Published in final edited form as:
J Immigr Minor Health. 2011 October ; 13(5): 809–817. doi:10.1007/s10903-010-9428-3.

Determinants of Fasting Plasma Glucose and Glycosylated Hemoglobin Among Low Income Latinos with Poorly Controlled Type 2 Diabetes

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Abstract

The objective of this study was to identify demographic, socio-economic, acculturation, lifestyle, sleeping pattern, and biomedical determinants of fasting plasma glucose (FPG) and glycosylated hemoglobin (HbA1c), among Latinos with type 2 diabetes (T2D). Latino adults (N = 211) with

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T2D enrolled in the DIALBEST trial were interviewed in their homes. Fasting blood samples were also collected in the participants' homes. Because all participants had poor glucose control, above-median values for FPG (173 mg/dl) and HbA1c (9.2%) were considered to be indicative of poorer glycemic control. Multivariate analyses showed that receiving heating assistance (OR: 2.20; 95% CI: 0.96–4.96), and having a radio (3.11, 1.16–8.35), were risk factors for higher FPG levels, and lower income (10.4, 1.54–69.30) was a risk factor for higher HbA1c levels. Lower carbohydrate intake during the previous day (0.04; 0.005–0.37), as well as regular physical activity (0.30; 0.13–0.69), breakfast (2.78; 1.10–6.99) and dinner skipping (3.9; 1.03–14.9) during previous week were significantly associated with FPG concentrations. Being middle aged (2.24, 1.12–4.47), 30–60 min of sleep during the day time (0.07, 0.01–0.74) and having medical insurance (0.31, 0.10–0.96) were predictors of HbA1c. Results suggest that contemporaneous lifestyle behaviors were associated with FPG and contextual biomedical factors such as health care access with HbA1c. Lower socio-economic status indicators were associated with poorer FPG and HbA1c glycemic control.

Keywords

Fasting plasma glucose; Glycosylated hemoglobin; Type 2 diabetes; Low income Latinos; Hispanics

Introduction

Diabetes contributes to 7.8% of disease burden in the Unites States (US) affecting 23.6 million people [1]. The economic impact of diabetes to health resources utilization and lost productivity in the US was approximately $174 million in 2007 [2]. The disease brings about serious complications due to dysfunction of multiple organ systems. Uncontrolled hyperglycemia is associated with micro and macrovascular pathologies [3].

Although metabolic glycemic control—the primary goal in the management of diabetes—reduces the incidence of complications such as visual impairments, end-stage renal diseases, mortality and lower extremity amputations in type 2 diabetes [3], achieving it is difficult. This is because, in addition to genetic predisposition and metabolic factors, various environmental factors impact disease outcomes [4]. Diabetes metabolic control involves diet, exercise and medications. Because these proximal determinants are influenced by more distal environmental factors it is important to consider these as well. For example, low socio-economic status (SES) and depression have been shown to interfere with a person's ability to attain adequate glycemic control [5].

The prevalence of risk factors such as obesity [6], lower physical activity [7], and lower SES [8] and diabetes-related complications [9] are more prevalent among Latinos compared to non-Hispanic Whites [10]. In Hartford County, Connecticut, the location of the current investigation, about 14% of the total population is Latino, and in the city of Hartford, this ethnic group represents more than 40% of the population. In Connecticut, Latinos are less likely than Non-Hispanic Whites to have health insurance coverage and to be employed [11]. They also have lower household incomes and levels of education and are more likely to be overweight or obese [11].

Among various blood tests for assessing glycemic control, fasting plasma glucose (FPG) and glycosylated hemoglobin A1c (HbA1c) measurements are widely used in clinical and research settings to assess short- and longer term glycemic control, respectively. Since the time frame of glycemic control predicted by these blood parameters is different, it is likely that the predictors of FPG and HbA1c are different. The scarcity of studies examining the associations between the distal and proximal factors with the short- (FPG) and/or longer-term (HbA1c) glycemic control among low-income Latino adults represents an important gap in knowledge.

