HHS Public Access

Author manuscript

J Health Care Poor Underserved. Author manuscript; available in PMC 2017 August 21.

Published in final edited form as:

J Health Care Poor Underserved. 2017 ; 28(2): 798–811. doi:10.1353/hpu.2017.0075.

Sedentary Behavior and Cardiovascular Disease Risk Factors among Latino Adults

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Abstract

Background—Sedentary behavior has been associated with increased risk for cardiovascular disease (CVD) among primarily White samples, while studies among Latinos have shown mixed results.

Purpose—To explore relationships between sedentary behavior and CVD risk factors among a sample of Latino adults.

Methods—A cross-sectional study of 602 Latino adults. Surveys of sedentary behavior and physical activity were orally administered. Anthropometric measurements included weight, height, waist circumference, and blood pressure. Medical record data for diabetes and dyslipidemia were obtained.

Results—Sedentary behavior was associated with BMI ($\beta = .164$, $p < .001$) and waist circumference ($\beta = .162$, $p < .001$). Sedentary behavior was not associated with blood pressure, high cholesterol, diabetes, or physical activity.

Conclusions—The consequences of sedentary behavior may differ across groups. Evaluating the relationship between sedentary behavior and CVD risk is critical in identifying behaviors contributing to CVD.

Keywords

Health behavior; sedentary behavior; cardiovascular health; health disparities

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The authors have no conflict of interest.

Cardiovascular disease (CVD) is the leading cause of death in the United States, killing more than 600,000 Americans every year, and often burdening individuals with serious illness, disability, decreased quality of life, and financial stress.[1,2] Minority groups, including Latinos, experience increased rates of CVD and CVD risk factors such as hypertension, inactivity, obesity, and diabetes, compared with other racial/ethnic groups in the U.S.[2] Latinos are 15% more likely to be obese and 65% more likely to have diabetes than non-Hispanic Whites.[3] Furthermore, similar to the general population, as of 2013, approximately one-third of Latino men (33.4%) and women (30.7%) age 20 years and older were diagnosed with CVD.[1]

Sedentary behavior has been defined as an important precursor for obesity, diabetes and CVD.[4] High levels of sedentariness have been linked to all-cause and CVD mortality, independent of physical activity participation.[5–8] Sedentary behavior has been defined in several ways including any activity during commuting, at the workplace, at the home environment, or during leisure time that does not increase energy expenditure above resting (1–1.5 METS), including sleeping, lying down, and sitting.[8,9] Sedentary behavior has also been gauged against physical activity recommendations, and a sedentary lifestyle has been defined as participating in less than 30 minutes of moderate physical activity per day (≥3 METS) on at least three days per week.[4] Research has found that, in the general population, approximately 51–68% of adult waking hours are spent in sedentary activities that include sitting while watching TV, using a computer, at work, or using transportation.[10–12] Engagement in sedentary behaviors has received little research attention among populations that bear a considerable burden of CVD, such as Latinos. However, one existing study did report that Latinos spend up to 74% of their waking hours being sedentary.[13]

The link between sedentary behavior and health outcomes has been primarily studied among White samples.[10] The few studies among Latinos revealed that relationships between sedentary behaviors and CVD risk factors may be complex for minority groups affected by CVD disparities. For example, a recent analysis from The Hispanic Community Health Study/Study of Latinos (HCHS/SOL) found prolonged sedentary time to be associated with decreased HDL-cholesterol, and increased diastolic blood pressure, triglycerides, two-hour glucose, and fasting insulin among 12,083 participants, aged 18–74 years.[13] However, an analysis of National Health and Nutrition Examination Survey data (NHANES, 2006) of Mexican Americans, aged 20 years and older, found no association between total sedentary time measured via accelerometers and one of two CVD risk factors (waist circumference or blood pressure), but found a negative association between sedentary behavior and insulin sensitivity.[6] Finally studies of pregnant Latinas found no association between sedentary behavior and hypertension or abnormal glucose tolerance before pregnancy.[14,15]

The above research is limited by several factors, including varying methodologies used to assess CVD risk, an incomplete assessment of modifiable CVD risk factors, and samples with varying age and gender characteristics. As a result, it is difficult to draw conclusions regarding the associations between sedentary behavior and CVD risk among Latino adults. Enhancing the scientific understanding of all factors that contribute to the development of CVD is critical for CVD prevention and treatment. Therefore, the purpose of this study was

to explore the relationships between sedentary behavior and modifiable CVD risk factors, including BMI, waist circumference, blood pressure, physical activity, dyslipidemia, and diabetes, among a sample of Latino adults.

