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Long work hours is associated with suboptimal glycemic control among US workers with diabetes

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Abstract

Background: Increasing numbers of US workers are diabetic. We assessed the relationship between glycemic control and work hours and type of occupation among employed US adults with type 2 diabetes.

Methods: Data were obtained from the 1999–2004 National Health and Nutrition Examination Survey (NHANES). A representative sample of employed US adults ≥ 20 years with self-reported type 2 diabetes (n=369) was used. Two dichotomous glycemic control indicators, based on various HbA1c level cut-points, were used as dependent variables in weighted logistic regression analyses with adjustment for confounders.

Results: Adults working over 40 hours per week were more likely to have suboptimal glycemic control (HbA1c ≥ 7%) compared to those working 20 hours or less (odds ratio= 5.09; 95% confidence interval: [1.38–18.76]).

Conclusions: Work-related factors, such as number of hours worked, may affect the ability of adults with type 2 diabetes to reach and maintain glycemic control goals. These factors should be considered in the development of workplace policies and accommodations for the increasing number of workers with type 2 diabetes.

Background

For adults with diabetes, maintaining normal or close to normal glucose levels is essential to the prevention of diabetes-related complications. In the United States (US), inadequate

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There are no conflicts of interest to declare.

glycemic control is a significant problem among adults with diabetes. Despite significant educational efforts, recent data have shown that approximately 50% of the US population with diabetes has hemoglobin values (i.e., HbA1c) greater than or equal to 7% (i.e., consistent with suboptimal glycemic control) [Hoerger, et al. 2008]. Since most adults spend over 30% of their time working, occupational factors may play an important role in their glycemic control. However, there have been few studies addressing the probable associations between working conditions (i.e., work hours and type of occupation) and glycemic control among workers with diabetes.

There is limited evidence that workers in specific occupations, such as truck drivers, may have either greater difficulty managing their glucose levels or may have a higher incidence of diabetes [Soule and Egede 2007]. In addition, the number of hours worked is one of the job characteristics that may be associated with poor glycemic control. It may be that individuals with long work-hours are unable to properly manage their diabetes because of the lack of time to check their blood glucose levels, take insulin or oral agents when necessary, and/or eat well-balanced meals at regular time intervals. Research has also shown that people with diabetes choose a job type and specific position based on available breaks and work schedule to better manage their diabetes [Trief, et al. 1999]. The purpose of this study was to investigate the association of two work characteristics, the number of work hours and the type of occupation, with suboptimal and poor glycemic control using a nationally representative sample of working US adults with type 2 diabetes.

Methods

Sample

The National Health and Nutrition Examination Survey (NHANES) is a public use survey developed by the National Center for Health Statistics (NCHS) to gather information about the health status of the US population. NHANES uses a stratified, multi-stage complex probability design that allows for a nationally representative sample of the non-institutionalized US population [NCHS 1989; NCHS 2008]. Data from the adult employed population from NHANES 1999–2004 were used. Individuals self-reporting being diagnosed with diabetes, aged 20 years or older, not pregnant, and with available glycosylated hemoglobin data were included in the analyses. Individuals defined as having type 1 diabetes (i.e. self-report of diabetes diagnosis before age of 30 and taking insulin only since diagnosis) were excluded; the remaining sample (n = 369) was considered to have type 2 diabetes, as defined in a previous studies [Ong, et al. 2008, Valentine, et al. 2006, Maney, et al. 2007, Chaudhry, et al. 2005, Pogach, et al. 2004, 2007, Tsai, et al. 2002, Saydah, et al. 2004].

Main outcome and independent variables

Glycosylated hemoglobin was measured using high performance liquid chromatography system for all participants aged 20 years of age or older. Recommended treatment goals from the American Diabetes Association (ADA) include HbA1c values of less than 7.0% [2003]. However, an HbA1c value less than 7.0% is not always appropriate for individuals that are older, who have several co-existing conditions, and/or who are terminally ill.

