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Racial Disparities Study in Diabetes-Related Complication Using National Health Survey Data

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by

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Under the Direction of Gengsheng Qin

ABSTRACT

The main aim of this study is to compare the prevalence of diabetes-related complications in white to the prevalence in other racial and ethnic groups in United States using 2009 Behavioral Risk Factor Surveillance System (BRFSS). By constructing the logistic regression model, odds ratios (OR) were calculated to compare the prevalence of diabetes complications in white and other groups. Compared to white, the prevalence of hypertension and stroke in African Americans were higher, while the prevalence of heart attack and coronary heart disease were lower. The Asian Americans or Pacific Islanders, African Americans and Hispanics were more likely to develop retinopathy compared to white. The prevalence of hypertension, hypercholesterolemia, heart attack, coronary heart disease, Stroke in Native Americans and "other" group were not significantly different from the prevalence in white. Asian or Pacific Islanders were less likely to experience stroke.

INDEX WORDS: CDC, BRFSS, Diabetes, National Health Survey, Complications, SPD, Hypertension, Hypercholesterolemia, Heart Attack, Coronary Heart Disease, Stroke, Retinopathy

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CHAPTER 1 INTRODUCTION

1.1 Diabetes Background

Diabetes mellitus or simply diabetes is a lifelong disease characterized by high levels of glucose in the blood which result from defects in the human body's ability to produce and/or use insulin. In 2007, nearly 8% out of 23.6 million US populations were estimated to have diabetes (National diabetes fact sheet 2008). Type 2 diabetes accounts for more than 90% of all diabetes case (Centers for Disease Control and Prevention 2003). The cost of diabetes in 2003 was estimated to be $132 billion, including $92 billion in direct diabetes-related health care costs and $40 billion in indirect costs, such as the costs paid on diabetes complications and decreased work productivity (Centers for Disease Control and Prevention 2003).

1.1.1 Risk Factors

The exact reason for diabetes is not clear. But several factors contribute to the occurrence of diabetes, especially for type 2 diabetes. Number one risk factor is obesity. Because fat can interfere with the body's ability to use insulin, greater weight means a higher risk of insulin resistance. The National Center for Health Statistics (National Center for Health Statistics 2010) states that 33.8% of adults (60 million) are obese. Our results also showed that 27% participants from 2009 BRFSS data reported to be obese which coincided with the previous report. The other factors such as sedentary lifestyle, unhealthy eating habits, family history and genetics, increased age, high blood pressure, high cholesterol and history of gestational diabetes, also play important roles in the occurrence of diabetes and its complications. It appears that people whose family members have been diagnosed with type 2 diabetes are more likely to develop it themselves.

African Americans, Hispanic-Americans and Native Americans all have a higher rate of type 2 diabetes (Konen, Summerson, Bell and Curtis 1999). All these signs showed that there is strong genetic trend for diabetes. Although there is strong genetic component in developing diabetes, life style plays an important part in determining who gets diabetes. The Surgeon General's Report on Physical Activity and Health states that inactivity and being overweight contribute a lot to a diagnosis of type 2 (National Center for Chronic Disease Prevention and Health Promotion 1996). Muscle cells have more insulin receptors than fat cells, so a person can decrease insulin resistance by exercising. Being more active also lowers blood sugar levels by helping insulin to be more effective. On the other hand, unhealthy eating habits contribute largely to obesity. One research found that healthy diet and active lifestyle may significantly decrease the risk of type 2 diabetes in spite of having a family history of diabetes (Midhet, Al-Mohaimeed and Sharaf 2010). Another important factor is age. The older we become, the greater possible to get type 2 diabetes because the pancreas ages right along with us, and doesn't pump insulin as efficiently as it did when we were younger. Also, as our cells age, they become more resistant to insulin as well. High blood pressure and high cholesterol are the hallmark risk factors for many diseases and conditions, including type 2 diabetes. Lastly, History of Gestational Diabetes also contributes to the prevalence of diabetes. Many women who have gestational diabetes develop type 2 diabetes years later. Their babies are also at some risk for developing diabetes later in life.

1.1.2 Complications

Although underreported on death certificates, diabetes is estimated to be the sixth leading cause of death in the United States (Centers for Disease Control and Prevention 2003). Most of the risk

factors for diabetes are also the behavioral risk factors that result in complications such as macro-vascular disease, lower extremity amputations, kidney disease, and blindness or visual impairment and serious psychology disease (Centers for Disease Control and Prevention 2003). Macro-vascular diseases include Angina or other coronary heart disease, heart attack and stroke. Diabetes itself is a risk factor to develop all these macro-vascular diseases because of the high blood level. Adults with diabetes have heart disease death rates about 2 to 4 times higher than adults without diabetes. The risk for stroke is 2 to 4 times higher among people with diabetes. Most previous research agreed that the African Americans with type 2 diabetes are more likely to develop macro-vascular diseases (Carter, Pugh and Monterrosa 1996, Black, Ray and Markides 1999, Hamel, Rodriguez-Saidana, Flaherty and Miller 1999).

Nevertheless, there was several studies reported that the African American subjects were less likely to experience diabetes related cardiovascular disease (Konen, et al. 1999). There are many other conditions, such as, obese, high blood pressure, high blood cholesterol and smoking also can increase the chance of developing angina, heart attack and stroke (U.S. Department of Health and Human Service 2005).

Same as the macro-vascular diseases, the subjects with type 2 diabetes were more likely to be hypertension or hypercholesterolemia. In 2003–2004, 75% of adults with self-reported diabetes had blood pressure greater than or equal to 130/80 mmHg, or used prescription medications for hypertension. Diabetes is the leading cause of new cases of blindness among adults aged 20–74 years. And diabetic retinopathy causes 12,000 to 24,000 new cases of blindness each year. People with diabetes are twice as likely to have depression (Anderson, Freedland, Clouse and Lustman 2001, Ali, Stone, Peters, Davies and Khunti 2006) and 1.4 times likely to have anxiety

as those without diabetes (Li, et al. 2008). On the other hand, longitudinal study has shown that adults with depression have 37% increased risk of developing type 2 diabetes (Knol, et al. 2006).

Several other diseases appeared to correlate to diabetes: Diabetes is the leading cause of kidney failure, accounting for 44% of new cases in 2005. About 60% to 70% of people with diabetes have mild to severe forms of nervous system damage. More than 60% of non-traumatic lower-limb amputations occur in people with diabetes.

1.2 Data Sources

The data used in this study were obtained from the Behavior Risk Factor Surveillance System (BRFSS), a publicly available database. The BRFSS was established in 1984 by the Centers for Disease Control and Prevention (CDC). The BRFSS is a state-based system that is used to gather information through telephone surveys conducted by the health departments of all 50 states, the District of Columbia, Guam, Puerto Rico, and the U.S. Virgin Islands, with help from CDC. The BRFSS is the world's largest continuously conducted telephone health surveillance system, which conducts more than 400,000 interviews per year (Balluz, et al. 2002, Hughes, et al. 2006). The BRFSS objective is to collect uniform, state specific data on preventive health practices and risk behaviors that are linked to chronic diseases, injuries, and preventable infectious diseases that affect the adult population (Centers for Disease Control and Prevention 2003).