The objective of these analyses was to identify the demographic, socio-economic, acculturative, lifestyle, sleeping patterns, and biomedical factors associated with FPG and HbA1c, among low income Latinos with type 2 diabetes. We hypothesized a priori that: (a) contextual socio-economic, demographic, and acculturative factors as well as chronic physical and mental health conditions would be related to both short- and longer-term glycemic control, (b) lifestyle factors such as diet, and physical activity representing a short period of time preceding the survey would be more strongly related to short versus longer-term glycemic control, (c) Health insurance coverage is likely to affect more longer-term than short-term glycemic control as it reflects better access to secondary prevention screenings and treatments.

Methods

This study was approved by the Institutional Review Board of the University of Connecticut, Hartford Hospital, and the Hispanic Health Council.

Study Participants

Latino adults with diagnosed type 2 diabetes were recruited from a metabolic syndrome clinic at Hartford Hospital from December 2006 to February 2009 (N = 211). This study presents the findings from the baseline data of a randomized controlled longitudinal study—the Diabetes among Latinos Best Practices Trial (DIALBEST)— involving peer-counselors in the diabetes care of low-income Latino adults with type 2 diabetes. Specific details about DIALBEST design and procedures have been reported elsewhere [12]. Participants were included if they: (1) were > 21 year, (2) were living in Hartford County, (3) had HbA1c levels ≥ 7%, and (4) had no medical conditions that completely limit their ability to perform physical activity.

Data Collection

Baseline data were collected after obtaining participants' written informed consent, and included survey questionnaire and clinical (fasting blood measurements, height, weight, waist circumference, hip circumference) measures.

Questionnaire

A pre-tested and validated study questionnaire was administered at the participants' home by one of three trained bicultural/bilingual (Spanish and English) interviewers. The DIALBEST research coordinators ensured quality control via frequent field visits with interviewers/phlebotomists and review of charts of all the participants every week. The survey questionnaire collected data on multiple domains.

Demographic—Data were collected on participant's age, gender, ethnicity, and marital status. Participants were classified as younger adults (21–40 year), middle-aged (41–60 year) and older adults (>60 year).

Socio-Economic—Variables measured included monthly income, education, employment, household size, household possessions, participation in government assistance programs and household food security. The 2000 US Census Bureau Current Population survey found that almost 1/3rd of Hispanic households have five or more people living in them [13]. Thus, this cut-off value was used to classify household size into two categories;

≤5 versus >5 people. A four-level household income variable was created to classify households into one of the following per capita income categories: <$100, $101–300, $301–500, or $>500. Household possessions were represented by dichotomous variables reflecting the presence/absence of the following items in the household: radio, television, DVD player, computer, internet connection, land phone, cell phone, microwave oven and car. Data were also collected regarding participation in government assistance programs such as the Supplemental Nutrition Assistance Program (SNAP) and heating assistance. Participation in food pantries was also recorded. Food security was measured using a short form of the US Household Food Security Survey Module [US HFSSM] [14]. If the participants affirmed any of the questions, their households were considered to be food insecure [14].

Acculturation—This construct was proxied by the amount of time living in the US, spoken language(s) preferences, and measured more directly with the Acculturation Rating Scale for Mexican Americans II (ARSMA), scale 1 [15].

Lifestyle—Dietary intake was assessed using a food frequency questionnaire (FFQ) covering the 12 months preceding the survey and a 24 h recall that collected dietary intake during the previous day of blood draw. Participants were also asked to report on their meal skipping patterns. Additional lifestyle related variables included physical activity, and blood glucose self monitoring.

The FFQ included questions on culture specific food items. Participants reported the frequency of intake on a daily, weekly, monthly or annual basis. Individual foods were grouped into frequency of consumption for the following food groups: fruits, vegetables, meats, fish and sea food, rice, wheat and other cereals, dairy products, and sweet and snacks intake.

