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Improved Clinical Outcomes Using a Culturally Sensitive Diabetes Education Program in a Hispanic Population

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Abstract

Purpose—The purpose of this study was to evaluate the effects of a culturally sensitive diabetes education program for Hispanics with type 2 diabetes.

Methods—This study is a prospective cohort study to test the impact of a comprehensive diabetes education program on blood glucose control on Hispanics with type 2 diabetes. The educational program focused on maintaining glycemic control and general aspects of managing diabetes and complications. The study participants were recruited by flyers placed in Hispanic markets and in ambulatory care clinics. A total of 34 Hispanic male and female subjects with type 2 diabetes participated in the study. The concentrations of glucose, insulin, hemoglobin A1c (HbA1c), total cholesterol, triglycerides, low-density lipoprotein and high-density lipoprotein (HDL) cholesterol were analyzed at baseline and at 3 months.

Results—A significant mean change was observed for HbA1c, fasting plasma glucose, cholesterol/HDL ratio, and HDL after 3 months of education compared with baseline. There were significant reductions in weight, total fat, percent fat, trunk fat, and waist-to-hip ratio compared with baseline. After 3 months, subjects showed a significant positive correlation between changes in body mass index and insulin and weight, total fat, trunk fat, and fat free mass and insulin.

Conclusions—A culturally sensitive program conducted in Spanish had a significant impact on important clinical parameters in Hispanic subjects with diabetes in a relatively short time period. The study demonstrates the importance of designing education intervention studies that are sensitive to cultural diversity, particularly in at-risk diabetic subjects.

The incidence of diabetes is increasing in the United States. The data indicate that ethnic disparities are present in diabetes-related morbidity and mortality.¹ The 1993 to 2001 Medicare beneficiaries' data show that the prevalence of diabetes was highest in Hispanics and African Americans for all ages.² In addition, the prevalence of diabetes is expected to increase by 149% among Hispanics between 2000 and 2050.³

The frequency of certain diabetic complications such as end-stage renal disease, amputation, and neuropathy is higher in minority populations such as Hispanics and African Americans.

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^{4,5} Interventions have been developed to improve care and to reduce or delay associated diabetic complications, such as intensive management of glycemia, blood pressure, and cholesterol.^{6,7} However, data have revealed that diabetes care is often deficient for minority populations in the United States,^{8,9} which may explain some of the ethnic disparities in the incidence of diabetes complications.

Type 2 diabetes is associated with a 2- to 4-fold increase in coronary heart disease.⁹ Although the degree of glycemia in diabetic patients is strongly related to the risk of microvascular disease, the correlation between glycemia and macrovascular disease is not clearly established. However, there has been strong evidence suggesting that lipid intervention in diabetic patients is associated with macrovascular risk reduction, specifically heart disease.¹⁰ Some have therefore suggested a multifactor approach that incorporates lipid management. The 2001 American Diabetes Association's clinical practice guidelines promote the importance of glucose control and lipid management in preventing cardiovascular disease.¹⁰

The most common pattern of dyslipidemia in type 2 diabetes is elevated triglyceride levels and decreased high-density lipoprotein (HDL) levels. In observational prospective studies, HDL was the most consistent predictor of coronary heart disease in type 2 diabetes followed by triglycerides and total cholesterol.^{10,11}

The San Luis Valley Diabetes Study investigated whether a less favorable risk factor pattern for cardiovascular disease among Hispanic and white male and female subjects with impaired glucose tolerance could be explained by fasting insulin, obesity, and/or central body fat distribution. Hyperinsulinemia, obesity, and central body fat distribution accounted for some, but usually not all, of the less favorable cardiovascular disease risk factor pattern in subjects with impaired glucose tolerance.¹²

In a mixed population of Mexican Americans and non-Hispanic whites in San Antonio, Texas, dyslipidemia was strongly associated with hyperinsulinemia and hypertension in both groups.¹³ Fat mass and body mass index (BMI) are significantly correlated with plasma glucose, insulin, and connecting c-peptide areas after glucose challenge. Trunk fat accumulation and the size of fat cells in the abdomen are correlated with postglucose insulin levels.¹⁴

