for specific information on activities or behaviors such as exercise, smoking cessation, and dietary changes (e.g., participants frequently asked whether eating less fried food would make a difference in their diabetes management). As described for this intervention and elsewhere,[13,14] MI lends itself well to addressing behavioral change on an individual basis, which is an important component in diabetes management.

Table 1. Participants' Baseline Demographic Characteristics

	Mean (SD)
n	26
Female sex (%)	53.8
Age (years)	54.0 (10.9)
Diabetes duration (years)	4.4 (1.0)
Blood quantum (%)	91 (17)
Tribal enrollment (%)	100
Baseline weight (lb)	202.3 (40.4)
BMI (kg/m^2)	31.8 (5.3)
Baseline A1C (%)	8.8 (1.8)
Random blood glucose (mg/dl)	203.7 (70.85)

Data analysis

The analyses were conducted using SPSS 12.0 software for Windows, with an alpha level of 0.05 for all tests of significance. Examination of the data set revealed the following missing data: three participants had medical charts that were missing the random blood glucose measurement taken 6 months before baseline; two other participants were missing baseline random blood glucose measures due to lab error; and six participants completed the baseline assessment but had no post-intervention data because of attrition. Imputation[15,16] was used to estimate the missing values.

The three missing random blood glucose values from 6 months before baseline were imputed using a regression equation based on the participants' A1C and average estimated daily blood glucose 6 months before baseline. The two missing baseline random blood glucose measures were imputed from the participants' baseline average estimated daily blood glucose and baseline A1C values. Finally, the post-intervention values for the six participants who did not complete the study were imputed based on their baseline measures and the relationship between baseline and post-intervention data observed in the complete data set.

No evidence of selective attrition was observed; comparison of baseline data of the 20 participants who completed the study to that of the 6 participants who did not complete the study showed no significant differences on demographic variables (age, sex, education, tribal enrollment, length of diabetes history, and BMI), baseline physiological measures (A1C and random glucose), baseline psychological measures (DC Fatalism, Diabetes Locus of Control, Diabetes Quality of Life, Beck Depression Inventory–II, and 5-Item Stage of Change), or measures of health-related behaviors (exercise and dietary intake). Table 1 details the demographic characteristics of the participants.

Results

When changes from baseline to post-intervention were examined initially, no significant changes were observed in the two physiological measures (random blood glucose and A1C). Among the measures of health-related behaviors, a trend toward decreased levels of self-reported consumption of unhealthy food was observed from baseline to post-intervention [$t(25) = 1.829$, $P = 0.079$] (Table 2). Participant scores on the psychological self-report instruments also showed improvement. Participant self-reported depressive

Table 2. Significant Mean Differences From Baseline to the 3-Month Follow-Up Appointment (*n* = 26)

	Baseline	Post-Intervention (3-month follow-up)
Health-Related Behaviors		
Unhealthy dietary choices[a]	7.92 (2.73)* (range 0–16)	7.18 (1.87)* (range 0–16)
Psychological Measures		
Beck Depression Inventory–II[a]	11.65 (11.04)*** (range 0–63)	7.18 (7.68)*** (range 0–63)
DC Fatalism, Genetic/Racial Fatalism[a]	2.47 (0.87)** (range 1–5)	2.28 (0.87)** (range 1–5)
Diabetes Locus of Control Self-blame[a] Family support[b]	4.50 (0.95)* 4.35 (0.89)* (range[a] 2–12; range[b] 1–6)	4.17 (1.19)* 4.77 (0.91)* (range[a] 2–12; range[b] 1–6)
Diabetes Quality of Life Scale A: treatment satisfaction[a] Scale C: worry about future[a] Scale D: worry about social/vocational issues[a]	37.77 (12.74)*** 17.62 (7.47)* 9.27 (4.00)*** (All scores are percentage scores, 0–100)	29.64 (9.68)*** 15.77 (6.75)* 8.23 (3.60)*** (All scores are percentage scores, 0–100)

Data are shown as mean (standard deviation).
[a]Lower scores on these measures reflect more positive outcomes.
[b]Higher scores on this measure reflect more positive outcomes.
**Means differ at P < 0.08.*
***Means differ at P < 0.05.*
****Means differ at P < 0.01.*

symptoms decreased significantly from baseline to post-intervention [$t(25) = 2.922$, $P < 0.01$]. Among the subscales of the DC Fatalism measure, a significant decrease was observed in Genetic/Racial Fatalism [$t(25) = 2.126$, $P < 0.05$]. Two positive trends were observed for the Diabetes Locus of Control subscales: improved family support [$t(25) = -2.026$, $P = 0.054$] and decreased self-blame [$t(25) = 2.032$, $P = 0.053$]. Participant scores on Diabetes Quality of Life Section A (satisfaction with treatment) [$t(25) = 4.865$, $P < 0.01$] and Section D (worry about social and vocational issues) [$t(25) = 3.00$, $P < 0.01$] revealed significant improvement; Section C (worry about future effects of diabetes) [$t(25) = 2.044$, $P = 0.052$] showed a trend toward improvement.