The 24-recall data were entered into the Nutrition Data System (NDS) (Nutrition Coordinating Center, University of Minnesota) by trained Spanish speaking Nutritional Science graduate students. The NDS estimates of total calorie, percentage consumption of macronutrient (total carbohydrate, fat and protein, and different types of carbohydrate, fat and protein), and dietary fiber (total, soluble, insoluble fiber) were used for our analyses. Nutrients were categorized into quintiles of intake. Carbohydrate intake was further classified based on the American Diabetes Association (ADA) recommendation. ADA recommends eating at least 130 *g* (~ 520 kcal) of carbohydrate everyday [16]. In our study, a carbohydrate intake of 330 g/day or more was defined as excessive as it corresponded to the 90th percentile of the intake distribution.

Participants were classified based on the frequency of meal skipping into the following categories: ≥4 times, 1–3 times, or never. Further, dinner skipping was re-classified into ≥1 time and never, since the first two categories (≥4 times, 1–3 times) showed similar associations with glucose control. Regarding physical activity, participants were asked whether or not they practiced moderate physical activity (for example, brisk walking) for at least 30 min a day, for five or more days a week [16,17] during the 7 days preceding the survey.*Sleeping Patterns*: Night and day sleeping time during a typical week was assessed. Various studies done on napping have used a range of cutoff points from 20 min to 2 h [18–21]. Following exploratory analyses, we categorized hours of sleep during the day time as the following: never, <30 min, 30–60 min, 1–2, or ≥2 h per day. Respondent's night hours of sleep was categorized into quartiles as <4, 4–6, 6–8 and >8 h per day.

Biomedical—Data were collected on health insurance status, self-reported hypertension, medication intake, and depression symptoms. Health insurance questions asked about the availability and type of health insurance during the previous 12 months. One variable identified participants as having or not having health insurance. A second variable identified the type of health insurance as Medicare, Medicaid, or private. Hypertension was self-reported based on the questions "Has the doctor told you that you have high blood pressure?" Participants' self-reported medication use was confirmed against the medication bottles in the participant's homes. Depression was measured using the Center for Epidemiologic Studies (CES-D) Scale [22]. CESD scale measures certain somatic symptoms such as decreased energy or sleep disturbances which are symptoms of chronic diseases as well as depression [23]. Among individuals with chronic diseases it has been previously recommended to use a CES-D cut-off point of at least 22 (vs. 16 in the general population [22]) to identify risk for clinical depression [24–26]. This is to counteract the high rates of physical symptoms attributable to medical disorders that might co-occur with depression. Another study conducted among Puerto-Ricans showed that participants having lower socio-economic status tend to report more depressive symptoms in self-reported scales that do not match the clinical criteria of depression [27]. Based on misclassification analyses, a cut-off point of 26 was recommended [27] and used in our study.

Clinical Assessments

Anthropometrics Measurements—Height, waist and hip circumferences were measured in centimeters and weight in Kg using calibrated equipment and following standard procedures. Body mass index (Weight in kilogram/height in meter^2), waist-height-ratio and waist-hip ratio were calculated.

Fasting blood Measurements—Fasting blood (2 ml) was collected into evacuated tubes coated with EDTA and sodium fluoride. Blood samples were transported to the laboratory and centrifuged at 2,200 × *g* for 30 min at 4°C to separate plasma for FPG analyses. FPG was measured using a YSI-2300 stat plus glucose & lactate analyzer (YSI life sciences, Yellow Springs, OH) in duplicate. HbA1c was measured from capillary blood using an A1cNow INView' device (Metrika Inc., Sunnyvale, CA), an FDA approved and National Glycohemoglobin Standardization Program certified instrument that accurately measures HbA1c in home settings. Because of inclusion criteria (HbA1c ≥7%) all the participants had poor longer-term (proxied by HbA1c) and short-term (proxied by FPG) glycemic control. Therefore, the median sample values for FPG (9.6 mmol/l (~173 mg/dl)) and HbA1c (9.2%) were used as the cut-off scores for defining glycemic control as either 'better' or 'poorer'.