Methods

This study is a cross-sectional analysis of the Lawrence Health and Well Being Study among Latino adults in the city of Lawrence, Massachusetts. Potential research participants were identified from the Greater Lawrence Family Health Center (GLFHC) by using proportional sampling to randomly select individuals from pre-defined age and gender strata. Participants were eligible for the study if they were Latino, Spanish-speaking or English-speaking, and between the ages of 21 and 85. Individuals were excluded if they were unable or unwilling to give informed consent, planned to move out of the area within the four-year study period, had cognitive impairments that precluded participation (i.e., answering orally administered questions), and/or had a life expectancy of less than five years as determined by their primary care provider (PCP).

Randomly selected GLFHC patients were informed about the study via letters signed by the chief medical officer, mailed to their homes. The letters described the study in Spanish and English, informed participants that they would be called on the phone, and provided a toll-free number for those who did not wish to participate. Within two weeks of the mailing, bilingual/bicultural community coordinators called patients to clarify their questions about the study, screen for eligibility, and invite eligible individuals to participate. Eligible and interested individuals were scheduled to attend the study assessment visit.

The assessment visit took place at a central location in the community (Lawrence Senior Center). The survey assessments were verbally administered by trained assessors and had a total duration of 2.5–3 hours with rest periods. Given that the primary purpose of the Lawrence Health and Well Being Study was to understand the factors associated with behavioral health of Latinos, additional surveys were included in the assessments that were not analyzed for the purpose of this paper. Anthropometric measurements were also taken and included weight, height, waist circumference, and blood pressure. Medical record data were obtained from electronic records and provided directly by qualified staff from the GLFHC, Lawrence General Hospital, and Holy Family Hospital. All procedures for this study were approved by the Institutional Review Board (IRB) at the University of Massachusetts Medical School. All participants received a $50 incentive for participating in the study.

Measures

Sedentary behavior—The Sedentary Behavior Questionnaire was used to assess sedentary behavior.[16] This 22-item questionnaire asked participants to report the amount of time they spent engaging in a list of sedentary behaviors, ranging from *None* to *Six or more hours* per day. Sedentary behavior was separated into time engaged in sedentary activities on weekdays and on weekends. Original sedentary behaviors from this questionnaire included sitting while watching television, playing computer/video games, listening to music, talking on the phone, doing paperwork or office work, reading, playing a musical instrument, doing

arts and crafts, and driving or riding in a car, bus, or train. This study modified the measure to include two additional sedentary behaviors: sitting while texting and sitting while using the computer or Internet. In order to ascertain number of hours spent in sedentary activities per day, weekday hours were multiplied by five, weekend hours were multiplied by two, and then sums for total hours/week were averaged across seven days. This questionnaire has a high intraclass correlation via test-retest reliability, and has modest associations with objective measures of sitting.[16]

Obesity—Body mass index (BMI) and waist circumference assessed obesity. Height (to the nearest 1/8 in.) and weight (to the nearest 1/10 lb.) were measured by study staff using a Charder HM200P stadiometer and Tanita BWB-800S scale, respectively. Body mass index was calculated using the formula, BMI = 703* [weight (lb.)/height^2 (in.^{2})]. Waist circumference was assessed by taking the average of two measures (to the nearest 1/8 in.) taken under the shirt, around the abdomen horizontally at the narrowest point between the lowest rib and the top of the hip bone.[4]

Blood pressure—Three measures of blood pressure were taken by the study staff in order to assess hypertension. Following 10 minutes of sitting, clinical staff measured participants' blood pressure three separate times using a PRO Series 100–400V2 Dinamap machine. The average systolic blood pressure and diastolic blood pressure of the three measures was used.

Physical activity—Physical activity was measured using the Women's Health Initiative Brief Physical Activity Questionnaire.[17] This was a nine-item survey measure of walking and recreational physical activity that asked participants to report how often they walked and engaged in strenuous, moderate, and mild exercise each week. Participants were also asked to report for how long they did each type of exercise. Scores for different levels of physical activity are combined into a single score (i.e., minutes of physical activity). Due to the high volume of participants engaging in 0 minutes of physical activity per week, a final score was dichotomized to classify respondents with regards to whether or not they were meeting recommendations for weekly minutes of physical activity (≥150 minutes per week). This questionnaire has been validated and demonstrated a correlation of .73 with an accelerometer and .88 with a seven-day physical activity questionnaire.[17]

Dyslipidemia—Medical records of participants were obtained from the GLFHC and two hospitals in order to determine dyslipidemia. Researchers used the International Classification of Diseases, Ninth Revision (ICD-9) codes, which are a set of codes used by hospitals and physicians to indicate diagnoses for patients. The indicator for dyslipidemia was created from clinical and hospital records using the corresponding ICD-9 code. The variable created selected those participants who had ever been diagnosed with high cholesterol.