Therefore, another cut-off to define glycemic control were used. To be consistent with other studies using glycemic control variables [Ong, et al. 2008, Valentine, et al. 2006, Maney, et al. 2007, Chaudhry, et al. 2005, Pogach, et al. 2004, 2007, Tsai, et al. 2002, Saydah, et al. 2004], suboptimal glycemic control was defined as:1) yes, if HbA1c ≥ 7%, and 2) no, if HbA1c < 7%. Poor glycemic control was defined as: 1) yes, if HbA1c ≥ 9%, and 2) no, if HbA1c < 9%.

Employment status was based on the question, “Did you work last week?”. The number of hours worked was based on the question, “How many hours did you work last week at all jobs or businesses?”. The number of work hours was collapsed into three categories based on the Bureau of Labor Statistics definitions of part-time and full-time employment as: 1) 1–20 hours, 2) 21–40 hours, and 3) 41+ hours. For the worked hours variable, both numeric and categorical scales were used in the analyses. For the type of occupation, occupational classifications were based on the 40 occupational groups that appear in the NHANES data file, which are based on the more detailed US Census Standard Occupation Classification (SOC) System [NCHS 1989; NCHS 2008; Krieger et al., 2005]. These 40 occupational groups were then collapsed into 4 groups by the NCHS as: 1) white collar (e.g., executive, administrative, managerial related occupations, teachers, writers, health care workers, engineers, architects, scientists, etc); 2) blue collar (e.g., vehicle and equipment mechanics and mobile repairers, construction trades, motor vehicle operators, laborers, fabricators); 3) service (e.g., waiters and waitresses, cooks, sale administrators and clerks, private and personal service occupations, protective service occupations); and 4) agricultural worker (e.g. agricultural operators, managers, supervisors, agricultural and nursery workers, related agricultural, forestry, and fishing occupations). Variables that were included in the models as potential confounders are shown in Table I. Several interaction terms were also tested, including the interaction of a work hours variable and occupation.

Statistical Analyses

All analyses were conducted using STATA statistical software version 10.0 (STATA Corporation College Station, TX) because of its ability to take into account the complex survey design and correct for survey non-response by using sampling and response weights. STATA commands were used to avoid loss of design information and errors in variance estimation when analyzing subpopulation data. Weighted univariate and multiple logistic regression analyses with the glycemic control variables (i.e., suboptimal and poor) as the outcome variables were performed with covariates included in the models. Covariates were those variables found in previous studies to have clinical significance and/or those that were significant at the 20% alpha level in univariate analyses. These covariates were gender, age group, race/ethnicity, insurance, insulin therapy, BMI, hypertension diagnosis, and history of cardiovascular disease. Age group, race/ethnicity, and gender were included in all models regardless of statistical significance. All other variables were manually and sequentially added in a step-by-step fashion in order to identify potential confounders or effect moderators in multiple logistic regression models (Table II). For all multivariable analyses, the type I error was set at the usual 5% level of significance. This study was approved as ‘Exempt’ by University of Miami’s and Florida International University’s Internal Review Boards.

Results

There were a total of 369 employed individuals who were classified with type 2 diabetes, aged 20 years or older, and who participated in the NHANES surveys between 1999 and 2004. Of these, 216 (58.5%) individuals had suboptimal glycemic control and 84 individuals (22.2%) had poor glycemic control. Although there were slightly more males (60.7%) than females in the study, the distribution of subjects by glycemic control was similar (Table I). The mean age was 53 ± 1.1 years, with the mean duration of diabetes of 8.6± 1.0 years. Furthermore, 66.1% of study sample had at least a high school education, and 85% were overweight or obese. Blacks (29% of the sample) had the highest percentage of suboptimal (68.5%) or poor (29.3%) glycemic control status. The occupational group most represented in the sample was white collar workers (45.0%), followed by blue collar workers (31.9%), service workers (20.1%), and agricultural workers (3.0%). However, the agricultural worker group had the highest percentage of subjects with suboptimal (90.0%) or poor glycemic control (30.0%). Finally, approximately 37% of the study subjects worked over 40 hours per week.