Statistical Analyses

All data were analyzed using the Statistical Program for the Social Sciences for Windows (SPSS v.15.0; SPSS Inc., Chicago). Bivariate analyses were done using Chi square test and were used to examine the association of FPG and HbA1c levels with demographic, socio-economic, acculturative, lifestyle, sleeping pattern and biomedical factors. In the current analyses, FPG and HbA1c were used as categorical dependent variables (above vs. below-median values). The independent variables that were significantly ($P \leq 0.05$) or marginally significantly ($P < 0.1$) associated with glycemic indicators in the bivariate analyses were then entered into the multivariate logistic regression model. These models were run using backward stepwise elimination procedures, and the Hosmer–Lemeshow test was used for assessing the goodness of fit of the models. Results were expressed as odds ratio (OR) and their respective 95% CI.

Results

Descriptive Characteristics

Mean participant age was 56.4 ± 11.8 year. The majority of the subjects were females (n = 155; 73.5%) and were predominantly Puerto Rican (n = 171; 81%). About 43% of participants were separated, divorced or widowed. Monthly household income from work, government assistance and other sources was very low with over half of the participants having a monthly income of $1,000 or less. About two-thirds (62.8%) of the participants had a monthly per capita income of <$500. The majority had either no education or did not finish high school (74%). Only ~ 16% of study participants were employed. The mean number of persons living in each household was 2.6 ± 1.6 with a range of 1–10 people per household. Households were also enrolled in government assistance programs such as the SNAP (73%) and Heating Assistance Program (36%). Above 65% of the participants spoke Spanish only. The majority of the participants reported having publicly funded health insurance during the past 12 months. The vast majority of the insured were enrolled in either Medicaid or Medicare and <3% had private insurance (Table 1).

An estimated 58% of participants had self-reported hypertension. Among those who were on prescription medications, a significant proportion used oral diabetes medications alone (48.8%) or in combination with insulin (40.1%). Mean BMI was high with an average of 33.7 ± 7.8 kg/m^2. About 71% of the participants were either overweight or obese, and 19% were morbidly obese. Mean FPG and HbA1c were 10.6 ± 4.7 mmol/l (~ 191 mg/dl) and 9.6 ± 1.8%, respectively. Median FPG was 9.6 mmol/l (~ 173 mg/dl) and median HbA1c was 9.2% (Table 1). About 17% of participants' with above-median HbA1c did not have above-median FPG levels. Likewise, 17% participants with below-median HbA1c did not have below-median FPG levels (data not shown). Thus, there was enough variance in the study to examine factors associated with both short- and longer-term glycemic control.

Multivariate Analyses

Factors Associated with FPG—Participants living in smaller households were less likely to have higher FPG concentrations compared to their counterparts coming from larger households (OR = 0.12; *P* = 0.08). The odds of having high FPG were 3.1 times higher among those who had radio (with or without stereo/CD player) at their household. The odds of having high FPG levels were 2.2 times higher among those who received heating assistance compared with those who did not receive it (*P* = 0.06). The participants who consumed <330 *g* of carbohydrate per day were less likely to have high FPG compared to their counterparts who consumed ≥330 *g* of carbohydrate (equivalent to ≥1,320 kcal of energy from carbohydrate alone) on the previous day (OR = 0.04). The odds of having high FPG among those who skipped breakfast for ≥4 times per week were 2.8 times higher than among those who never skipped their breakfast. Similarly, the odds of having poorer FPG control were 3.9 times higher among participants who skipped dinner at least once per week compared to others who never skipped dinner. Participants who followed the recommended levels of physical activity during the previous week were less likely to have high FPG levels (OR = 0.30) (Table 2).