1.2.1 Questionnaire

The questionnaire includes the core component, optional modules and state-added questions. The core component questions were asked by all states. All these questions are standard questions

included queries about current health-related conditions, perceptions, and behaviors, such as, health status, health insurance, diabetes, tobacco use, disability, and HIV/AIDS risks, as well as demographic questions. Optional CDC modules are used in state's questionnaires which are about specific topics (e.g., cardiovascular disease, arthritis, women's health). In 2009, 29 optional modules were supported by CDC. State-added questions are questions developed or acquired by participating states and added to their questionnaires (Centers for Disease Control and Prevention 2009).

1.2.2 Data Collection

In 2009, all states and districts used computer-assisted telephone interviewing (CATI) which was supported by CDC using the Ci3 CATI software package. The core component questions last an average of 15 minutes, and modules and state-added questions usually took 5-10 more minutes. Materials developed by CDC were used to train the state interviewers or coordinators. These materials cover seven basic areas: overview of the BRFSS, the questionnaire, sampling, role descriptions for staff, codes and dispositions (three-digit codes indicating the outcome of each call attempts), survey follow-up, and practice sessions. Contractors typically use experienced interviewers, but these interviewers are still given additional training on the BRFSS questionnaire and procedures before they are approved to work on BRFSS. Telephone interviewing was conducted during each calendar month, and calls were made seven days per week, during both daytime and evening hours. Standard procedures were followed for rotation of calls over days of the week and time of day (Centers for Disease Control and Prevention 2009).

1.2.3 Sources of Error

Non-coverage Error: Because the BRFSS is a telephone survey system, the households without telephones make this a larger source of non-coverage error. Although overall, approximately 94% of U.S. households have telephones, the coverage differs across states and subgroups. For example, people living in the South, minorities, and those in lower socioeconomic groups typically have lower telephone coverage (Bureau of the Census 1994). Persons without telephones tend to have lower household incomes, and low income is associated with certain health risk behaviors. Another source of non-coverage error came from the exclusion of person who lived in nonresidential settings, such as hospitals, nursing homes, prisons, military bases, and college dormitories. Compared with the size of the whole adult population of the state, the number of persons within the above-mentioned groups is generally small (Centers for Disease Control and Prevention 2009).

Sampling Error: Like all the other survey data, all estimates in BRFSS are based on only a sample of the population rather than on the entire population. This may lead to sampling error. Strictly adhering to the BRFSS calling rules and randomly selecting a household member can avoid some sampling error (Centers for Disease Control and Prevention 2009).

Non-response Error: This is a common problem in surveillance work. There are two levels of non-response: unit non-response and item non-response. For BRFSS data, unit non-response occurs when a person does not respond or refuses to participate in the survey. Item non-response occurs when useful data are not obtained for all questionnaire items. Because non-response bias is inversely related to response rate, surveys with higher response rates will generally have lower non-response bias (Centers for Disease Control and Prevention 2009).

Measurement Error: The quality of measurements in BRFSS data can be affected by the question order, question wording, response-code precision, recall error, length of interview, interviewer technique, coding errors and simple data entry error (Centers for Disease Control and Prevention 2009).

1.2.4 Variables Related to Data Analysis

Primary sampling unit (_PSU): Value should be unique for a state for a year.

Sample design stratification variable (_STSTR): This is a five digit number that combines the values for state, Geographic Stratum Code and Household Density Stratum Code.

_FINALWT = _POSTSTR*(NRECSTR/ NRECSEL)*(NUMADULT/_IMPNPH)

Where _POSTSTR (Post-stratification weight) = Population estimate for race/gender/age categories divided by the weighted sample frequency by race/gender/age

NRECSTR = number of records in a stratum

NRECSEL = the number of records selected

NRECSTR/ NRECSEL = _STRWT (Stratum weight)

NUMADULT = number of adults in the household_

IMPNPH = the imputed number of phones

NUMADULT / IMPNPH =_RAW (Raw weighting factor)

_STRWT*_RAW =_WT2 (Design weight)

Post stratification weights are used in order to partially correct any bias caused by non-telephone coverage. The growth of cellular telephone only households also needs to consider. The percentage of cellular phone service only households increased to 22.7% in 2009 (Blumberg and Luke 2009). The regular BRFSS sample in 2009 did not include the cellular telephones.

However the BRFSS is making adjustments to include this segment of the population. In 2009, 48 states, District of Columbia, Puerto Rico, and Virgin Islands collected a sample of 250 or more cell phone only interviews in a pilot study to reach this portion of the population (Centers for Disease Control and Prevention 2009).

1.3 Purpose of Study

Before the early 1990s, research showed that the prevalence of type 2 diabetes in all minorities except Alaskan natives were 2-6 times more than Non-Hispanic Whites (Haffner 1998, Ness, Nassimiha, Feria and Aronow 1999). Diabetes was considered as chronic diseases that required patients' self-management which have great correlations with individual life style, preventive care and demographic characteristics (Harris, Pan and Mukhtar 2010). In recent years, there was a few research focused on the racial disparities of diabetes-related diseases, especially using large survey data. Our study focused on the racial disparities of diabetes complications in order to provide more specific diabetes management according to different races/ethnicities. There are two purposes of this study: in the first place, for each complication, to compare the prevalence in Non-Hispanic White Americans to the prevalence in the other racial and ethnic groups in the United States using 2009 BRFSS data. Secondly, to evaluate potential correlates for each diabetes-related disease, such as the demographic characteristics, preventive care, other risk factors and other diseases.

CHAPTER 2 METHODS AND PROCEDURES

2.1 Study Population

Adults aged >=18 years with type 2 diabetes from the 2009 Behavior Risk Factor Surveillance system were utilized to do analysis. The variables which missing values exceeded 20% were excluded from the study measures. Data files were downloaded from the CDC website in SAS Transport format.

2.2 Study Measures

2.2.1 Diabetes Status and Typology

Diabetes status was determined using responses to the question, “Have you ever been told by a doctor that you have diabetes”. BRFSS participants were considered to have diabetes if they reported having been told by a doctor that they had the disease. The following three types of population are considered not to have this disease: (1) Persons had not been so told. (2) Women reported having diabetes only during pregnancy. (3) People reported having pre-diabetes or borderline diabetes. People were considered to have type 2 diabetes if their age at diagnosis was 30 years or older or if their age at diagnosis was less than 30 years and they did not use insulin (World Health Organization Study Group 1994, Beckles, Engelgau and Narayan 1998).

2.2.2 Race and Ethnicity

Ethnicity was coded into Hispanic or non-Hispanic. Participants who reported themselves as non-Hispanic were assigned one of the following racial categories based on self-report: White, African American/Black, Asian, Native Hawaiian/Pacific Islander, American Indian/Native

Alaskan (Native American), other, or mixed race. Because number of participants with hypertension in Asian, Native Hawaiian/Pacific Islander, other and multiple races is160, 60, 125, and 327 respectively, we combined Asian, Native Hawaiian/Pacific Islander into one group, also other and mixed race were combined into one group. Therefore, there contained six groups in this study: White, Black, Asian or Pacific Islander, Native American, others and Hispanic.

2.2.3 Diabetes Complications

The BRFSS asks respondents questions about diabetes-related complications: heart attack, stroke, angina, high blood pressure, high cholesterol, retinopathy and mental health.

Hypertension: Participants were considered to have hypertension if they reported that any health professional ever said that their blood pressure was high. Hypertension data were missing for 77 participants.

Hypercholesterolemia: Participants were considered high cholesterol if they reported that any health professional ever said that their cholesterol was high. Cholesterol data were missing for 1746 participants.

Heart attack: Heart attacks were identified using the question: “Has a doctor, nurse, or other health professional ever told you that you had a heart attack, also called a myocardial infarction?” Heart attack status was missing for 347 participants.