Diabetes—Diabetes prevalence was obtained using the same procedures as dyslipidemia. Medical records from the health center and hospital were examined, and the indicator for all types of diabetes was created using the appropriate ICD-9 code.

Statistical analysis

SPSS IBM Statistics (version 23) was used for data analysis.[18] Means, standard deviations, and frequencies were calculated for demographic factors, obesity, blood pressure, diabetes, sedentary behavior, and physical activity. A series of one-way ANOVAs evaluated the difference in sedentary behavior across categories of socio-demographic variables; age, gender, employment, education, and marital status. A series of multiple linear regression models evaluated the extent to which sedentary behavior was associated with continuous CVD risk factors, including BMI, waist circumference, systolic blood pressure, and diastolic blood pressure. Multiple logistic regression models were conducted to assess the association of sedentary behavior with dichotomous CVD risk factors, diagnosed diabetes, high cholesterol, and physical activity. Sedentary behavior was entered into the models first, and then age, gender, education level, and smoking status were entered to control for pre-determined confounding demographic factors.

Results

Demographic information

In all, 3,067 patients were sampled, of whom 284 (9.3%) were ineligible. Among the remaining 2,783 potentially eligible individuals, 1,236 (44.4%) could be contacted. Of these, 602 were eligible and agreed to participate. Means, standard deviations, and frequencies of demographic characteristics are presented in Table 1. Participants were, on average, 46.64 years old (SD = 15.45) and overweight or obese (BMI M = 29.79, SD = 5.97). Slightly over half (51.2%) of the sample was female, 43% were married, 41.9% had a less than high school education and 59.3% were employed full or part time. Furthermore, almost half (45.7%) of the sample had high cholesterol, and almost a third (27.1%) had diabetes. Participants had an average systolic blood pressure of 127.69 mmHg (SD = 16.44), diastolic blood pressure of 76.89 mmHg (SD = 9.9), and waist circumference of 35.6 inches (SD = 5.75). On average, participants engaged in sedentary behaviors approximately 7.32 hours per day (SD = 4.8), with no differences across weekday (M = 7.43; SD = 5.19) and weekend (M = 7.10; SD = 4.86). A breakdown of sedentary behaviors by weekday and weekend is presented in Table 2. The most common sedentary behavior was television watching (M = 2.26, SD = 1.62) and traveling in a car, bus, or train (M = 1.16, SD = 1.35).

Sedentary behavior

Differences in sedentary behavior time by socio-demographic factors—

Analyses of variance showed that the effect of age on sedentary behavior was significant, (F = 25.6, p < .001). Participants aged 21–34 years spent significantly more time being sedentary (M = 9.21 SD = 5.68) than participants aged 35–54 years (M = 7.02, SD = 4.12) and participants over 55 years (M = 5.92, SD = 3.95). The effect of gender was also significant (F = 9.06, p = .003), with males (M = 7.90, SD = 4.92) spending significantly more time being sedentary than females (M = 6.73, SD = 4.62). The effect of education level was also significant, F = 14.33, p < .001. Participants who had a lower than high school education (M = 5.71, SD = 3.75) were spending significantly less time being sedentary than high school graduates (M = 7.99, SD = 5.19), high school graduates with vocational training (M = 7.89, SD = 4.40), participants with some college education (M = 9.36, SD = 5.46), and

college graduates or post-graduates (M = 9.48, *SD* = 5.08). Finally, the effect of marital status on sedentary behavior was significant ($F = 17.03$, $p < .001$). Participants who were single spent significantly more time being sedentary (M = 9.49, *SD* = 5.82) than participants who were married (M = 6.93, *SD* = 4.21) or previously married (separated, divorced, widowed) (M = 6.34, *SD* = 4.67). The effect of employment on sedentary behavior was not statistically significant.