Being middle aged (41–60 year), being single, having a DVD player in the household, participating in the SNAP programs, higher SNAP benefits, and higher total energy and starch intake on the previous day, were all significantly associated with high FPG in the bivariate analysis although not associated in the multivariate analyses (data not shown). Bivariate analyses also showed that short sleeping time during day (30–60 min) and 4–6 h of sleep during the night, and use of fibrates (a medicine used to treat hyperlipidemia) were significantly associated with lower FPG, but these associations were no longer significant in the multivariate analyses (data not shown).

Factors Associated with HbA1c—Multivariate analyses showed that middle aged participants had 2.2 times the odds of having high HbA1c compared to their elderly counterparts. Individuals living in households earning <$ 100 monthly per capita had 10.4

times the odds of having high HbA1c. Consistent with this, participants living in smaller households (i.e., <5 members) were less likely to have high HbA1c (OR = 0.14; $P = 0.052$). Sleeping time during day was a significantly associated with HbA1c following a non-linear pattern. Participants who took a nap for 30–60 min/day were less likely to have high HbA1c compared to those who did not (OR = 0.07). However, taking shorter (<30 min) or longer naps during the day (>60 min) increased the odds of having high HbA1c. Participants with health insurance coverage were less likely to have high HbA1c (OR = 0.31) (Table 3). Use of fibrate medication was associated with lower HbA1c levels in the bivariate but not in the multivariate analyses (data not shown).

Discussion

Findings from this study provide new insights on the factors influencing short versus longer-term glycemic control among highly disenfranchised individuals with poorly controlled type 2 diabetes. In agreement with our hypotheses, multivariate analyses showed that whereas some factors were associated with both FPG and HbA1c, others were specifically associated with only one of them. Specifically, SES indicators were associated with both FPG and HbA1c. Long-term glycemic control was better among participants having medical insurance. Taking short naps was also protective against higher HbA1c concentrations. Being in the middle age bracket was associated with poorer HbA1c control. By contrast, lower carbohydrate intake in the previous day, and not skipping meals and following recommended physical activity in previous week, were protective against higher FPG concentrations.

Factors Associated with Both FPG and HbA1c

As expected [28–30] SES variables were associated with both FPG and HbA1c although the SES indicators were not necessarily the same in both instances. Household size was an important predictor of short and longer-term glycemic control. Having a higher number of persons in the household could strain even further the lower SES of the household in the absence of adequate income. Our finding that, “possession of radio” is a risk factor for having higher FPG even after adjusting for carbohydrate intake during the previous day, exercise, and breakfast/dinner skipping during previous week is interesting. In this study having a radio may have been an SES proxy as this indicator was related to unemployment ($P = 0.02$). Participants who received assistance to pay for heating had higher FPG levels. We observed that, those who received heating assistance were from lower SES households ($P = 0.02$) compared to others who did not receive the assistance. It is possible that in addition to the constant stress associated with poverty together with acute stress related to lack of money to pay for heating during the cold months explains this finding. This hypothesis needs to be tested through future research. In addition, the current study shows that lower monthly household income was a risk factor for having poorer longer-term glycemic control. Results from various studies underline the fact that low SES has a strong negative influence on health status [30]. Poverty may limit substantially the access that individual with type 2 diabetes may have to follow healthy lifestyles [28] and proper medical care [29].

In the case of diabetes care, overall improvement in household SES is essential to support various aspects of self-care management other than medical treatment which include transportation to doctor’s office, or pharmacy, and financial support for glucose monitoring supplies, leisure time physical activity facilities, and access to a healthy diet [31].

Factors Associated with FPG Only

Lower carbohydrate intake, not skipping meals and recommended physical activity during previous week were protective against higher FPG concentrations.