Angina or other coronary heart disease: Anginas were indentified using the question: “Has a doctor, nurse, or other health professional ever told you that you had angina or coronary heart disease?” Angina status was missing for 721 participants.

Stroke: For question “Has a doctor, nurse, or other health professional ever told you that you have a stroke?” the participants were considered have had stroke if they answer “yes”. There were 178 participants that their stroke status was missing.

Retinopathy: Participants with diabetic retinopathy were identified using the question: “Has a doctor ever told you that diabetes has affected your eyes or that you had retinopathy?” Retinopathy status was unknown for 421 participants.

Serious psychology disease (SPD): The K6 scale was used to determine the status of SPD. The K6 scale assessed participants’ psychological distress on the basis of how frequently they reported having felt 1) nervous, 2) hopeless, 3) restless or fidgety, 4) so depressed that nothing could cheer them up, 5) that everything was an effort, and 6) worthless during the previous 30 days. A 5-point Likert scale was used to rank the frequency: 0 = “None of the time,” 1 = “A little of the time,” 2 = “Some of the time,” 3 = “Most of the time,” and 4 =“All of the time.” Total scores thus are from 0 to 24. Respondents were considered to have probable SPD if their total K6 score was 13 or above (Kessler, et al. 2002, Kessler, et al. 2003). The status of SPD was unknown for 28646 participants because only participants in 6 states were asked these kinds of questions. In the following data analysis, we only constructed the two-way frequency table and ANOVA test for SPD because of the large amount of missing values.

2.2.4 Risk Factors

Smoke: Respondents were considered to be current smokers if they reported smoking at least 100 cigarettes in their lifetime and were currently smokers. Those who formerly smoked or never smoked were considered to be nonsmokers. 144 participants were missing for smoking status.

Physical inactive: Persons were considered to be physically inactive if they had not participated in any leisure time physical activity or exercise during the previous 30 days (Caspersen, Powell and G.M.Christenson 1985). The number of missing for physical inactive status is 1286.

Body mass index (BMI): Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters. Persons were considered obese if their BMI was $\geq$30 kg/m^2 (NHLBI Expert Panel on the Identification 1998, WHO Consultation on Obesity 2003). Overweight were defined as 25<=BMI<30 kg/m^2. The BMI number is unknown for 1678 diabetes participants.

Binge drinking: Binge drinking was defined as the consumption of five or more drinks on at least one occasion in the past month. The missing value is 653 for binge drinking status.

Fruit and vegetables consumption: If the fruit and vegetables consumption is less than five times per day, it is considered as not enough consumption. The Status is missing for 1013 diabetes participants.

Life dissatisfaction: In general, if the participants were dissatisfied or very dissatisfied with their life, they were defined as life dissatisfaction. The status is missing for 1718 participants.

2.2.5 Preventive Care

Health care access: The health care access status was defined by the following question: “Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare?” 60 participants were missing this status.

Blood sugar check: Check blood for glucose is identified by question: “About how many times in the past 12 months has a doctor, nurse, or other health professional checked you for A1C?” If the participants checked blood sugar at least 1 time/2 days, the status was considered regularly. There were 530 missing value for participants.

Checkup Status: “About how long has it been since you last visited a doctor for a routine checkup?” Three levels were defined for this status: within past year, within past 2 years and past 2 years. There were 373 missing value for checkup status.

Doctor visiting: Times seen health professional for diabetes depends on question: “About how many times in the past 12 months have you seen a doctor, nurse, or other health professional for your diabetes?” Two levels were defined for this variable: yes and no. The number of missing value was 1045.

A1C check: “About how many times in the past 12 months has a doctor, nurse, or other health professional checked you for A1C?” were asked to determine the A1C status. Also two levels were defined for it: yes and no. 4560 participants were unknown for this status.

Flu shot status: “During the past months, have you had an influenza vaccine injected into your arm?” Yes and no were two levels. 633 missed in this status.

Blood cholesterol check: “About how long has it been since you last had your blood cholesterol checked?” Same as checkup status, there were three levels: within past year, within past 2 years and past 2 years. There were 1827 missing values for this status.

Insulin:"Are you now taking insulin?" were asked to define the insulin taking status. Only 67 participants did not have response for this question.

Eye exam: "When was the last time you had an eye exam in which the pupils were dilated?" were asked. Three levels were constructed: within past month, within past year, past 1 year. And there were 541 participants unknown.

2.2.6 Other Diseases

Asthma: The asthma is defined using the question:" Have you ever been told by a doctor, nurse, or other health professional that you had asthma?" The number of missing is 108.

Arthritis burden: Arthritis burden was identified using question:" Have you ever been told by a doctor or other health professional that you have some form of arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia?" There were 871 participants who did not have response.

Cancer Survivors: Cancer Survivors was defined using question:" Have you EVER been told by a doctor, nurse, or other health professional that you had cancer?" 1483 participants were unknown for this status.

2.2 Statistical Analysis

Individual variables were compared across the defined race groups using analysis of variance or Rao-Scott chi-square test. Multivariate logistic regression model for complex survey data was constructed to calculate the odds ratios (OR) for heart attack, coronary heart disease, high blood pressure, high blood cholesterol, stroke, and retinopathy. All statistical analyses took into

account several survey study design factors, such as strata, primary sample units, and sampling weights.

All the odds ratios were adjusted for demographic characters (age, duration, sex, marital status, education level, income level, health care access and unable to see doctor because of cost), preventive care (last checkup time, insulin taken status, time of sugar check, attending class for diabetes, see health professional for diabetes, time of checking hemoglobin, everyday Aspirin taken, flu shot status and cholesterol checking), and other risk factors (body mass index, participating physical activities and exercise, fruit and vegetable consuming, life satisfaction, smoking and drinking status). The odds ratio for hypertension also was adjusted for some other diseases: asthma, arthritis, cancer, high blood cholesterol, one or more macro-vascular diseases and retinopathy. The odds ratio for hypercholesterolemia also was adjusted for some other diseases: asthma, arthritis, cancer, high blood pressure, one or more macro-vascular diseases and retinopathy. The odds ratio for heart attack also was adjusted for some other diseases: asthma, arthritis, cancer, high blood pressure, high blood cholesterol, stroke, angina and coronary heart disease, retinopathy. The odds ratio for stroke also was adjusted for some other diseases: asthma, arthritis, cancer, heart attack, high blood cholesterol, high blood pressure, angina and coronary heart disease, retinopathy. The odds ratio for angina also was adjusted for some other diseases: asthma, arthritis, cancer, heart attack, high blood cholesterol, stroke, high blood pressure and retinopathy. The odds ratio for retinopathy also was adjusted for some other diseases: asthma, arthritis, cancer, high blood cholesterol, high blood pressure and one or more macro-vascular diseases.

In the large survey data like BRFSS, there include different cluster, stratum and weighted data during the design. The SURVEY procedure instead of the regular SAS procedure needs to be used in order to consider all the survey design study. For two categorical variables, we use PROC SURVEYFREQ to calculate the weighted frequency and constructed RAO_SCOTT Chi-square test which is a design-adjusted Pearson chi-square test, which involves differences between observed and expected frequencies (Rao and Scott 1981, 1984, 1987). Two forms of correction were applied: one is proportion estimates and another one uses null hypothesis proportions. For one continuous variable and one categorical variable, the PROC SURVEYMEANS was used to calculate the means in different categories and the PROC SURVEYREG was used to test the significance. The PROC SURVEYLOGISTIC was used to fit linear logistic regression models for discrete response survey data by the method of maximum likelihood. For statistical inferences, PROC SURVEYLOGISTIC incorporates complex survey sample designs. Variances of the regression parameters and odds ratios were computed by using either the Taylor series (linearization) method or replication (re-sampling) methods to estimate sampling errors of estimators based on complex sample designs (SAS Institute Inc. 2008).