Several factors contribute to the health disparities in the Hispanic community. Limited access to health care services in low-income areas that are highly occupied by the Hispanic population results in fewer medical visits, underdiagnosis, lower rates of recommended monitoring tests for diabetes, and a significant decrease in optimal health. As a consequence of a low exposure to prevention measures, diabetes mellitus has tripled in the past 30 years and is responsible for 14% of health care expenditures in the United States.¹⁵ Also, Hispanics had lower rates of self-monitoring of blood glucose and worse glycemic control than whites.¹⁶

Adequate health intervention has been proven to decrease the risk factors and health effects associated with diabetes. Corkery et al¹⁷ demonstrated that diabetes education helped to decrease the HbA1c levels from 11.7% to 9.9% in a Hispanic population.

Several lines of evidence suggest that diabetes education can reduce the HbA1c levels and fasting blood glucose (FBG) levels in minority populations. For instance, Anderson-Loftin et al¹⁸ found that a culturally sensitive diabetes education program is important for the improvement of diabetes and even for weight loss in African Americans. Skelly et al¹⁹ noted that a language-specific instrument is necessary to better communicate an idea. In the Hispanic population, Duraski²⁰ demonstrated that to decrease the risk of stroke, as well as the levels of HbA1c and blood glucose, a "culturally sensitive program" with the combination of education and risk identification was needed. Also, in the Starr County Study, Brown and Hanis²¹ demonstrated that a culturally sensitive education program for Hispanics decreased the levels

of HbA1c and glucose. However, there is a lack in the literature of studies providing comprehensive evaluation of successful educational programs that properly address diabetes in Hispanic populations. The purpose of this study was to evaluate the effects of a culturally sensitive diabetes education program for Hispanics with type 2 diabetes. In addition, the study participants were evaluated for the potential effects of the education program on plasma lipid concentration.

Methods

Research Study Design

A total of 34 Hispanic male and female individuals with type 2 diabetes and a BMI of 21 to 47 kg/m² and whose primary language is Spanish participated in the study. The study participants were recruited by flyers placed in Hispanic markets and in ambulatory care clinics serving the Hispanic population. The subjects' ages ranged from 37 to 69 years. Subjects were excluded if they were pregnant or lactating; had a history of drug or alcohol abuse; had an impaired mental condition due to other pathological causes such as Alzheimer's disease; were on steroid therapy, which can worsen insulin resistance; had a clinically relevant history of cardiovascular disease; had a hepatic, neurologic, endocrine, or other major systemic disease, making implementation of the study results difficult; or had a pacemaker (bioelectrical impedance analysis [BIA] was used for alternate body composition analysis). All subjects underwent initial screening through telephone and personal interviews with the investigators, during which brief medical histories, medications, physical activity, and diet histories were obtained. Of the 44 subjects who enrolled, 34 completed the study, and 10 dropped out because of a lack of transportation. All subjects gave written informed consent to participate. The study protocol was approved by the Loma Linda University Institutional Review Board.

The advantage of cohort study data is the longitudinal observation of the individual through time and the collection of data at regular intervals, thereby reducing recall error. However, cohort studies are expensive to conduct, are sensitive to attrition, and take a long time to generate useful data. This study is a prospective cohort study to test the impact of a comprehensive diabetes education program on blood glucose control on Hispanics with type 2 diabetes. The primary outcomes were changes in fasting blood glucose and serum hemoglobin A1c levels. This 3-month study included the following phases: recruitment, collection of data at baseline and 3 months, health education, and final data analysis.

Sample Size

Estimated sample size calculations were based on a predicted reduction in FBG of 13% from baseline over a 3-month follow-up period as a result of the investigators' health education efforts. To have 80% power to detect this 13% reduction in FBG as being statistically significant, allowing for a type I (α) error of 5%, this study needed 44 subjects to complete the health education protocol.

Setting

The education program was conducted in the School of Public Health at Loma Linda University. The participants of the study attended the classes during the evening weekdays. Blood draws for sample collections were conducted on Sunday mornings. Transportation was provided for participants without transportation, and family members were encouraged to attend the education sessions.