As hypothesized, participants who consumed less carbohydrate on the day preceding the FPG assessment were much less likely to have high FPG compared to those who consumed more carbohydrate during the same period of time. It has been previously shown that high blood glucose levels following a carbohydrate rich meal do not induce a compensatory increase in insulin levels among patients with type 2 diabetes [32]. In our study, participants who skipped breakfast or dinner were more likely to have higher FPG levels. Evidence on the influence of breakfast skipping on glycemic control is scarce. A study that examined the effects of breakfast skipping on obesity found that regular breakfast eating helped to reduce dietary fat consumption and impulsive snacking [33]. In addition, a cross-sectional survey among a group of young Latinos found that regular breakfast consumption was associated with lower visceral adiposity [34]. Apart from breakfast skipping, dinner skipping was also a risk factor for short-term glycemic control. In patients with type 2 diabetes on glucose lowering drugs, hypoglycemia may occur early in the morning (at around 3 AM), especially when they skip their dinner as this behavior evokes the release of counter-regulatory hormones such as growth hormone, cortisol, and catecholamines leading to hyperglycemia in the morning hours (at around 7 AM); i.e., the Somogyi effect [35].

Multivariate analyses showed that exercising moderately for at least 30 min per day for five days during the week preceding the survey was protective for short term glycemic control. This is in agreement with longer-term physical activity interventions for type 2 diabetes patients. Baldi et al. observed that a 10-week regular exercise schedule was associated with significant reduction in FPG levels [36]. Muscle contraction during exercise stimulates GLUT 4 translocation to the muscle surface, increasing the glucose transport [37]. Exercise is also associated with increased insulin sensitivity, intramuscular triglyceride utilization and fat oxidation [38]. Decreased fat mass and increased glucose utilization eventually favors proper glycemic control among individuals with diabetes [38].

Factors Associated with HbA1c Only

In support of our hypothesis, health insurance during the year preceding the survey was protective against higher HbA1c levels. This finding supports the conclusion that health insurance coverage is important in the management of type 2 diabetes [39]. Diabetes, being a chronic disease warrants regular and uninterrupted health care and medication access, nutritional support and mental health services [36].

The results from our study suggest a protective effect of short napping during the day (30–60 min) on long term glycemic control. Studies done in the general population have demonstrated beneficial effects such as improved night time sleep, day time alertness and work performance associated with short day time napping [18].The effect of napping on glycemic control among people with type 2 diabetes has not been previously reported. Thus, future prospective studies are needed to better understand the non-linear association between napping time and HbA1c found in our study.

Our study showed that glycemic control was poorer among middle-aged people compared to the elderly sub-sample. Longer-term glycemic control among the younger adult participants was not significantly better than among the older adults. In order to further understand this finding, we examined the bivariate association between age and other independent variables. Younger and middle aged participants had lower incomes and were less likely to have health insurance. Both of these factors are associated with poorer longer-term glycemic control and may partially explain this unexpected finding.

Factors not Associated with Either FPG or HbA1c

All indicators of low SES associated with glycemic control in our study represent household level variables. In our study, demographic factors such as gender or ethnicity, and individual level SES factors such as participants' education or employment status did not have a significant association with either FPG or HbA1c levels. Household food security, acculturation, food group variables derived from the FFQ, night sleeping pattern, self-reported hypertension, regular self-monitoring of blood glucose, medication intake, depression symptoms, and anthropometric measurements were not significantly associated with either FPG or HbA1c levels in multivariate analyses.

In sum, in support of our original hypotheses, the current study shows that life style behaviors followed within a day or week prior to blood draw were more likely to be associated with FPG levels rather than HbA1c. These behaviors included meal skipping, carbohydrate intake, and physical activity. By contrast and as expected, health insurance during the previous year was associated with better longer-term glycemic control and SES indicators were associated with both.