Factors which p-values were less or equal than 0.05 were considered to be statistically significant. All the analyses were conducted using SAS (version 9.2).

CHAPTER 3 RESULTS

3.1 Frequencies and Descriptive Statistics

Of 432607 participants in 2009 BRFSS data, diabetes people occupied more than 9% (Centers for Disease Control and Prevention 2009). The prevalence of diabetes in different races is

significantly different (p<0.0001, Table 1). African American occupied the highest rate and also Native Americans have relative high prevalence of diabetes while Asians or Pacific Islanders have the lowest rate. Of 52386 diabetes people, the type 2 diabetes occupied more than 90% while the prevalence of type II diabetes in different races were not significantly different (P=0.2959, Table 1).

The characteristics of 31906 participants with type 2 diabetes are shown in Table 2. Of the racial/ethnic groups studied, the Asian or Pacific Islanders were youngest and Whites were oldest (p<0.0001 cross all eight groups). More than 2 times Asian or Pacific Islander graduated from college compared with Hispanic (p<0.0001). Asian or Pacific Islander have the highest employed rate which included employed for wages, self-employed and homemaker and the highest rate of income more than $50000 (p<0.0001 cross all six groups). Hispanic were the least likely to have health care access while only fewer than 8% of White and fewer than 9% Asian or Pacific Islander were uninsured. More than 25% Hispanic could not see a doctor because of cost, whereas fewer than 9% Whites did. The duration of Native American's diabetes is almost 12 years, whereas the Asian or Pacific Islander's only continued less than 8.5 years.

Table 1 Diabetes frequency in different races/ethnicities.

	Total diabetes (52386)		P-value	Total type 2 diabetes (31906)		P-value
	Frequency	Column Percent*		Frequency	Column Percent**	
White	37284	8.20 (0.07)	<0.0001	23059	92.98 (92.31-93.65)	0.2959
Black	6720	13.42 (0.35)		4359	91.02 (88.26-93.77)	
Asian or Pacific Islander	898	7.72 (0.50)		383	94.75 (90.19-99.32)	
Native American	1109	14.31 (0.97)		615	86.05 (75.77-96.32)	
Other	1287	9.64 (0.57)		647	89.88 (84.22-95.93)	
Hispanic	4308	9.83 (0.30)		2843	91.97 (88.20-95.74)	

Note:* The number of diabetes of specific race/the total number of specific race.

** The number of type 2 diabetes of specific race/the total number of diabetes of specific race.

Table 2 Demographic characteristics of participants with type2 diabetes by races/ethnicities.

	White (STD)[a]	African American (STD) [a]	Asian or Pacific Islander (STD) [a]	Native American (STD) [a]	Other (STD) [a]	Hispanic (STD) [a]	*P* value
n	23059	4359	383	615	647	2843	-
Percent of total participants	67.06	15.45	0.22	1.36	0.68	12.14	-
Age (mean years)	62.35(0.19)	58.37(0.56)	52.40(1.28)	57.56(0.73)	59.51(0.55)	56.60(0.66)	<.0001
Duration (mean years)	9.80(0.10)	10.6(0.27)	8.33(0.65)	11.59(0.48)	10.00(0.51)	9.81(0.39)	0.0226
Sex (% male)	51.73(0.57)	42.14(1.58)	62.27(4.83)	48.68(4.24)	59.48(4.14)	47.86(2.14)	<.0001
Employed (%)	40.38(0.57)	39.35(1.59)	65.59(4.74)	34.61(3.75)	40.63(4.74)	48.44(2.12)	<.0001
Marital status (%)							<.0001
1.Married	64.06(0.52)	43.70(1.57)	84.46(3.00)	49.31(4.24)	52.88(4.68)	60.83(2.10)	
2.Divorced	11.71(0.34)	15.43(0.92)	4.35(1.78)	21.57(3.83)	13.19(2.09)	13.47(1.93)	
3.Widowed	14.90(0.32)	17.35(0.94)	4.28(1.07)	9.39(1.56)	12.30(1.99)	11.27(0.91)	
4.Unmarried	9.32(0.37)	23.51(1.38)	6.91(2.22)	19.73(3.54)	21.63(4.94)	14.43(1.44)	
Education (%)							<.0001
1. Less than High school	11.75(0.34)	18.64(1.06)	5.22(1.94)	18.24(2.94)	15.64(3.16)	35.54(1.92)	
2.High school	36.07(0.54)	35.74(1.48)	13.87(2.96)	34.83(3.97)	34.75(5.18)	26.75(1.71)	
3. College	52.18(0.56)	45.62(1.55)	80.91(3.46)	46.93(4.26)	49.61(4.67)	37.71(2.16)	
Income (%)							<.0001
1. Less than 20000	20.60(0.46)	39.25(1.54)	12.60(3.07)	40.96(4.39)	35.66(4.20)	46.68(2.30)	
2. 20000-50000	43.65(0.61)	39.82(1.62)	27.94(4.69)	37.08(4.06)	32.23(3.66)	34.79(2.10)	
3. >=50000	35.75(0.60)	20.93(1.50)	59.47(5.21)	21.96(3.94)	32.11(5.33)	18.53(2.29)	
Health care(% yes)	92.87(0.35)	86.44(1.16)	91.56(2.50)	83.15(3.27)	83.37(4.59)	77.27(2.24)	<.0001
Medicare cost (% yes)	11.91(0.43)	19.83(1.39)	20.00(4.51)	24.31(3.75)	17.52(2.86)	26.83(2.16)	<.0001

Note: a Standard deviation.

The frequencies of preventive care in 31906 participants with type 2 diabetes are shown in Table 3. More than 7% “other” group and more than 5.5% Hispanic did not check their blood cholesterol for more than 2 years, while only less than 2% Asian or Pacific Islander did not. Only 41% Hispanic got flu shots during past 12 months compared with Almost 65% White. Native American and Hispanic were less likely to get social and emotional support. There were no significant differences in the rate of taking aspirin (p=0.1003) and taking class in managing diabetes (p=0.0508) across groups, while there were significant differences in the rate of taking insulin (p<0.0001). The Asian or Pacific Islander were more likely to check their eyes (p<0.0001) and least likely to see health professional for their diabetes and check their blood sugar. The Black were more likely to do regular checkup and check their blood sugar (p<0.0001).