Data Collection

The health status and dietary habits were characterized by a comprehensive evaluation consisting of blood, dietary assessments, and total and regional body composition measurements conducted at baseline and 3 months. Fasting blood samples were collected in a morning blood draw clinic at baseline and 3 months.

Diabetes Education

Diabetes education classes were conducted in Spanish once a week during the 3-month study period. The education team consisted of Hispanic registered dietitians, registered nurses, physicians, and nutrition students. The educators' first language is Spanish. Therefore, they were able not only to communicate in Spanish without using translators but also to "connect" culturally with the study participants. Each class was conducted for 2 hours and focused on maintaining glycemic control and general aspects of managing diabetes and complications. To reinforce the education principles of blood sugar control, monthly follow-up sessions were conducted for the duration of the study. Subjects received a free glucose monitor and a log to check their daily blood glucose levels. A series of classes was conducted, which included "What Is Diabetes?" "Complications of Diabetes," "Blood Glucose Control," "Hyperglycemia," "Hypoglycemia," "How to Use the Glucose Monitor," "The Role of Nutrition in Diabetes Care," "Taking Care of Your Feet," "What to Do When You Get Sick," "How to Choose Healthier Foods," "Nutrition Labeling," "Weight Control Principles," "Dining Out," "Principles of Exercise and Weight Control," "Food Portions Control," "Food Pyramid," and a summary of the program.

Evaluative Measures

Serum insulin, glucose, and hemoglobin A1c—Serum insulin was measured by radioimmunoassay (Quest Diagnostics, Teterboro, New Jersey; Nichols Institute Diagnostics, San Juan Capistrano, California) using guinea pig antibodies to the porcine ^{125}I -insulin (Linco Research, Inc, St. Louis, Missouri) radioactive tracer. Serum glucose was determined by reacting subjects' serum with glucose oxidase, which converts glucose to gluconolactone.²² Hemoglobin A1c was tested at the Loma Linda University Medical Center Laboratory. The test is a boronate affinity binding assay that measures and reports percent glycated hemoglobin and is also standardized to report percent hemoglobin A1c.²²

Plasma lipids—Blood analyses for lipids were carried out at the Loma Linda University Medical Center Laboratory. Cholesterol and triacylglycerol were analyzed on a Beckman CX7 (Beckman Coulter, Fullerton, California) instrument following standard procedures. HDL cholesterol and low-density lipoprotein (LDL) cholesterol were analyzed on a Beckman CX4CE instrument following standard procedures.^{23,24}

Body composition—Total and regional body composition was measured by dual-energy X-ray absorptiometry (DXA) using a Hologic QDR-4500A instrument and body composition analysis software Version 8.1A (Hologic, Inc, Waltham, Massachusetts). Scans were obtained with the subject in the supine position, wearing only a hospital gown and undergarment and with all metal and jewelry removed. Whole-body scans were taken, and regions of interest were isolated. Scan time was approximately 3 minutes for each assessment with a radiation exposure of 1.5 mrem. DXA scans were obtained at baseline and at 3 months of intervention for all subjects. All scans were read and signed by a radiologist.

Statistical Analysis

Statistical analyses were calculated using SPSS for Windows Version 10.05 (SPSS, Inc, Chicago, Illinois) with type I error set at $\alpha = 0.05$. Data are presented as mean $\pm$ SD. Log

transformations were used to improve the normality of some variables (fasting glucose, fasting insulin, HbA1c, total cholesterol, HDL cholesterol, LDL cholesterol, and triglycerides). This transformation stabilizes the variance when the standard deviation varies directly as the mean.

Univariate analyses, means, and standard deviations were calculated to summarize the outcomes at each time point. Pearson's product-moment correlations were performed to relate changes in body composition with changes in plasma lipids, glucose, and insulin concentrations. The differences between the means of insulin, glucose, HbA1c, plasma lipids, and body composition before and after diabetic education were assessed using a paired-samples *t* test with $P < .05$ set for significance. Nonparametric Spearman's correlations were also calculated, and because they did not differ appreciably from the Pearson's correlations, only the Pearson's correlations are presented.