Our study has some limitations. Due to its cross-sectional design the temporal sequence of events could not be assessed. For example, the temporal relationship between lower monthly income and higher HbA1c levels could not be deduced. It could be that low monthly income was a consequence of high HbA1c levels or vice versa. In the current study, a single 24 h recall was used to study the association between nutrient intakes and FPG levels. Further studies including multiple 24 h recalls (including week days and weekend days) are likely to detect additional associations as a result of lowering the intra-individual day-to-day dietary intake variability. Our study targeted by design individuals with low SES. It is possible that lack of a significant association between education and occupation with FPG or HbA1c could be due to lack of sufficient variability in our sample. Also, our subjects were mostly females and Puerto-Ricans, thus limiting the external validity of our study to predominantly female Puerto-Rican populations with very low SES. Lastly the time since diagnosis with type 2 diabetes could not be established in our study, and thus this important variable could not be examined in relationship to glycemic control outcomes.

Conclusion

The protective roles of medical insurance and regular exercise in diabetes care were supported by our study. Our study also indicated that even though several determinants of poorer short- and longer-term glycemic control differed, both were associated with household level SES indicators. Also this study demonstrated that while previous day's/week's lifestyle and dietary intake related activities influence short-term glycemic control, socio-demographic factors, health insurance, and short-napping influence longer term glycemic control.

Acknowledgments

This study was funded and supported by Connecticut NIH Export Center for Eliminating Health Disparities among Latinos (NIH- NCMHD grant # P20MD001765). Special thanks to all who participated in the study and to community health care workers at the Hispanic Health Council. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Center on Minority Health and Health Disparities or the National Institutes of Health.

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Table 1

Demographic, socio-economic, and biomedical characteristics of participants, N = 211

Age (year), mean ± SD	56.4 ± 11.8
Gender—female, n (%)	155 (73.5)
Ethnicity, n (%)	
Puerto Rican	171 (81.0)
Other Hispanic or Latino	13 (6.2)
Puerto Rican–American	27 (12.8)
Marital status, n (%)	
Single	59 (28.0)
Married/living together	62 (29.3)
Separated/divorced/widowed	90 (42.7)
Monthly household income per capita, n (%)	
≤$100	18 (8.7)
$ 101–300	59 (28.5)
$ 301–500	53 (25.6)
$>500	77 (37.2)
Educational status, n (%)	
No education	9 (4.3)
Some schooling	147 (69.7)
High school graduate/technical training	42 (19.9)
College education	11 (6.2)
Employed, n (%)	33 (15.6)
Number of persons living in household, mean ± SD	2.6 ± 1.6
Possessions	
Radio, yes	164 (77.7)
DVD player, yes	145 (68.7)
Government assistance	
Heating assistance	75 (35.5)
Supplemental nutrition assistance program	154 (73.0)
Languages spoke, n (%)	
English and Spanish	73 (34.6)
Spanish only	138 (65.4)
Health insurance, yes, n (%)	182 (86.3)
Medicare/medicaid	177 (97.3)
Individual/group insurance	5 (2.7)
Hypertension (N = 208), Yes, n (%)	120 (57.7)
Hypoglycemic medication	
Oral medication only	101 (48.8)
Insulin only	17 (8.2)
Both oral medication and insulin	83 (40.1)
Fibrates use	10 (4.7)

Body mass index (kg/m^2)	
Mean	33.7 ± 7.8
Normal (18.4–24.9)	21 (10.2%)
Over weight (25–29.9)	47 (22.9%)
Obese (30–39.9)	99 (48.3%)
Morbidly obese (>40)	38 (18.5%)

	Fasting plasma glucose	**n (%)**	**HbA1c (%)**	**n (%)**
Fasting blood measurements				
Quartile 1	<7.4 mmol/l	47 (22.3)	<8.3	52 (24.6)
Quartile 2	≥7.4 to <9.6 mmol/l	58 (27.5)	≥8.3—9.2	52 (24.6)
Quartile 3	≥9.6 to 12.3 mmol/l	52 (24.6)	≥9.2—11	53 (25.1)
Quartile 4	≥12.3 mmol/l	54 (25.6)	≥11	54 (25.6)
Mean ± SD	10.57 ± 4.7 mmol/l		9.57 ± 1.8	
Median	9.6 mmol/l (~ 173 mg/dl)		9.2	