Table 3 Frequency of preventive care in different type of races/ethnicities with type 2 diabetes

	White (STD)[a]	African American (STD)[a]	Asian or Pacific Islander (STD)[a]	Native American (STD)[a]	Other (STD)[a]	Hispanic (STD)[a]	*P* value
See doctor for diabetes	3.91(0.05)	5.01(0.24)	3.37(0.18)	4.35(0.15)	4.34(0.31)	5.65(0.25)	<.0001
Check hemoglobin	2.96(0.04)	3.53(0.22)	2.56(0.12)	2.96(0.08)	3.38(0.26)	4.03(0.14)	<.0001
Insulin (%yes)	21.97(0.45)	28.21(1.40)	14.92(3.17)	26.07(3.45)	20.95(3.01)	21.32(1.51)	<.0001
Last checkup							<.0001
1. Within past year	87.60(0.42)	90.93(1.00)	88.22(3.21)	84.51(2.81)	81.66(4.53)	82.66(1.86)	
2.Within past two years	5.81(0.32)	5.26(0.88)	8.07(2.93)	7.29(2.02)	4.95(1.32)	8.21(1.27)	
3. More than two years	6.59(0.31)	3.81(0.52)	3.71(1.46)	8.20(2.08)	13.40(4.54)	9.12(1.53)	
Frequently Check blood sugar (%yes)	70.32(0.54)	75.67(1.44)	57.82(5.20)	72.56(3.72)	61.72(4.71)	64.93(2.12)	<.0001
Check eyes							0.0009
1.Within the past month	18.51(0.42)	21.24(1.19)	20.69(4.24)	15.78(3.29)	17.25(3.54)	18.20(1.42)	
2.Within the past year	51.62(0.57)	50.53(1.58)	50.98(5.15)	53.94(4.20)	42.45(4.34)	44.45(2.10)	
3. More than one year	29.87(0.54)	28.23(1.50)	28.34(4.32)	30.27(3.70)	40.31(5.05)	37.35(2.15)	
Diabetes education(%yes)	54.25(0.57)	56.02(1.57)	52.65(5.10)	56.23(4.09)	52.89(5.79)	48.42(2.10)	0.0508

	White (STD)[a]	African American (STD)[a]	Asian or Pacific Islander (STD)[a]	Native American (STD)[a]	Other (STD)[a]	Hispanic (STD)[a]	*P* value
Take Aspirin (%yes)	61.25(0.91)	55.58(2.06)	53.94(14.47)	60.95(6.85)	50.59(6.15)	50.79(6.00)	0.1003
Emotional support							<.0001
1. Always	48.73(0.58)	46.61(1.66)	47.49(5.41)	41.32(4.44)	45.27(4.98)	45.70(2.19)	
2. Usually	26.39(0.51)	13.49(1.03)	14.90(3.52)	17.44(3.98)	20.22(3.11)	18.86(1.76)	
3. Sometimes	13.95(0.42)	24.87(1.50)	17.63(4.41)	17.37(3.08)	14.88(2.36)	17.96(1.62)	
4. Rarely	5.68(0.26)	6.17(0.69)	11.81(3.87)	10.51(2.63)	11.36(4.77)	5.58(0.77)	
5. Never	5.25(0.22)	8.85(0.84)	8.17(1.90)	13.37(2.84)	8.25(2.31)	11.92(2.37)	
Flu shots (%yes)	64.73(0.57)	49.85(1.60)	52.42(5.21)	61.12(4.24)	58.09(4.76)	41.11(2.00)	<.0001
Cholesterol check							<.0001
1. Within past year	94.28(0.26)	92.78(1.01)	95.04(1.78)	90.44(2.43)	88.92(4.78)	87.72(2.34)	
2. Within past 2 years	3.63(0.19)	5.38(0.91)	3.40(1.50)	6.39(2.23)	3.41(1.40)	6.69(1.46)	
3. More than 2 years	2.09(0.18)	1.84(0.48)	1.56(0.95)	3.17(1.05)	7.67(4.74)	5.59(2.02)	

Note: [a] Standard deviation.

The frequencies of other risk factors in 31906 participants with type 2 diabetes are shown in Table 4. Asian or Pacific Islander were most likely to have normal weight (BMI<25kg/m^2; p<0.0001) and least likely to smoke and drink. Lower cutoffs for overweight and obesity have been proposed for Asian population (Health Communications Australia 2004, McNeely and Boyko 2005b) normal weight (<23kg/m^2), overweight (23<=BMI<25 kg/m^2), and obese (BMI>=25kg/m^2). The percentage of life satisfaction in Asian or Pacific Islander is the highest while the percentage in Native American is lowest (p=0.0246). Asian or Pacific Islander were most likely to participate exercise (p=0.0004) and less likely to smoke (p=0.0059). The Native Americans had the highest rate of smoking and binge drinking (p=0.0012).

Table 4 Frequency of other risk factors in different type of races/ethnicities with type 2 diabetes

	White (STD)[a]	African American (STD)[a]	Asian or Pacific Islander (STD)[a]	Native American (STD)[a]	Other (STD)[a]	Hispanic (STD)[a]	*P* value
Fruit vegetable (<5 times/day)	77.03(0.49)	77.06(1.44)	66.10(5.20)	80.10(3.57)	69.76(4.81)	79.03(1.69)	0.0268
Exercise (yes %)	81.54(0.44)	82.28(1.12)	92.51(2.10)	80.00(3.43)	77.73(4.70)	77.17(1.51)	0.0004
Life satisfaction (yes %)	91.24(0.33)	90.88(0.88)	96.31(1.92)	84.72(3.22)	85.57(2.91)	90.92(1.28)	0.0246
Body mass index							<.0001
Normal	13.93(0.38)	11.85(1.04)	42.37(5.15)	7.73(2.13)	11.31(2.13)	13.76(1.23)	
Overweight	32.23(0.54)	28.80(1.44)	35.37(4.74)	30.58(3.94)	37.54(4.72)	33.54(1.93)	
Obese	53.84(0.58)	59.35(1.57)	22.26(4.11)	61.70(4.11)	51.15(4.43)	52.7(2.12)	
Smoke (%yes)	15.25(0.44)	16.55(1.09)	7.99(3.08)	24.50(3.46)	22.77(3.16)	13.22(1.93)	0.0059
Drink (%yes)	2.34(0.18)	0.87(0.18)	0.49(0.36)	2.61(1.21)	0.87(0.45)	2.29(0.64)	0.0012

Note: Note: [a] Standard deviation.

The frequencies of other diseases in 31906 participants with type 2 diabetes are shown in Table 5. African American were more likely to have asthma and Asian or Pacific Islander were less likely to have it (p<0.0001). Of all the groups, White persons have highest rate of cancer (p<0.0001) and "other" group have highest percentage of arthritis.

Table 5 Frequency of other diseases in different races/ethnicities with type 2 diabetes

	White (STD)[a]	**African American** (STD)[a]	**Asian Pacific Islander** (STD)[a]	**Native American** (STD)[a]	**Other** (STD)[a]	**Hispanic** (STD)[a]	***P* value**
Asthma (%)	68.75(0.55)	78.38(1.42)	48.45(5.09)	66.13(4.07)	63.71(4.79)	63.19(2.15)	<.0001
Arthritis (%)	64.54(0.56)	63.42(1.53)	55.46(5.34)	63.36(4.15)	66.81(4.23)	59.18(2.23)	0.0449
Cancer (%)	15.85(0.41)	10.53(0.83)	10.00(3.44)	15.68(2.77)	12.75(2.00)	12.40(1.21)	<.0001

Note: [a] Standard deviation.

The percentage of diabetes complications in different type of races were shown as table 6. The raw prevalence of hypercholesterolemia was lowest in Asian or Pacific Islander (55%) and highest in "other" group (67%) and it just reached the significant level all over the groups

(p=0.0449). More than 75% African American reported hypertension while only less than 50% Asian or Pacific Islander have (p<0.0001 all over the groups). Also the prevalence of heart attack and coronary heart disease was the lowest in Asian or Pacific Islander (around 10%) and highest in White group (around 15%; p<0.0001). only 2.3% Asian or Pacific Islander reported stroke, while more than 10% Native American and almost 10% African American did. Nearly 30% Hispanic reported retinopathy, whereas only 16% White's eyes were affected by diabetes. 0.03 percent of Asian or Pacific Islander and 0.52 percent of Hispanic reported serious psychology disease, compared with 3.74% of participants in the "other" group and 1.76% of Native Americans (p<0.0001).