Results

The descriptive characteristics of the subjects ($n = 34$) at baseline are summarized in Table 1. The mean age of the study subjects was 52 years. Study participants' age ranged from 37 to 69 years. There were 25 women and 9 men. Study subjects' mean weight ranged from 49 to 122 kg, and BMI ranged from 21 to 47 kg/m² at baseline.

Table 2 summarizes the changes in fasting blood glucose, hemoglobin A1c, insulin, and plasma lipids levels after the 3-month education program. A significant reduction in means was observed for fasting blood glucose (23.20 mg/dL, $P < .001$), HbA1c (0.82%, $P < .001$), HDL (−4.20 mg/dL, $P < .001$), and cholesterol/HDL ratio (0.48%, $P < .001$) after 3 months of education compared with baseline. There were no significant mean changes in insulin, total cholesterol, LDL, and triglyceride levels at 3 months compared with baseline.

Mean changes in body compositions are summarized in Table 3. There were significant reductions in weight (0.94 kg, $P = .02$), total fat (0.92 kg, $P < .001$), percent fat (3.83, $P < .001$), trunk fat (0.61 kg, $P < .001$), and waist-to-hip ratio (0.02%, $P = .03$) compared with baseline. BMI and fat-free mass did not decrease significantly compared with baseline.

Table 4 summarizes correlations between changes in body compositions and insulin over the 3-month study period. There were significant ($P < .01$) correlations between plasma insulin, plasma lipids, and body composition changes. After 3 months of diabetes education, subjects showed a significant positive correlation between changes in insulin and BMI ($r = 0.522$, $P < .01$), weight ($r = 0.550$, $P < .01$), total fat ($r = 0.480$, $P < .01$), trunk fat ($r = 0.468$, $P < .01$), and fat-free mass ($r = 0.440$, $P < .01$). In addition, after 3 months of treatment, there were significant positive correlations between changes in BMI and triglycerides ($r = 0.342$, $P < .05$) and percent fat and total cholesterol ($r = 0.377$, $P < .05$).

Fifteen percent of study subjects had a fasting plasma glucose ≤ 105 mg/dL at baseline versus 30% at 3 months. At baseline, 24% of the subjects had hemoglobin A1c (HbA1c) $\leq 5.9\%$ versus 33% at 3 months (Figure 1). Of the subjects, 27% had a baseline insulin level ≤ 17.8 μ g/L versus 33% at 3 months. In addition, at baseline, 70%, 30%, 29%, 27%, and 38% of the participants had a total cholesterol level ≤ 199 mg/dL, HDL level ≤ 40 mg/dL, LDL level > 99 mg/dL, cholesterol/HDL ratio ≤ 3.5 , and triglycerides ≥ 150 mg/dL versus 68%, 21%, 44%, 38%, and 47% at 3 months, respectively (Figure 2).

Discussion

This study used a culturally and language-customized education program and demonstrated significant clinical benefit in a population of Spanish-speaking Hispanic diabetic subjects. These beneficial results were seen within a very short 3-month interval. After only 3 months

of education, subjects had a reduction of 23% in fasting plasma glucose and, more important, a significant reduction of 0.82% in HbA1c from baseline. The Diabetes Control and Complications Trial (DCCT) demonstrated that a reduction of 0.5 percentage points in HbA1c resulted in a significant reduction in diabetes complications, suggesting that if these changes can be sustained over time, this will translate into a significant reduction in diabetic complications in this study's Hispanic subjects. However, there was not a significant change in plasma insulin concentration compared with baseline. These results are in agreement with reported data from Ferrannini et al.¹³

A randomized clinical trial study by Corkery et al¹⁷ found that glycohemoglobin levels decreased from a baseline level of 11.7% to 9.9% at program completion. The authors concluded that intervention with a bicultural community health worker enhanced rates of diabetes education program completion in an inner-city Hispanic patient population, and completion of a specific diabetes educational approach could improve patient knowledge, self-care behaviors, and glycemic control.