Associations of sedentary behavior time with CVD factors—Table 3 and Table 4 present the results of multiple linear and logistic regression models examining the associations of sedentary hours per day and BMI, waist circumference, systolic blood pressure, diastolic blood pressure, dyslipidemia, diabetes, and physical activity. After controlling for demographic factors, sedentary behavior was significantly associated with BMI ($\beta = .164$, $p < .001$) and waist circumference ($\beta = .162$, $p < .001$). Sedentary behavior was not associated with systolic blood pressure or diastolic blood pressure. Logistic regression models (Table 3) showed sedentary behavior explained 38.4% (Nagelkerke's R^2) of the variance in high cholesterol, but sedentary behavior was not associated with high cholesterol (OR = 1.03, $p = .260$). Sedentary behavior explained 25.6% (Nagelkerke's R^2) of the variance in diabetes, but was not significantly related to diabetes (OR = 1.04, $p = .135$). Finally, sedentary behavior explained 5.4% (Nagelkerke's R^2) of the variance in physical activity, and was not significantly associated with physical activity (OR = 1.01, $p = .724$).

Discussion

Previous research has provided evidence that Latino individuals engage in high levels of sedentary behavior, and that high levels of sedentariness are associated with an increased risk for CVD and mortality in studies with predominantly White samples.[19,20] However, few previous studies have examined the relationship between sedentariness and CVD risk factors among Latinos. In this sample of Latino adults, there were significant differences in sedentary behavior across age groups, gender, and education level. This study showed that participants in older age strata, females, and participants with a less than high school education were considerably less sedentary than their younger, male, and more educated counterparts.

Even though physical activity and sedentary behavior are often considered reciprocal behaviors, researchers have distinguished sedentary behavior uniquely from physical activity, arguing that sedentary behavior is not merely the absence of physical activity.[8,21] Individuals may sufficiently meet the physical activity guidelines while also spending a considerable amount of time sitting while at work, using a computer, or watching television.[21] As a result, research suggests that sedentary behavior may have a distinct set of demographic correlates.[8,21,22] Our findings are not consistent with studies of physical activity in the general population of U.S. adults that have showed older age and female gender to be associated with less physical activity, and higher education to be associated with more physical activity.[23,24] Similar studies exploring sedentary behavior and its associated demographic correlates are scarce, with Owen et al. suggesting that researchers begin to examine demographic characteristics as moderators of the behavioral, physical, and social contexts in which sedentary behavior may take place.[21] One possible explanation for

our findings could be that participants who have a higher education may have secured occupations with extended sitting time, whereas lower-wage jobs (e.g., food service, cashiers) are not sitting for such prolonged periods. Additionally, the younger age groups (21–34 years, 35–54 years) may be employed and spending sedentary time traveling to and from work. However, our interpretations are speculative, and these findings show that more research needs to be conducted to understand the different patterns of sedentariness across factors such as age, gender, education, and socioeconomic status among Latinos.

There were significant, positive associations between sedentary behavior and our measures of obesity, including BMI and waist circumference. These findings contrast with NHANES data in which there is no relationship between sedentary behavior and waist circumference among Mexican Americans.[6] As a result, the ability of sedentary behavior to predict obesity among Latinos may require further examination. Given that 77% of Latino adults in the U.S. are either overweight or obese,[25] and there is a well-known link between obesity and CVD, it is critical to understand the factors that contribute to this trend. This may have important implications for future interventions targeting reductions in obesity via behavior change.

This study found no relationship between sedentary behavior and blood pressure, diabetes, or dyslipidemia. These results are consistent with NHANES analysis finding no relationship between sedentary behavior and hypertension or cholesterol among Mexican Americans.[6] Our results conflict with the most recent HCHS/SOL analysis that associated increased sedentariness with decreased HDL cholesterol and increased diastolic blood pressure, glucose, and insulin.[13] However, the CVD biomarkers in the HCHS/SOL sample were within normal ranges across all quartiles of sedentary behavior. An original HCHS/SOL analysis on the prevalence of CVD risk factors among Latinos (N = 16,415) reported that over half (51.7%) of men and one third of women (36.9%) had dyslipidemia, a quarter of men (25.4%) and women (23.5%) had hypertension, and 16.7% of men and 17.2% of women had diabetes.[26]

Although these prevalence rates are consistent with our findings, 4,332 individuals were dropped from the original HCHS/SOL analysis due to incomplete data, and sample adjustments may have biased the sample to appear healthier than the original. Thus, interpreting the relationships between sedentary behavior and CVD factors may be difficult without keeping track of the health status of the individuals. Ensuring that the sample is not only representative of the Latino population but also unbiased in terms of health status is important for detecting the relationship between sedentariness and CVD. Therefore, the compiled results of these studies, including our findings, call for a further understanding of the contribution of sedentary behavior to CVD-related health conditions among Latinos. The null relationships between sedentary behavior and diabetes, hypertension, and dyslipidemia suggest the negative impact of sedentariness may not be uniform across population subgroups. It is important to understand the unique relationships among Latinos in order to advance disease prevention and health promotion programs.