After comparisons of the means with paired sample *t*-tests comparing pre- and post-intervention scores, multiple regression analysis was used to examine whether change in measures of diet, exercise, depression, locus of control, fatalism, and quality of life would be predictive of participants' improvement in physiological measures (A1C and random blood glucose) from baseline to post-intervention when A1C change from 6 months before baseline was held constant. Change scores were then computed for the independent variables, with positive values representing an improvement (Table 3). Change scores were entered in a stepwise model with A1C change from 6 months before baseline to obtain the best predictors of change in A1C from baseline to post-intervention (Table 4). Seven predictors were entered stepwise into the model: *1*) change in A1C from 6 months before baseline to baseline, *2*) change in provider trust from baseline to post-intervention, *3*) total blood quantum, *4*) completion of the study, *5*) change in depression from baseline to post-intervention, *6*) change in hours of reported exercise/physical activity in the previous week from baseline to post-intervention, and *7*) change in treatment acceptance from baseline to post-intervention. Each of these seven predictors and their independent effects on A1C are described in the order of their partial R^2 values in Table 4. The final model had an R^2 of 0.896, thus accounting for almost 90% of the variance in change in A1C.

Conclusions

This study was undertaken as a pilot assessment of MI techniques as an intervention to improve behavioral management of diabetes in American Indians, a population with high rates of diabetes and related complications. Additionally, changes in health-related variables and psy-

Table 3. Mean Change Scores of Predictive Variables (Regression Model)

	Mean (SD)
Demographic Variables*	
Completer versus noncompleter	—
Total blood quantum	—
Physiological Measures	
Change in A1C (from 6 months before baseline to end of study)	−0.169 (1.693)
Health-Related Behaviors	
Exercise (hours in previous week)[a]	1.395 (11.303)
Psychological Measures	
Beck Depression Inventory–II[a]	4.4735 (7.806)
DC Fatalism Provider trust[a] Treatment acceptance[a]	 110 (0.690) 0.050 (1.00)

*No means are displayed for these demographic/categorical variables: percentage completed was 76.9.
[a] Change from baseline to post-intervention, calculated so that positive values reflect improvement.

chological factors were examined to explore which variables might be predictive of improvement in glycemic control. The data demonstrate support for the use of MI techniques, as shown by the decrease in unhealthy dietary choices, decline in depressive symptoms and fatalistic thinking, and improvement in elements of diabetes-related locus of control and quality of life observed from baseline to post-intervention. The improvement in these psychological variables is clinically significant because of the well-documented relationship between diabetes management and depression, fatalistic thinking, locus of control, and quality of life.[9,17–20]

No significant changes were observed initially in the physiological measures (A1C and random blood glucose) from baseline to 3 months post-intervention, most likely because of the study's inability to control for the effects of other possible predictors, limited sample size, short duration, limited number of interventions, and A1C change 6 months before baseline. Indeed, among those who had experienced a decrease in glycemic control in the 6 months before the baseline assessment, we did see significant improvement in A1C by study completion. Worsening glycemic control could be a factor in an individual's readiness to address change leading to improved glycemic control; however, a larger trial is needed to examine this potential factor more closely.

Approximately half of the participants who completed the study (11 of 20) improved their A1C from baseline to post-intervention, with two remaining the same and eight experiencing worsening glycemic control. These improvements in A1C can be clinically significant, because even a small change in A1C can lead to a significant reduction in diabetes complications. For example, a 1.5% decrease in A1C has been estimated to lead to a 24–33% decrease in the 10-year incidence of proliferative retinopathy.[21]

The stepwise regression revealed several significant predictors of improvement in A1C from baseline to the 3-month follow-up appointment. This technique was chosen because, by holding relevant study variables constant, it can identify those that may be useful as targets of future research and intervention.

These predictors included change in three of the psychological variables: increased trust in medical care providers, decline in self-reported depressive symptoms, and greater treatment acceptance. These variables were each significantly related to improved A1C at study end. These findings are consistent with previous literature supporting a relationship between psychological factors and glycemic control.[18,22–24]

Decline in depressive symptoms and greater treatment acceptance together only accounted for a small but significant (i.e., 1.2 and 2.5) percentage of the total variance in the model, and the multiple comparisons made increase the probability of type I error, the chance of spurious correlations, or bias from outliers. Increased provider trust in this study, however, explained one-fifth of the total variance in baseline to post-intervention A1C improvement once other change measures were statistically controlled.

Thus, although the statistical power was limited by the small sample size, the use of stepwise multiple regression analysis allowed the consideration of powerful confounders, as well as important psychological and other study variables, while eliminating problems of multi-colinearity confounding the results of the study.