In a study of African American diabetic subjects from the southern United States, Anderson-Loftin et al¹⁸ demonstrated a 1.8-kg decrease in weight for the experimental group versus a 1.9-kg increase in the control group. In addition, the researchers observed a trend in the reduction of hemoglobin A1C and lipids. They concluded that a culturally competent dietary self-management intervention could be effective in improving health outcomes for southern African Americans. In African American women with type 2 diabetes, Skelly et al¹⁹ rated that a language-specific instrument is necessary to better communicate an idea. In a Hispanic population, Duraski²⁰ demonstrated that to decrease the risk of stroke, as well as the levels of HbA1c and blood glucose, a "culturally sensitive program" with the combination of education and risk identification was needed.

A study by Brown and Hanis²¹ found that the intervention, which included knowledge regarding diabetes and self-management strategies, was successful in significantly improving metabolic control in the target Mexican American population. An average of 1 kg of body weight, 4% of total fat, 0.61 kg of trunk fat, and 0.03 cm of waist-to-hip ratio were reduced as assessed by DXA. In addition, there was a significant increase in HDL cholesterol (4%) and cholesterol/HDL ratio (0.5%).

Nelson et al²⁵ found that DXA measures of trunk fat contribute more information than waist circumference, and the DXA abdominal region of interest assessed ethnic differences in insulin sensitivity between older Hispanic and non-Hispanic white women with normal glucose tolerance.

The findings in this study are consistent with previous studies demonstrating the effectiveness of diabetes lifestyle interventions in improving glycemic control. Improvements in outcomes might be partly due to the bilingual (English- and Spanish-speaking) Hispanic educators, as well as the frequency and the close location of the venue where education classes were conducted. It is harder to demonstrate causality from nonexperimental designs that may perhaps be subject to selection bias. However, nonexperimental designs, if methodologically sound, could show information about the efficacy of education.

During the study, participants reported difficulties with transportation, cost, and availability of the foods that were suggested for improving dietary habits. In addition, the study subjects had inadequate access to health care providers; some had limited literacy, and most had longstanding diabetes with very old lifestyle habits that negatively affect health. Overcoming such ecological obstacles is an essential component to the design of effective interventions to improve health behaviors in a low-resource population.

Conclusion

This study demonstrated that a properly designed and culturally tailored diabetic education program involving minute technology and few health care resources could have positive impacts such as improving glycemic control and lipid profiles among Hispanics with type 2 diabetes. If this significant improvement in glycemic control can be maintained, the Hispanic Diabetic Education Program has the potential to considerably decrease microvascular complications, morbidity, and health care utilization costs. More research should be performed for validating, improving, and maintaining the effect of this kind of intervention among populations in which health disparities exist. Forthcoming studies should incorporate measures of dietary change, physical activity, medication adherence, and changes in medication throughout the intervention period. A longer intervention period might also be necessary to detect change in some outcomes.

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References

- Centers for Disease Control and Prevention. Preventive-care practices among persons with diabetes—United States, 1995 and 2001. *MMWR Morb Mortal Wkly Rep* 2002;51:965–969. [PubMed: 12433019]
- McBean AM, Li S, Gilbertson DT, Collins AJ. Differences in diabetes prevalence, incidence, and mortality among the elderly of four racial/ethnic groups: whites, blacks, Hispanics, and Asians. *Diabetes Care* 2004;27:2317–2324. [PubMed: 15451894]
- Engelgau MM, Geiss LS, Saaddine JB, et al. The evolving diabetes burden in the United States. *Ann Intern Med* 2004;140:945–950. [PubMed: 15172919]
- Harris MI. Racial and ethnic differences in health care access and health outcomes for adults with type 2 diabetes. *Diabetes Care* 2001;24:454–459. [PubMed: 11289467]
- Centers for Disease Control and Prevention. Data and Trends Diabetes Surveillance System. Available at: <http://www.cdc.gov/diabetes/pubs/factsheet.htm>
- Karter AJ, Ferrara A, Liu JY, et al. Ethnic disparities in diabetic complications in an insured population. *JAMA* 2002;287:2519–2527. [PubMed: 12020332]
- UK Prospective Diabetes Study (UKPDS) Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). *Lancet* 1998;352:837–853. [PubMed: 9742976]
- Beckles GL, Engelgau MM, Narayan KM, et al. Population-based assessment of the level of care among adults with diabetes in the U.S. *Diabetes Care* 1998;21:1432–1438. [PubMed: 9727887]
- Saaddine JB, Engelgau MM, Beckles GL, et al. A diabetes report card for the United States: quality of care in the 1990's. *Ann Intern Med* 2002;136:565–574. [PubMed: 11955024]
- American Diabetes Association. Management of dyslipidemia in adults with diabetes. *Diabetes Care* 2001;24:S58–S61.
- Haffner SM. Management of dyslipidemia in adults with diabetes. *Diabetes Care* 1998;21:160–178. [PubMed: 9538988]
- Burchfiel CM, Shetterly SM, Baxter J, Hamman RF. The San Luis Valley Diabetes Study. The roles of insulin, obesity, and fat distribution in the elevation of cardiovascular risk factors in impaired glucose tolerance. *Am J Epidemiol* 1992;136:1101–1109. [PubMed: 1462970]
- Ferrannini E, Haffner SM, Stern MP, et al. High blood pressure and insulin resistance: influence of ethnic background. *Eur J Clin Invest* 1991;21:280–287. [PubMed: 1909631]
- Després JP, Nadeau A, Tremblay A, et al. Role of deep abdominal fat in the association between regional adipose tissue distribution and glucose tolerance in obese women. *Diabetes* 1989;38:304–309. [PubMed: 2645187]