Suboptimal glycemic control

In univariate analyses, working over 40 hours relative to working less than 20 hours was significantly associated with having suboptimal glycemic control (odds ratio (OR) = 2.54; 95% confidence interval (CI): [1.24–5.22]). After adjusting for potential confounders (Table II), working over 40 hours relative to working less than 20 hours remained significantly associated with having suboptimal glycemic control (OR = 5.09; 95% CI: [1.38–18.76]). When looking at work hours as a numeric variable, there was a statistically significant relationship between every one hour increase of work and the odds of having suboptimal glycemic control (OR= 1.03; 95% CI: [1.01–1.06]) (results not shown). In un-adjusted analyses, neither being a service worker nor a blue collar worker, relative to a white collar worker, was significantly associated with suboptimal glycemic control (OR = 1.52; 95% CI: [0.77–3.04] and OR= 1.60; 95% CI: [0.85–3.01], respectively) (results not shown). However, agricultural workers were more likely than white collar workers to have suboptimal glycemic control (OR = 22.10; 95% CI: [2.41–202.11]). Likewise, after adjusting for potential confounders, the relationship between being a agricultural worker and suboptimal glycemic control remained statistically significant (OR = 27.6; 95% CI: [1.85–412.50]). The work hours*occupation interaction term was not statistically significant (results not shown).

Poor glycemic control

There was no statistically significant relationship found between working 21–40 hours or 41+ hours versus 1–20 hours and having poor glycemic control in univariate analyses (OR= 2.28; 95% CI: [0.59–8.78] and OR= 2.84; 95% CI: [0.72–11.18], respectively). The relationships remained statistically non significant in adjusted models (Table II). In addition, when looking at work hours as a numeric variable, no statistically significant relationship between every one hour increase of work and the odds of having poor glycemic control was found (OR= 1.01; 95% CI: [0.98–1.04]) (results not shown). In univariate analyses involving the type of occupation, only agricultural workers and blue collar workers were both more likely to have poor glycemic control relative to white collar workers (OR = 9.21; 95% CI:

[1.66–51.09]) and (OR = 2.35; 95% CI: [1.06–5.21]), respectively). However, after adjusting for covariates, being a agricultural worker or a blue collar worker was no longer statistically associated with poor glycemic control, (OR = 8.02; 95% CI: [0.78–82.21]) and (OR = 1.15; 95% CI: [0.41–3.27]), respectively (Table II). The work hours*occupation interaction term was not statistically significant (results not shown).

Discussion

In this study we found that adults with type 2 diabetes who worked over 40 hours per week relative to those that worked 1–20 hours may be five times as likely to have suboptimal glycemic control. To our knowledge this is the first population-based study showing a relationship between suboptimal glycemic control and working long hours in US adults with type 2 diabetes. In addition, as for the type of occupation, we found that agricultural workers were more likely than white collar workers to have suboptimal glycemic control, although this finding needs to be interpreted with caution due to the small number of agricultural workers in the sample.

The number of work hours and glycemic control

There are several reasons why working a greater number of hours may be associated with worse glycemic control. The reasons for suboptimal glycemic control may be simply related to the lack of time (i.e. time scarcity) to properly manage diabetes. For example, workers may lack time to check blood glucose levels or eat regularly or at scheduled time intervals [Weijman, et al. 2005]. In a study from the Netherlands, a higher work load was perceived as a barrier to proper diabetes management, particularly insulin injection, in both adults with type 1 and type 2 diabetes [Weijman, et al. 2005]. Time scarcity has been associated with an increased risk of obesity and of making poor food choices [Williamson, et al. 2000]. In addition, time scarcity is one of the barriers associated with the lack of adherence to a diabetic regimen or treatment [Williamson, et al. 2000]. Furthermore, lack of time, because of greater work hours, may also interfere with important diabetes management activities outside of work such as getting medical care or visiting a diabetes healthcare provider or educator. For example, it has been shown that individuals who work a full time or even a part-time job (as opposed to being unemployed or retired) are more likely to discontinue going to diabetes self-management education programs [Gucciardi, et al. 2008]. Weight gain and obesity, both risk factors for type 2 diabetes, have also been found to be more prevalent among individuals working long hours [Shields 1999].