Table 6 Frequency of diabetes-related complications in different race/ethnicity with type 2 diabetes

	White (STD)[a]	**African American** (STD)[a]	**Asian Pacific Islander** (STD)[a]	**Native American** (STD)[a]	**Other** (STD)[a]	**Hispanic** (STD)[a]	***P* value**
Hypertension (%)	68.75(0.55)	78.38(1.42)	48.45(5.09)	66.13(4.07)	63.71(4.79)	63.19(2.15)	<.0001
Hypercholesterolemia (%)	64.54(0.56)	63.42(1.53)	55.46(5.34)	63.36(4.15)	66.81(4.23)	59.18(2.23)	0.0449
Heart attack (%)	15.85(0.41)	10.53(0.83)	10.00(3.44)	15.68(2.77)	12.75(2.00)	12.40(1.21)	<.0001
Coronary heart disease (%)	16.27(0.41)	8.73(0.71)	10.32(2.81)	15.65(3.23)	15.20(2.45)	10.83(0.97)	<.0001
Stroke (%)	7.67(0.26)	9.69(0.75)	2.30(0.74)	11.51(2.71)	10.76(2.03)	7.19(1.09)	0.0008
Retinopathy (%)	16.01(0.41)	22.18(1.33)	25.23(4.23)	24.11(3.45)	17.85(3.10)	27.27(1.83)	<.0001
SPD	0.62(0.08)	1.28(0.35)	0.03(0.03)	1.76(1.15)	3.74(3.24)	0.52(0.25)	<.0001

Note: [a] Standard deviation.

3.2 Comparisons of Diabetes-related Diseases by Race/Ethnicity Using Odds Ratio

3.2.1 African Americans and White Americans

Without adjusting any covariate of all the complications, the African Americans were 1.65 times more likely to have hypertension than white and were almost 1.3 times more likely to have

strokes, whereas they were more than 30% less likely to have heart attack and more than a half less to have angina or other coronary heart disease. Similarly, the African Americans were 1.5 times more likely to have retinopathy compared with Non-Hispanic White. After partial adjusting (demographic or demographic and preventive care or demographic and other risk factors or demographic and other diseases) and fully adjusting (demographic, preventive care, other risk factors and other diseases), the prevalence ratio between Black and White was greatly strengthened for hypertension and almost keep the same for coronary heart disease and stroke while attenuated for retinopathy (Table 7).

Table 7 Odds ratio between African American and non-Hispanic white

	Hypertension (95% CI)[a]	Hypercholesterolemia (95% CI)[a]	Heart attack (95% CI)[a]	Angina or coronary heart disease (95% CI)[a]	Stroke (95% CI)[a]	Retinopathy (95% CI)[a]
Raw odds ratio	1.65* (1.39-1.96)	0.95 (0.83-1.09)	0.63* (0.52-0.75)	0.49* (0.41-0.59)	1.29* (1.08-1.55)	1.50* (1.27-1.76)
Adjusted demographic	1.81* (1.51-2.17)	0.93 (0.80-1.09)	0.70* (0.57-0.86)	0.55* (0.45-0.68)	1.23* (1-1.53)	1.28* (1.06-1.56)
Adjusted demographic and preventive cares	1.97* (1.59-2.43)	0.93 (0.78-1.11)	0.67* (0.53-0.85)	0.58* (0.45-0.72)	1.21 (0.96-1.52)	1.26* (1.02-1.56)
Adjusted demographic and other risk factors	1.88* (1.54-2.29)	0.91 (0.77-1.08)	0.73* (0.59-0.90)	0.54* (0.43-0.67)	1.32* (1.06-1.66)	1.32* (1.07-1.62)
Adjusted demographic and other diseases	2.01* (1.64-2.45)	0.82* (0.70-0.98)	0.88 (0.69-1.11)	0.56* (0.44-0.70)	1.38* (1.08-1.75)	1.42* (1.15-1.75)
Adjusted demographic preventive care, other risk factors and other diseases	2.11* (1.67-2.66)	0.87 (0.72-1.06)	0.85 (0.65-1.11)	0.51* (0.34-0.74)	1.30* (1.01-1.69)	1.29* (1.03-1.63)

Note: *p<0.05

[a] 95% confident interval for odds ratio.

Table 8 Odds ratio of diabetes-related diseases between Asian or Pacific Islander and non-Hispanic white

	Hypertension (95% CI)[a]	Hypercholesterolemia (95% CI)[a]	Heart attack (95% CI)[a]	Angina or coronary heart disease (95% CI)[a]	Stroke (95% CI)[a]	Retinopathy (95% CI)[a]
Raw odds ratio	0.43* (0.29-0.64)	0.68 (0.45-1.05)	0.59 (0.28-1.25)	0.59 (0.33-1.08)	0.28* (0.15-0.54)	1.77* (1.14-2.76)
Adjusted demographic	0.71 (0.47-1.08)	0.80 (0.50-1.26)	1.04 (0.46-2.38)	0.93 (0.49-1.74)	0.52 (0.26-1.02)	2.11* (1.26-3.52)

Adjusted demographic and preventive cares	0.69 (0.44-1.10)	0.78 (0.47-1.28)	1.22 (0.47-3.20)	1.03 (0.50-2.09)	0.38* (0.17-0.86)	1.92* (1.07-3.46)
Adjusted demographic and other risk factors	0.95 (0.61-1.50)	0.82 (0.50-1.32)	1.19 (0.48-2.94)	1.06 (0.53-2.13)	0.56 (0.26-1.18)	1.93* (1.10-3.38)
Adjusted demographic and other diseases	0.79 (0.48-1.31)	0.81 (0.49-1.35)	1.31 (0.43-4.03)	1.17 (0.55-2.52)	0.42* (0.18-0.99)	2.05* (1.17-3.57)
Adjusted demographic preventive care, other risk factors and other diseases	1.03 (0.60-1.76)	0.80 (0.46-1.38)	1.88 (0.62-5.73)	0.89 (0.14-5.80)	0.37 (0.12-1.16)	1.86* (1.01-3.46)

Note: *p<0.05

[a] 95% confident interval for odds ratio.

3.2.2 Asian or Pacific Islander and White American

Without adjusting correlate categories of diabetes-related complications, comparing with Non-Hispanic white American, the Asian or Pacific Islander were more than 50% less likely to have hypertension and also more than 70% less likely to experience stroke. After partial adjusting for stroke, the prevalence ratio between Asian or Pacific Islander and White remain significant while there was no significant difference after full adjusting. For the prevalence ratio of hypertension between Asian or Pacific Islander and White, even after partial adjustment, the significant difference disappeared. Like the Black persons, Asian Americans or Pacific Islanders were almost 1.8 times more likely to be eye-affected by diabetes and the prevalence of retinopathy greatly increased after partial and full adjustment. There were no significant differences in the unadjusted and adjusted prevalence ratios of coronary heart disease, heart attack and hypercholesterolemia between Asian or Pacific Islander and White (Table 8).