Table 2

Multivariate analyses of factors associated with high fasting plasma glucose among Latinos with type 2 diabetes

	N	Crude OR	95% CI	N[a]	Adjusted OR[b]	95% CI
Number of person in the household						
≤5	197	0.21	0.04–1.00	137	0.12	0.01–1.35
>5	11	1	–	8	1	–
Possession of radio in the household						
Yes	164	2.09	1.07–4.09	108	3.11	1.16–8.35
No	47	1	–	37	1	–
Heating assistance						
Yes	75	1.72	0.97–3.05	58	2.20	0.96–4.96
No	135	1	–	87	1	–
Carbohydrate intake on the previous day						
<330 g	187	0.15	0.04–0.53	128	0.04	0.005–0.37
≥330 g	20	1	–	17	1	–
Breakfast skipping per week (d)						
≥4	54	3.45	1.75–6.83	44	2.78	1.10–6.99
1–3	15	0.89	0.29–2.62	11	0.38	0.08–1.90
Never	142	1	–	90	1	–
Dinner skipping per week (d)						
≥1	26	3.01	1.23–7.62	16	3.9	1.03–14.9
Never	185	1	–	129	1	–
Regular and adequate physical activity						
Yes	95	0.47	0.27–0.82	68	0.30	0.13–0.69
No	116	1	–	77	1	–

[a] N corresponds to the sample size in the logistic regression analyses. It was reduced in the regression model

[b] Backward stepwise multivariate logistic regression: The following variables were removed from the model during backward stepwise variable elimination process: age, marital status, payment method for diabetes medication, SNAP benefit, fibrates, soup kitchen, DVD player in the house, and total energy intake during the previous day. Hosmer–Lemeshow goodness of fit test *P* value = 0.62

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Table 3

Multivariate analyses of factors associated with high HbA1c among Latinos with type 2 diabetes

	N	Crude OR	95% CI	N[a]	Adjusted OR[b]	95% CI
Age						
21–40 year	23	0.99	0.36–2.33	21	0.56	0.17–1.84
41–60 year	99	2.27	1.26–4.10	86	2.24	1.12–4.47
>60 year	87	1	–	82	1	–
Household income per capita						
<$100	18	4.43	1.34–14.68	15	10.4	1.54–69.3
$ 100–300	59	1.22	0.62–2.41	55	1.05	0.46–2.42
$ 300–500	53	1.42	0.70–2.86	48	1.6	0.71–3.56
>$ 500	77	1	–	71	1	–
Number of persons in house						
<5	197	0.21	0.05–1.02	178	0.14	0.02–1.02
≥5	11	1	–	11	1	–
Sleeping time–day						
<30 min	42	1.29	0.64–2.61	40	1.78	0.79–3.95
30–60 min	13	0.08	0.01–0.64	13	0.07	0.01–0.74
1–2 h	14	1.29	0.42–3.94	14	1.77	0.52–6.08
≥2 h	13	2.18	0.64–7.45	12	1.8	0.43–7.87
No	124	1	–	110	1	1
Medical insurance						
Yes	182	0.34	0.14–0.81	163	0.31	0.10–0.96
No	29	1.00	–	26	1.00	–

[a]N corresponds to the sample size obtained in the logistic regression analyses. It was reduced in the regression model

[b]Backward stepwise multivariate logistic regression: Following variables were dropped from model during backward stepwise variable elimination process: Medicare, amount of time living in the US, blood glucose self-monitoring, payment method for diabetes medication, sleeping time during night, ACE inhibitor, and fibrates. Hosmer–Lemeshow goodness of fit test *P* value = 0.85