Work long hours may also result in suboptimal glycemic control due to greater job stress or strain as a result of working greater hours [Belkic, et al. 2004, Marmot, et al. 1997, Schnall, et al. 1994, Schnall, et al. 1994]. Job strain has been linked to higher HbA1c levels among employed individuals without diabetes in non-US studies [Yang, et al. 2006, Caruso 2006]. Stress management programs have been associated with improved glycemic control [Surwit, et al. 2002]. Although the biological mechanism is not well understood, stress may affect glycemic control via behaviors and neurohumoral pathways such as the counter-regulatory hormones; glycemic control may be related to the allostatic load or body’s way of adjusting to long-term stress [Seeman, et al. 2001]. Poor glycemic control could also be in part due to the release of catecholamines and stress hormones (such as cortisol), which have been linked with increased cardiovascular risk factors [Surwit and Schneider 1993]. The elevated stress levels could also result in negative behavioral habits, such as increased eating, in order to cope with such stress. In fact, weight gain and obesity have been found to be the highest among individuals reporting high job strain [Wamala, et al. 1997].

It is possible that greater work hours may lead to worse glycemic control due to a greater propensity of late night eating. The time of day that meals are consumed has been reported to affect insulin levels and to increase glucose intolerance [Halberg 1989]. In addition, shift work and night shift may be related to glycemic control because the night shift work has been associated with the metabolic syndrome [Lin et al., 2009]. Nevertheless, more research is needed to understand the mechanism behind the relationship between working long hours and suboptimal glycemic control among adult with diabetes.

The type of occupation and glycemic control

With regards to our findings about agricultural workers being more likely to have suboptimal glycemic control compared to white collar workers, there are no known studies to compare out studies to. Our findings need to be interpreted with caution given the small size of agricultural workers group (n=10). Despite the group size, there are several potential mechanisms to explain the findings. Agricultural workers, compared to white collar workers, may have less knowledge about diabetes self-management, have inflexible work schedules, and be more likely to have unhealthy eating behaviors; all factors that may be responsible for the poor glycemic control. For example, unhealthy diets are found to be greater among workers with high workloads, low status jobs and low control at work, and among workers with lower education and income [Wickrama, et al. 1995], all characteristics that are likely more predominant among agricultural workers. Moreover, other factors such as social isolation, lack of social support, and depression, among agricultural workers may explain their higher likelihood of poor glycemic control. For example, a study of agricultural workers with diabetes found that over 66% reported themselves as being depressed and were greatly concerned about the long-term consequences of diabetes [Ingram, et al. 2007]. In addition, stress may be higher in agricultural workers compared to white collar workers and may be contributing to the worse glycemic control in this group. For example, migrant agricultural workers may be stressed due to fear of being unemployed, working strenuous hours, being away from the family, fear of being deported or discriminated against [Ingram, et al. 2007]. This fear of losing their job may make the worker more hesitant to ask for time off and therefore be less able to access healthcare and routinely get diabetes care including getting their HbA1c checked and getting physician advice about diabetes. Finally, it may be that agricultural workers have more trouble managing their glucose levels due to not getting appropriate medical advice as a result of lack of access to healthcare and/or financial resources [Arcury and Quandt 2007].

Strengths and Limitations

There are some limitations that should be noted. First of all, this study was based on a cross-sectional design, which does not allow for the establishment of causal relationships.

Second, the study sample of workers with type 2 diabetes and its size (n = 369) did not allow for enough people in the various subpopulations defined by the sample characteristics. Small numbers were observed, particularly when looking at specific occupational groups such as agricultural workers. The limitation in sample size is in part due to the data on industry and occupation only being available through 2004.