15. Mainous AG, King DE, Garr DR, et al. Rural residence and control of diabetes and hypertension. *Ann Fam Med* 2004;2:563–568. [PubMed: 15576542]
16. Brown SA, Duchin SP, Villagomez ET. Diabetes education in a Mexican-American population: pilot testing of a research-based videotape. *Diabetes Educ* 1992;18:47–51. [PubMed: 1370266]
17. Corkery E, Palmer C, Foley ME, et al. Effect of a bicultural community health worker on completion of diabetes education in a Hispanic population. *Diabetes Care* 1997;20:254–257. [PubMed: 9051367]
18. Anderson-Loftin W, Bennett S, Bunn P, et al. Soul Food Light: culturally competent diabetes education. *Diabetes Educ* 2005;31:555–563. [PubMed: 16100331]
19. Skelly A, Samuel-Hodge C, Elasy T, et al. Development and testing of culturally sensitive instruments for African American women with type 2 diabetes. *Diabetes Educ* 2000;26:769–777. [PubMed: 11140006]
20. Duraski SA. Stroke prevention education in the Hispanic community. *Rehabil Nurs* 2006;31:5–9. [PubMed: 16422038]
21. Brown SA, Hanis CL. Culturally competent diabetes education for Mexican Americans: the Starr County Study. *Diabetes Educ* 1999;25:226–236. [PubMed: 10531848]
22. Reljic R, Ries M, Anic N, et al. New chromogen for assay of glucose in serum. *Clin Che* 1992;38:522–535.
23. Rifai, N.; Warnick, GR. *Methods for Clinical Laboratory Measurement for Lipid and Lipoprotein Risk Factors*. Washington, DC: AACC Press; 1991.
24. Stein, EA.; Myres, GI.; Burtis, CA., et al. Lipids, lipoprotein and apolipoprotein. In: Burtis, CA.; Ashwood, ER., editors. *Tietz Textbook of Clinical Chemistry*. Vol. 2nd ed.. Philadelphia: W. B. Saunders; 1994. p. 1002-1093.
25. Nelson TL, Bessesen DH, Marshall JA. Relationship of abdominal obesity measured by DXA and waist circumference with insulin sensitivity in Hispanic and non-Hispanic white individuals: the San Luis Valley Diabetes Study. *Diabetes Metab Res Rev* 2008;24:33–40. [PubMed: 17510915]

Figure 1. Percentage of study subjects for mean fasting plasma glucose, insulin, and hemoglobin A1c at baseline and 3 months. * $P < .001$.

Figure 2. Percentage of study subjects for mean fasting plasma lipid profile at baseline and 3 months. HDL, high-density lipoprotein; LDL, low-density lipoprotein. * $P < .001$.