Among the health-related behaviors, an increase in the reported amount of time spent performing physical activity/exercising per week was predictive of an improvement in glycemic control during the study; indeed, holding other model variables constant, it accounted for 5% of the total variance in A1C improvement. The relationship between amount of time spent exercising and glycemic control has been previously supported in adults with type 2 diabetes; regular aerobic exercise is associated with decreased blood pressure and improved A1C. (Completion of the counseling intervention was also predictive of improvement in stable glycemic control at the 3-month follow-up appointment. In conjunction with the

Table 4. Regression Model Coefficients*

	Nonstandard Coefficients		Standard Coefficients	*T*	Significance	Correlations			Other Statistics	
	B	Standard Error	Beta			Zero-order	Partial	Part	Tolerance	R^2
(Constant)	1.959	0.663		2.956	0.008					
Change in A1C from 6 months before baseline	−0.703	0.077	−0.828	−9.153	0.000	−0.609	−0.907	−0.697	0.709	0.504
Change in provider trust, baseline to post-intervention	0.966	0.179	0.465	5.404	0.000	0.425	0.787	0.412	0.784	0.197
Total blood quantum	−3.342	0.756	−0.391	−4.420	0.000	−0.242	−0.721	−0.337	0.742	0.095
Completer versus noncompleters	0.881	0.282	0.264	3.130	0.006	0.045	0.594	0.238	0.818	0.012
Change in BDI, baseline to post-intervention	0.079	0.017	0.430	4.599	0.000	0.028	0.735	0.350	0.664	0.012
Change in reported hours of exercise, baseline to post-intervention	0.030	0.010	0.240	2.901	0.010	0.210	0.564	0.221	0.850	0.050
Change in acceptance of treatment, baseline to post-intervention	−0.263	0.115	−0.183	−2.284	0.035	−0.137	−0.474	−0.174	0.900	0.025

**Dependent variable is change in A1C from baseline to post-intervention. BDI, Beck Depression Inventory;* R^2 *= proportion of total variance*

observed lack of differences between study completers and noncompleters at baseline, this finding suggests that participation in the intervention was beneficial for participants' diabetes management. However, this result is limited by the use of imputation to calculate the post-intervention data for the noncompleters and by the lack of a control group. A larger, longer-lasting trial with a control group could further address the utility of this type of intervention among participants with diabetes.

The only demographic variable associated with improved A1C was total blood quantum. This finding should be interpreted with caution because it is potentially a proxy variable for a wide range of social and cultural variables (e.g., degree of genetic risk for diabetes, degree of traditionalism, level of education, degree of discrimination experienced, acculturation stress, exposure to historical trauma, age, and fear and distrust of medical providers), some of which have been shown to affect glycemic control in other minority populations.[26,27] The degree to which these factors are interrelated may make it difficult to analyze them separately. This finding must be explored with sensitivity to the potential for misrepresentation and misuse of data regarding such variables.

In conclusion, this is the first study to use MI techniques in brief counseling sessions as an intervention among American Indian participants with type 2 diabetes. This study's strengths include the quality of the intervention and the systematic collection of a wide range of physiological and psychological data. Limitations include the lack of a control group, the lack of coding of the intervention sessions to ensure fidelity to the MI model, and the small sample size that limited the power and precluded holding out a subsample to cross-validate the results of the regression model.

This was a small pilot study with limited resources, which restricted our ability to recruit participants and adequately follow up or reschedule missed appointments. A larger study with a longer follow-up period and designated staff to focus on recruitment and follow-up is needed.

The findings of the present study also are limited by the collection of data in only one American Indian community. There are more than 500 American Indian tribes in the United States, each having a unique culture and background. The results of this project may not be applicable to other tribal populations. Replication of this study with other American Indian tribes is needed, and cross-validation should be a priority in future research in this area.

Despite several limitations, the data suggest that there may be clinical utility to using an MI approach among American Indians with type 2 diabetes. In this pilot study, we saw improvement in several areas, including depressive symptoms, fatalistic thinking, and quality of life, and individuals appeared to benefit from participating. In addition, a number of psychosocial and other predictors of improvement in glycemic control were identified. Thus, this preliminary study can serve as a template for a larger trial.

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Darren Calhoun, PhD, is director of the Phoenix Field Office and a senior research fellow at MedStar Health Research Institute in Phoenix, Ariz. Rod Brod, PhD, David Schuldberg, PhD, and Christine Fiore, PhD, are professors at the University of Montana in Missoula. Kristin Kirlin, PhD, is an instructor in medicine at the Mayo Clinic/Hospital in Phoenix, Ariz. Barbara V. Howard, PhD, is a senior scientist at MedStar Health Research Institute in Hyattsville, Md.