This small number of workers limits the generalizibility of findings and decreases the power to detect any significant result when conducting analyses adjusting for all potential confounders. Because of the potential limitation in power when adding various covariates, several logistic regression models were performed adjusting for demographic variables (e.g. age, gender, race/ethnicity) and similar odds ratios as well as levels of statistical significance were found as when adding several other covariates as presented in Table II. Although the findings were statistically significant, they are less reliable due large standard errors of the estimates

Another limitation was that the individual's diabetes status and duration of diabetes were based on self-reported information. However, self report of diabetes has been found to be fairly accurate when compared to physician diagnosis, with overall agreement of 96.3% (sensitivity of 85.2% and specificity of 98.3%) [Goldman, et al. 2003]. Also, glycemic control was based on only one HbA1c reading leaving the possibility of measurement error of glycemic control. However, the possibility of measurement error is minimal given that the NCHS HbA1c laboratory protocol includes strict quality control procedures to limit measurement error . In addition, research using NHANES III data has shown low variability and high sensitivity of HbA1c measurements repeated after a two week period in an subset of individuals from NHANES, with a within-person coefficient of variation of 3.6% [Selvin, et al. 2007].

Also, other possible determinants of glycemic control were not measured, such as patient adherence to medication and dietary regimen, frequency of self blood glucose monitoring, stress, health literacy, diet, and the frequency of meals and beverages consumed. In addition, details about working conditions that may influence glycemic control such as job strain, work shift and night work, information on job satisfaction, number and type of responsibilities, job titles and work tasks, social support and job stressors were not available.

Moreover, employment, occupation, and work hours are based on work in the prior week only, which is problematic because of the possibility of misclassification of these factors. However, previous reports have shown such work related data to reliable [Gomez-Marin, et al. 2005].

Finally, the manner in which the work hours variable was categorized was somewhat arbitrary. Therefore sensitivity analyses were performed creating three new variables. The first new variable categorized work hours as 1) 1–20 (reference), 2) 21–35, and 3) >35 hours. The second new variable categorized work hours as 1) 1–40 (reference) and 2) 41+ hours. The third new variable categorized work hours as 1) 1–35 (reference) and 2) 35+ hours. However, when using these three new variables for work hours, the findings were similar (results not shown). Thus, regardless of how work hours was categorized, those working overtime were always shown to be at higher risk for suboptimal glycemic control In addition, working greater hours was associated with worse glycemic control.

Despite these limitations, the present study has important strengths that include the use of data from a nationally representative sample of adults with type 2 diabetes, the availability of several potential confounders, and the fact that it is the first known study to address the relationship of both work hours and type of occupation with glycemic control among US adults with diabetes.

Conclusion

Work characteristics, such as working long hours, have long been found to be associated with various negative health outcomes. Our findings suggest that working long hours and being employed in the agricultural industry may be associated with suboptimal glycemic control in US workers with type 2 diabetes.

Most of the research studies on the effects of long work hours on diabetes and health have been based on non-US populations despite the fact that American workers report some of the highest work hours among industrialized countries. In fact, the amount of overtime work in the US has increased since the 1970s. Among the 15 industrialized European, South American, and Asian nations in the world, the US ranked in 2003 as the 4^{th} highest in average annual work hours, preceded only by Thailand, Hong Kong, and South Korea [International Labour Office 2004]. According to the American Diabetes Association, maintaining good diabetes control costs the employer approximately $24 a month, a much lower expense than the $115 a month it would cost the employer due to employees not having adequate control [2009]. Thus, it is imperative for employers to understand the potential effects of long work hours on glycemic control. Further research is needed, however, to understand the mechanisms involved in the relationships between work hours, type of occupation, and glycemic control.

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Table I.