3.2.3 Hispanic and White American

The unadjusted prevalence of hypertension, hypercholesterolemia, heart attack and coronary heart disease for Hispanic were all lower than for White (p), but the unadjusted prevalence of stroke was the same with White. The odds ratio of retinopathy between Hispanic and White was almost 2. Similar to Black American, the prevalence of retinopathy between Hispanic and White were attenuated after partial and full adjustment. The significance for hypertension and heart attack disappeared after partial adjustment and full adjustment while the prevalence of hypercholesterolemia and coronary heart disease were still significant after partial adjustment.

Table 9 Odds ratio of diabetes-related diseases between Hispanic and non-Hispanic white

	Hypertension (95% CI)[a]	Hypercholesterolemia (95% CI)[a]	Heart attack (95% CI)[a]	Angina or coronary heart disease (95% CI)[a]	Stroke (95% CI)[a]	Retinopathy (95% CI)[a]
Raw odds ratio	0.78* (0.65-0.94)	0.80* (0.66-0.96)	0.75* (0.60-0.94)	0.63* (0.51-0.77)	0.93 (0.67-1.29)	1.97* (1.63-2.38)
Adjusted demographic	0.87 (0.71-1.07)	0.77* (0.63-0.94)	0.80 (0.59-1.06)	0.66* (0.52-0.84)	0.94 (0.66-1.36)	1.60* (1.29-2.00)
Adjusted demographic and preventive cares	0.90 (0.70-1.15)	0.83 (0.66-1.03)	0.71* (0.54-0.94)	0.67* (0.51-0.89)	1.06 (0.73-1.55)	1.79* (1.37-2.34)
Adjusted demographic and other risk factors	0.90 (0.72-1.12)	0.76* (0.61-0.95)	0.93 (0.68-1.27)	0.73* (0.57-0.94)	1.11 (0.76-1.62)	1.64* (1.30-2.08)
Adjusted demographic and other diseases	0.91 (0.72-1.15)	0.80* (0.65-0.99)	0.93 (0.70-1.23)	0.76* (0.58-0.99)	1.07 (0.72-1.59)	1.73* (1.38-2.17)
Adjusted demographic preventive care, other risk factors and other diseases	0.95 (0.73-1.23)	0.82 (0.65-1.03)	0.86 (0.63-1.24)	0.63 (0.28-1.41)	1.26 (0.80-1.99)	1.71* (1.29-2.26)

Note: *p<0.05

[a] 95% confident interval for odds ratio

Table 10 Odds ratio of diabetes-related diseases between Native American and non-Hispanic white

	Hypertension (95% CI)[a]	Hypercholesterolemia (95% CI)[a]	Heart attack (95% CI)[a]	Angina or coronary heart disease (95% CI)[a]	Stroke (95% CI)[a]	Retinopathy (95% CI)[a]
Raw odds ratio	0.89	0.95	0.99	0.96	1.57	1.67*

	(0.62-1.27)	(0.67- 1.35)	(0.65-1.49)	(0.59- 1.55)	(0.93-2.65)	(1.15- 2.43)
Adjusted demographic	0.90 (0.62-1.32)	0.97 (0.69- 1.36)	1.37 (0.84-2.24)	1.31 (0.79- 2.18)	1.52 (0.81-2.84)	1.42 (0.95- 2.11)
Adjusted demographic and preventive cares	0.91 (0.60- 1.39)	0.88 (0.61- 1.29)	1.48 (0.85- 2.59)	1.19 (0.68- 2.09)	1.22 (0.64- 2.33)	1.41 (0.92- 2.16)
Adjusted demographic and other risk factors	0.92 (0.60-1.43)	0.99 (0.68-1.44)	1.50 (0.89-2.53)	1.43 (0.85-2.41)	1.53 (0.81-2.87)	1.49 (0.97-2.30)
Adjusted demographic and other diseases	0.83 (0.54-1.26)	0.96 (0.63-1.44)	1.14 (0.52-2.52)	1.47 (0.79-2.74)	1.59 (0.78-3.21)	1.57 (0.99-2.49)
Adjusted demographic preventive care, other risk factors and other diseases	0.90 (0.56-1.45)	0.93 (0.57-1.52)	1.43 (0.70-2.93)	1.64 (0.56-4.76)	1.14 (0.56-2.30)	1.47 (0.93-2.33)

Note: *p<0.05

[a] 95% confident interval for odds ratio

Table 11 Odds ratio of diabetes-related diseases between "other" and non-Hispanic white

	Hypertension (95% CI)[a]	Hypercholesterolemia (95% CI)[a]	Heart attack (95% CI)[a]	Angina or coronary heart disease (95% CI)[a]	Stroke (95% CI)[a]	Retinopathy (95% CI)[a]
Raw odds ratio	0.80 (0.53-1.20)	1.11 (0.76-1.61)	0.78 (0.54-1.11)	0.92 (0.63-1.35)	1.45 (0.95-2.21)	1.14 (0.75-1.73)
Adjusted demographic	0.77 (0.50-1.18)	1.01 (0.67-1.53)	0.88 (0.61-1.29)	1.13 (0.77-1.64)	1.64* (1.06-2.54)	1.20 (0.78-1.86)
Adjusted demographic and preventive cares	0.69 (0.43-1.10)	0.95 (0.61-1.48)	0.82 (0.54-1.25)	1.18 (0.78-1.77)	1.85* (1.19-2.88)	1.41 (0.89-2.25)
Adjusted demographic and other risk factors	0.74 (0.47- 1.17)	0.93 (0.59- 1.46)	0.85 (0.57- 1.27)	1.16 (0.77- 1.74)	1.46 (0.90- 2.37)	1.15 (0.71- 1.86)
Adjusted demographic and other diseases	0.62 (0.37- 1.05)	1.00 (0.61- 1.64)	0.68* (0.46- 0.99)	1.08 (0.71- 1.64)	1.55 (0.95- 2.55)	1.34 (0.85- 2.11)
Adjusted demographic preventive care, other risk factors and other diseases	0.57* (0.33- 0.99)	0.93 (0.53- 1.62)	0.68 (0.44- 1.06)	0.67 (0.33- 1.39)	1.51 (0.87- 2.64)	1.30 (0.77- 2.20)

Note: *p<0.05

[a] 95% confident interval for odds ratio

3.2.4 Native American "Other" Group and White American

There were no significant differences in the unadjusted and adjusted prevalence of all these observed diabetes-related diseases between the Native American and White and also between "other" race group and White.

3.3 Correlations of Diabetes Complications

3.3.1 Hypertension

From the raw estimate, the prevalence ratio of high blood pressure was highest among older age, longer duration, unemployed, widowed, female, lower education level, lower income, more health plan access, cannot see a doctor because of medical cost, had last checkup within one year, take insulin, check blood sugar per time two days, receive flu shot in the past 1 year, got cholesterol check within past one year, had a dilated eye exam within past year, see health professional for diabetes, had A1C test, overweight or obese, physical inactive, smoker, arthritis burden, cancer, high blood cholesterol, one or more macro-cardiovascular diseases and diabetes-related eye disease. After adjustment, the following factors were independent correlates of hypertension among people with diagnosed diabetes: older age, lower education level, received flu shot in the past 1 year, took A1C test over past three months, overweight and obese, non-smoker and drinker, arthritis burden, high blood cholesterol, one or more macro-cardiovascular diseases and diabetes-related eye disease.