Table 1

Baseline Characteristics of Study Subjects (N = 34)

Variable	%
Age, y	
37–39	11.8
40–49	26.5
50–59	41.2
60–69	20.6
Gender	
Female	73.5
Male	26.5
Weight, kg	
49–59	11.8
60–69	17.6
70–79	23.5
80–89	11.8
90–99	20.6
100–122	14.7
Body mass index, kg/m ²	
21–24	14.7
25–29	29.4
30–47	55.9

Table 2

Changes in Lipid Profile, HbA1c, Fasting Blood Glucose, and Insulin After 3 Months of Spanish Diabetes Education, Both Genders (N = 34)

Variable	Baseline, Mean $\pm$ SD	3 Months, Mean $\pm$ SD	Mean Difference	P Value ^a
Fasting glucose, mg/dL	166.41 $\pm$ 65.98	143.21 $\pm$ 57.89	23.20	.001 ***
HbA1c, %	7.9 $\pm$ 2.02	7.08 $\pm$ 1.66	0.82	.00001 ***
Insulin, μ g/L	12.89 $\pm$ 9.6	12.55 $\pm$ 12.41	0.34	.75
Total cholesterol, mg/dL	190.59 $\pm$ 44.18	185.00 $\pm$ 49.57	5.59	.22
HDL, mg/dL	44.65 $\pm$ 8.87	48.85 $\pm$ 11.43	-4.20	.001 ***
LDL, mg/dL	123.38 $\pm$ 38.28	118.41 $\pm$ 37.64	4.97	.21
Cholesterol/HDL ratio, %	4.35	3.87	0.48	.001 ***
Triglycerides, mg/dL	217.41 $\pm$ 131.03	193.97 $\pm$ 128.59	23.44	.07

Actual means, standard deviations, and mean differences are presented in the table. HDL, high-density lipoprotein; LDL, low-density lipoprotein.

^a P values are calculated based on the log transformation.

*** P < .001 (t test).

Table 3

Changes in Body Weight, Body Mass Index, and DXA Body Composition After 3 Months of Spanish Diabetes Education, Both Genders (N = 34)

Variable	Baseline, Mean $\pm$ SD	3 Months, Mean $\pm$ SD	Mean Difference	P Value
Body weight, kg	81.25 $\pm$ 17.90	80.31 $\pm$ 17.97	0.94	.02 ***
Body mass index, kg/m ²	32.18 $\pm$ 7.02	31.73 $\pm$ 6.72	0.45	.13
Total fat, kg	30.41 $\pm$ 10.68	29.49 $\pm$ 10.52	0.92	.001 ***
Total fat, %	39.60 $\pm$ 10.61	35.77 $\pm$ 7.52	3.83	.001 ***
Trunk fat, kg	16.54 $\pm$ 5.73	15.93 $\pm$ 5.59	0.61	.001 ***
Fat-free mass, kg	49.81 $\pm$ 10.65	49.58 $\pm$ 10.71	0.23	.29
Waist-to-hip ratio, cm	0.934 $\pm$ 0.076	0.910 $\pm$ 0.073	0.02	.03 ***

P < .001 (t test).

Table 4

Pearson Correlation Coefficients for Selected Body Compositions Changes: Baseline Versus 3 Months (N = 34)

Variable	Body			Total			Fat-Free			Total	
	Insulin	Mass	Index	Weight	Fat	Fat	Mass	Triglycerides	Cholesterol	Cholesterol	Cholesterol
Insulin	1.00	—	—	—	—	—	—	—	—	—	—
Body mass index	0.522	**	1.00	—	—	—	—	—	—	—	—
Weight	0.550	**	0.921	1.00	—	—	—	—	—	—	—
Total fat	0.480	**	0.942	0.826	**	1.00	—	—	—	—	—
Trunk fat	0.468	**	0.936	0.874	**	0.968	**	1.00	—	—	—
Fat-free mass	0.440	**	0.582	0.836	**	0.384	*	0.496	**	1.00	—
Triglycerides	0.238	0.342	0.252	0.295	0.284	0.109	0.109	1.00	—	—	—
Total cholesterol	0.058	0.184	0.078	0.274	0.285	-0.144	-0.144	0.472	**	1.00	—

* $P < .05$.

** $P < .01$.