Sample characteristics by suboptimal (HbA1c ≥7%) and poor (HbA1c ≥9%) glycemic control of employed adults classified with type 2 diabetes, NHANES 1999–2004 (n=369)

	Total[a]	Glycemic Control[b]			
Sample Characteristics		**Suboptimal**		**Poor**	
	N	**Yes (%)**	**No (%)**	**Yes (%)**	**No (%)**
Sex					
Male	224	131 (58.4%)	93 (41.6%)	54 (24.1%)	170 (75.9%)
Female	145	85 (58.6%)	60 (41.4%)	28 (19.3%)	117(80.7%)
Age group					
20–44	80	51 (63.8%)	29 (36.2%)	24 (30.0%)	56 (70.0%)
45–64	233	140 (60.1%)	93 (39.9%)	55 (23.6%)	178 (76.4%)
65+	56	25 (44.6%)	31 (55.4%)	3 (0.05%	53 (95.5%)
Race/ethnicity					
Non-Hispanic White	80	56 (70.0%)	24 (30.0%)	17 (21.5%)	63 (78.5%)
Non-Hispanic Black	92	63 (68.5%)	29 (31.5%)	27 (29.3%)	65 (70.7%)
Hispanic	133	87 (65.4%)	46 (34.6%)	35 (26.3%)	98 (73.7%)
Other	16	10 (62.5%)	6 (37.5%)	3 (18.8%)	13 (81.5%)
Education					
Less than high school	125	86 (68.8%)	39 (31.2%)	37 (29.6%)	88 (70.4%)
High school graduate	80	40 (50.0%)	40 (50.0%	14 (17.5%)	66 (82.5%)
More than high school	164	90 (54.9%)	174 (94.3%)	31 (18.9%)	133 (81.1%)
Marital status					
Not married	261	152 (58.2%)	109 (41.8%)	58 (22.2%)	203 (77.8%)
Married/living with partner	192	54 (28.1%)	138 (71.9%)	20 (10.4%)	172 (89.6%)
Hours worked during previous week					
1–20 hours	52	26 (50.0%)	26 (50.0%)	7 (13.5%)	45 (86.5%)
21–40 hours	180	106 (58.8%)	172 (41.2%)	44 (24.4%)	136 (75.6%)
41+ hours	119	75 (63.0%)	44 (37.0%)	28 (23.5%)	91 (76.5%)
Occupational group					
White collar worker	166	91 (54.8%)	177 (45.2%)	30 (18.1%)	136 (81.9%)
Service worker	74	46 (62.2%)	28 (37.8%)	15 (20.3%)	59 (79.7%)
Agricultural worker	10	9 (90.0%)	1 (10.0%)	3 (30.0%)	7 (70.0%)
Blue collar worker	118	70 (59.3%)	48 (40.7%)	34 (28.8%)	84 (71.2%)
Insurance status					
Uninsured	72	40 (55.5%)	32 (45.5%)	24 (33.3%)	48 (66.7%)
Insured	292	172 (58.9%	120 (41.1%)	57 (19.5%)	235 (80.5%)
Smoking and secondhand smoke (SHS) exposure					
Non-smoker & no SHS	77	47 (61.0%)	30 (38.9%)	16 (20.7%)	61 (79.2%)
Smoker with SHS exposure	192	111 (57.8%)	81 (42.2%)	44 (22.9%)	148 (77.1%)
Smoker	91	53 (58.2%)	38 (41.8%)	19 (20.8%)	72 (79.2%)
History of cardiovascular disease					

	Total[a]	Glycemic Control[b]			
Sample Characteristics		**Suboptimal**		**Poor**	
	N	**Yes (%)**	**No (%)**	**Yes (%)**	**No (%)**
No	324	192 (59.3%)	132 (40.7%)	75 (23.1%)	249 (76.9%)
Yes	45	24 (53.3%)	21 (46.7%)	7 (15.6%)	38 (84.4%)
Alcohol use					
No	127	78 (61.5%)	49 (38.5%)	27 (21.3%)	100 (78.7%)
Yes	232	131 (56.5%)	101 (43.5%)	50 (21.6%)	182 (78.4%)
Physical activity					
None	164	101 (61.6%)	63 (38.4%)	40 (24.4%)	124 (75.6%)
Moderate	110	64 (58.2%)	46 (41.8%)	20 (18.2%)	90 (81.2%)
Vigorous	87	48 (55.2%)	39 (44.8%)	19 (21.8%)	68 (78.2%)
Take Insulin					
No	311	171 (55.0%)	140 (45.0%)	64 (20.6%)	247(79.4%)
Yes	58	45 (77.6%)	13 (22.4%)	18 (31.0%)	40 (69.0%)
Diagnosis of hypertension					
No	163	101 (62.0%)	62 (38.0%)	39 (23.9%)	124 (76.1%)
Yes	206	115 (55.8%)	91 (44.2%)	43 (20.8%)	163 (79.2%)
BMI category [c]					
Normal/under weight	55	33 (60.0%)	22 (40.0%)	16 (30.0%)	39 (70.0%)
Overweight	124	71 (57.3%)	53 (42.7%)	29 (23.4%)	95 (76.6%)
Obese	183	108 (59.0%)	75(41.0%)	36 (19.7%)	147 (80.3%)