There are several limitations to this study. First, it is limited by the cross-sectional design, making it impractical to draw conclusions regarding the explanation for any differences found. One direction for future research is to establish causal relationships between

sedentary behavior and CVD risk factors in different population subgroups. The preliminary evidence that prolonged sitting has deleterious biological effects has been confined to animal models and homogeneous human samples.[27,28] Focusing experimental research on Latinos will provide greater understanding in terms of the causality of sedentary behavior on CVD risk in this population.[5]

Next, the potential long-term consequences of sedentary behavior could not be pinpointed in this study, and the apparent lack of impact of sedentary behavior on hypertension, dyslipidemia, and diabetes may have important implications for public health and health promotion programs. Longitudinal studies will provide a better understanding of the contribution of sedentariness to the development of CVD in Latinos, and may allow researchers either to confirm or deny the initial assertions. Another limitation of this study is the variable measurement, as sedentary behavior and physical activity were self-reported. As a result, participants may have under-or over-estimated their physical activity. Accelerometers have been used in the past to measure sedentary behavior and physical activity, and future research evaluating the effect of sedentariness on CVD risk should prioritize direct measures in order to obtain an accurate record of participants' behavior.[8,13] Finally, although the sample was representative of the Latino population in Lawrence, Massachusetts, the results may not be generalizable to other Latino adults in the United States. Latino adults living in different areas of the country, with different environments, cultures, and climates, may be prone to higher or lower levels of sedentariness. The current study helps pave the way for the evaluation of sedentary behavior and CVD risk in Latino adults, and replication in other Latino samples is needed in order to solidify these relationships.

There is growing evidence to support the view that sedentary behavior is not equivalent to lack of exercise, and that it may have its own unique set of metabolic consequences.[10] However, it is becoming increasingly apparent that the consequences of sedentary behavior are not uniform across population subgroups.[6] In this sample of Latino adults, sedentary behavior was related to obesity, but not related to hypertension, dyslipidemia, diabetes, or physical activity. These findings contrast with those of predominantly White samples that have emphasized the importance of sedentary behavior in the development of CVD risk factors as well as all-cause and CVD mortality.[5,6,8,12] Continuing to evaluate the relationship between sedentary behavior and CVD risk is critical. Identifying behaviors, such as sedentariness, that contribute to the development of CVD risk factors among minority subgroups at higher risk for CVD may aid in the development of disease prevention programs. For, it is through these programs that researchers can positively influence modifiable CVD risk factors in order to bring about lasting disease prevention.

Acknowledgments

We acknowledge the contributions of our community partners and organizations who made this research possible: the Lawrence Mayor's Health Task Force, the Lawrence Senior Center (Martha Velez, Martha Cruz, and Angelina García), the YWCA (Vilma Lora and Esther Alburquerque), the Greater Lawrence Family Health Center (Dean Cleghorn, Ph.D., Carlos Cappas-Ortíz, Jeffrey Geller, MD, Mary Kay,MD, and Donna Rivera, MSW) and our University of Massachusetts Medical School colleagues (Ira Ockene, MD and Lisa Fortuna, MD), students (Kate Pellegrini and Jessica Long) and staff (Karen Ronayne, Chris Frissard, and Dane Netherton).

Funding Source

This research was generously supported grants from the National Institute of Mental Health (R01 MH085653), National Heart, Lung and Blood Institute Training Grant 1T32HL120823-01, the Centers for Disease Control and Prevention (U48 DP005031-01), and the National Institute of Minority Health and Health Disparities (1 P60 MD006912-02).