[a]Totals are based on column percentage, column percentage=100

[b]Suboptimal and poor glycemic control are not mutually exclusive

[c]BMI categories: Normal/underweight (BMI <25 kg/m^2); Overweight (BMI 25–29.9 kg/m^2); Obese (BMI ≥30 kg/m^2)

Table II.

Relationship between suboptimal (HbA1c ≥7%) and poor (HbA1c ≥9%) glycemic control and work characteristics among employed adults with type 2 diabetes, NHANES 1999–2004: Weighted multiple logistic regression models adjusted for potential covariates.

	Glycemic Control	
	Suboptimal	**Poor**
Characteristic	**Odds Ratio (95% Confidence Interval)**	**Odds Ratio(95% Confidence Interval)**
Main variables		
Hours worked during previous week		
1–20 hours	1.00	1.00
21–40 hours	1.92 (0.72– 5.15)	1.37 (0.30– 6.36)
41+ hours	5.09[a] (1.38–18.76)	2.05 (0.39–10.72)
Occupation		
White collar	1.00	1.00
Service	1.18 (0.50– 2.76)	0.85 (0.27–2.69)
Agricultural worker	27.6[a] (1.85– 412.50)	8.02 (0.78–82.21)
Blue Collar	0.77 (0.36–1.64)	1.15 (0.41–3.27)
Covariates		
Sex		
Male	1.00	1.00
Female	0.94 (0.36–2.45)	0.70 (0.32–1.53)
Age group (years)		
20–44	1.00	1.00
45–64	0.90 (0.39– 2.10)	0.65 (0.29–1.48)
65+	0.98 (0.38–2.52)	0.12[a] (0.02– 0.93)
Race/Ethnicity		
Non-Hispanic White	1.00	1.00
Non-Hispanic Black	3.43[a] (1.51–7.81)	3.08[a] (1.18–8.03)
Hispanic	2.11 (0.92– 4.84)	1.83 (0.61–5.54)
Other	4.23 (0.91–19.69)	1.52 (0.44–5.25)
Education		
Less than high school	1.00	1.00
High school graduate	0.53 (0.20–1.40)	0.98 (0.33–2.92)
More than high school	0.60 (0.28–1.30)	0.65 (0.27–1.57)
Have insurance		
No	1.00	
Yes	0.87 (0.35– 2.12)	0.37[a] (0.15–0.91)
Taking insulin		
No	1.00	
Yes	3.98[a] (1.44–11.00)	2.79[a] (1.11–7.00)

BMI category		
Under/normal weight	1.00	1.00
Overweight	0.48 (0.16–1.47)	0.81 (0.28–2.30)
Obese	0.80 (0.35–1.82)	0.45 (0.17–1.24)
Hypertension diagnosis [b]		
No	1.00	---
Yes	0.90 (0.49–1.64)	----
History of cardiovascular disease [c]		
No	---	1.00
Yes	---	0.30 (0.07–1.26)

[a]Variables statistically significant at the 5% alpha level;

[b]Hypertension diagnosis was not statistically associated with poor glycemic control in univariate analyses at the 20% alpha level and therefore was not included in the adjusted logistic regression model;

[c]History of CVD was not statistically associated with suboptimal or borderline glycemic control in univariate analyses at the20% alpha level and therefore was not included in the adjusted logistic regression model