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Table 1

FREQUENCY OF DEMOGRAPHIC CHARACTERISTICS AND DEMOGRAPHIC CHARACTERISTICS BY MEAN SEDENTARY TIME[a]

			Sedentary Time	
Variable	**n**	**%**	**Mean**	**SD**
Gender				
Male	294	48.8	7.90	4.92
Female	308	51.2	6.73	4.62
Age				
21–34	183	30.4	9.21	5.68
35–54	207	34.4	7.02	4.18
55+	212	35.2	5.92	3.95
Employment				
Employed	357	59.3	7.38	4.95
Unemployed	99	16.4	7.62	4.86
Retired	57	9.5	6.93	3.94
Disabled	56	9.3	6.45	4.23
Other	31	5.1	7.75	5.31
Education				
< High School	252	41.9	5.71	3.75
< High School, w/vocational training	56	9.3	6.58	4.64
High School Graduate	67	11.1	8.00	5.19
High School Graduate, w/vocational training	53	8.8	7.89	4.40
Some College	107	17.8	9.36	5.46
College Degree or Post-Graduate	67	11.1	9.48	5.08
Marital Status				
Single (never married)	119	19.8	9.49	5.82
Married or Living with Partner	344	57.1	6.93	4.21
Separated, Divorced, or Widowed	139	23.1	6.34	4.67
BMI Category				
Normal Weight	117	19.4	7.03	4.56
Overweight	235	39	7.06	4.57
Obese	248	41.2	7.67	5.13
High Cholesterol				
Yes	275	45.7	6.63	4.16
No	322	53.5	7.89	5.25
Diabetes				
Yes	163	27.1	6.72	4.29
No	431	71.6	7.53	4.99
Physical Activity Level				
Did not meet the guidelines (<150 minutes/week)	351	58.3	7.2	4.66
Did meet the guidelines (≥150 minutes/week)	251	41.7	7.44	4.99

[a]Sedentary time is presented in hours per day SD = Standard Deviation

Table 2

BREAKDOWN OF SEDENTARY BEHAVIORS ON WEEKDAYS AND WEEKEND DAYS

	Weekday		Weekend		Total	
Variable	**M**	**SD**	**M**	**SD**	**M**	**SD**
Watching TV	2.24	1.71	2.33	1.93	2.26	1.62
Playing computer/video/smart phone games	0.39	1.10	0.35	1.06	0.38	1.04
Computer or Internet	0.78	1.44	0.67	1.30	0.75	1.33
Listening to Music	0.65	1.23	0.84	1.35	0.71	1.15
Talking on the Phone	0.69	1.04	0.67	0.98	0.69	0.95
Texting	0.30	0.86	0.29	0.88	0.29	0.84
Doing Paper/Office Work	0.44	1.03	0.19	0.50	0.36	0.80
Reading	0.62	1.00	0.50	0.86	0.59	0.90
Playing a Musical Instrument	0.06	0.45	0.05	0.38	0.05	0.40
Arts and Crafts	0.17	0.66	0.09	0.49	0.14	0.55
Driving/Riding in car, bus, or train	1.17	1.48	1.11	1.38	1.16	1.35
Total	7.43	5.19	7.10	4.86	7.32	4.8

M = Mean

SD = Standard Deviation

J Health Care Poor Underserved. Author manuscript; available in PMC 2017 August 21.

Table 3

RESULTS FROM LINEAR REGRESSION MODELS EXAMINING RELATIONSHIP BETWEEN SEDENTARY BEHAVIOR AND CVD RISK FACTORS[a]

	BMI			WC			SBP			DBP		
Variable	**B**	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**
Sedentary Behavior (hrs/day)	0.20	0.06	<.001	0.19	0.05	<.001	0.17	0.14	0.236	–0.08	0.09	0.352

[a]Model is adjusted for age, gender, education level, and smoking status

BMI = Body Mass Index
WC = Waist Circumference
Sbp = Systolic Blood Pressure
Dbp = Diastolic Blood Pressure
B = Unstandardized Coefficient
SE = Standard Error
p = Significance Level

Table 4

RESULTS FROM LOGISTIC REGRESSION MODELS EXAMINING RELATIONSHIP BETWEEN SEDENTARY BEHAVIOR AND CVD RISK FACTORS[a]

	High Cholesterol				Diabetes				Physical Activity			
Variable	**OR**	**95%**	**CI**	**p**	**OR**	**95%**	**CI**	**p**	**OR**	**95%**	**CI**	**p**
Sedentary Behavior (hrs/day)	1.03	0.90	1.00	0.26	1.04	0.99	1.10	1.35	1.01	0.97	1.05	0.724

[a]Model is adjusted for age, gender, education level, and smoking status

OR = Odds Ratio
CI = Confidence Interval
p = Significance Level