Table 12 Odds ratio of all characteristics in type 2 diabetes population with high blood pressure

	Unadjusted OR[a]			Adjusted OR[b]		
	Point estimate	95% CI		Point estimate	95% CI	
Age	1.03*	1.02	1.03	1.02*	1.01	1.03
Duration	1.02*	1.02	1.03	1.01	1.00	1.01
Employed	0.57*	0.51	0.63	0.86	0.75	1.00
Married versus unmarried	1.03	0.87	1.22	0.86	0.70	1.07
Divorced versus unmarried	1.19	0.96	1.48	0.92	0.69	1.22
Widowed versus unmarried	1.69*	1.41	2.02	1.08	0.83	1.41
Male versus female	0.85*	0.78	0.94	0.90	0.78	1.03
Lower than high school versus college	1.39*	1.20	1.59	1.26	1.00	1.58
High school versus college	1.23*	1.10	1.37	1.17*	1.02	1.34
Less than 20000 versus greater than 50000	1.52*	1.32	1.76	1.03	0.82	1.29
20000-50000 versus greater than 50000	1.38*	1.22	1.56	1.09	0.93	1.28
Health plan versus no health plan	1.43*	1.16	1.75	0.85	0.66	1.11
Can not see doctor because of cost	0.80*	0.68	0.94	0.94	0.73	1.21
Had last check up within 1year	1.46*	1.20	1.78	1.02	0.74	1.40
Had last check up within 2 years	0.90	0.67	1.20	0.74	0.50	1.11
Take insulin	1.30*	1.17	1.45	0.93	0.79	1.10
Check blood sugar at least 1 time/2 days	1.16*	1.04	1.30	0.90	0.77	1.04
Received a flu shot in the past year	1.52*	1.37	1.68	1.19*	1.04	1.36
Got cholesterol checked within 1 year	2.05*	1.28	3.30	1.22	0.71	2.09
Got cholesterol checked within 2 year	1.58	0.93	2.70	1.54	0.82	2.89
Had a dilated eye exam within 1 month	1.21*	1.05	1.39	0.94	0.78	1.13
Had a dilated eye exam within 1 year	1.14*	1.02	1.28	0.89	0.77	1.04
Seen health professional for diabetes	1.47*	1.27	1.71	0.92	0.74	1.14
Hemoglobin A1C test	1.91*	1.60	2.28	1.58*	1.22	2.05
Taken class for managing diabetes	1.10	1.00	1.21	1.04	0.91	1.19
Overweight	1.43*	1.25	1.64	1.69*	1.41	2.03
Obese	2.12*	1.85	2.42	2.66*	2.22	3.18

	Unadjusted OR[a]			Adjusted OR[b]		
Consumed fruits and vegetables less than 5 times per day	1.05	0.94	1.18	0.98	0.84	1.14
Physical active or exercise	1.35*	1.19	1.53	1.03	0.87	1.22
Life satisfied	1.19	1.00	1.41	1.10	0.86	1.41
Smoking	0.72*	0.63	0.83	0.69*	0.58	0.82
Drinker	0.98	0.80	1.20	1.34*	1.05	1.72
ASTHMA	1.03	0.91	1.17	0.90	0.76	1.07
Arthritis burden	1.89*	1.72	2.08	1.33*	1.17	1.51
Any type of cancer	1.31*	1.17	1.47	1.00	0.85	1.18
High blood cholesterol	2.20*	1.99	2.43	1.96*	1.72	2.22
One macro cardiovascular disease	1.90*	1.65	2.19	1.57*	1.30	1.90
Two macro cardiovascular disease	2.24*	1.88	2.68	1.58*	1.26	1.96
Three macro cardiovascular disease	1.90*	1.65	2.19	2.35*	1.46	3.78
Diabetes-related eye diseases	1.46*	1.29	1.65	1.32*	1.10	1.59

Note: * $p<0.05$

[a] The raw odds ratio without any adjustment.

[b] Adjust for demographic characters, preventive care, other risk factors and other diseases.

3.3.2 Hypercholesterolemia

From the raw estimate, the prevalence ratio of high blood pressure was highest among older age, unemployed, lower education level, lower income, cannot see a doctor because of medical cost, take insulin, check blood sugar per time two days, receive flu shot in the past 1 year, got cholesterol check within past one year, see health professional for diabetes, consume fruits and vegetables less than 5 times per day, had A1C test, overweight or obese, physical inactive, life dissatisfied, smoker, asthma, arthritis burden, high blood pressure, one or more macro-cardiovascular diseases and diabetes-related eye disease. After adjustment, the following factors

were independent correlates of hypertension among people with diagnosed diabetes: less duration, lower education level, check cholesterol within 1 year, took A1C test over past three months, overweight and obese, consume fruits and vegetables less than 5 times per day, smoker and drinker, life dissatisfied, high blood pressure, one or more macro-cardiovascular diseases and diabetes-related eye disease.

Table 13 Odds ratio of all characteristics in type 2 diabetes population with high blood cholesterol

	Unadjusted OR [a]			**Adjusted OR [b]**		
	Point estimate	95% CI		Point estimate	95% CI	
Age	1.01	1.00	1.01	1.01	1.00	1.01
Duration	1.00	0.99	1.00	0.99	0.98	1.00
Employed	0.74*	0.67	0.81	0.89	0.78	1.02
Married versus unmarried	0.92	0.79	1.07	0.92	0.75	1.13
Divorced versus unmarried	0.99	0.81	1.22	0.86	0.67	1.09
Widowed versus unmarried	0.90	0.76	1.05	0.67*	0.53	0.85
Male versus female	0.92	0.84	1.01	0.82*	0.73	0.94
Lower than high school versus college	1.38*	1.22	1.57	1.27*	1.04	1.55
High school versus college	1.16*	1.05	1.28	1.10	0.97	1.25
Less than 20000 versus greater than 50000	1.33*	1.16	1.51	1.02	0.83	1.24
20000-50000 versus greater than 50000	1.06	0.94	1.19	0.87	0.75	1.02
Health plan versus no health plan	1.13	0.91	1.39	1.21	0.94	1.57
Can not see doctor because of cost	1.20*	1.09	1.43	1.25	0.97	1.61
Had last check up within 1year	1.02	0.82	1.28	0.85	0.64	1.14
Had last check up within 2 years	0.89	0.65	1.22	1.09	0.75	1.57
Take insulin	1.17*	1.05	1.30	1.05	0.91	1.22
Check blood sugar at least 1 time/2 days	1.11	1.00	1.24	0.96	0.84	1.09
Received a flu shot in the past year	1.19*	1.08	1.31	0.98	0.86	1.11
Got cholesterol checked within 1 year	1.75*	1.09	2.79	2.01*	1.19	3.41
Got cholesterol checked within 2 year	0.93	0.55	1.57	1.22	0.69	2.15

	Unadjusted OR [a]			Adjusted OR [b]		
Had a dilated eye exam within 1 month	1.01	0.89	1.15	0.93	0.78	1.10
Had a dilated eye exam within 1 year	1.04	0.93	1.17	0.93	0.80	1.07
Seen health professional for diabetes	1.21*	1.04	1.40	0.96	0.78	1.18
Hemoglobin A1C test	1.49*	1.24	1.78	1.38*	1.08	1.76
Taken class for managing diabetes	1.01	0.92	1.11	1.08	0.96	1.22
Overweight	1.32*	1.15	1.52	1.22*	1.02	1.47
Obese	1.51*	1.32	1.72	1.22*	1.03	1.45
Consumed fruits and vegetables less than 5 times per day	1.20*	1.08	1.34	1.16*	1.01	1.33
Physical inactive	1.14*	1.02	1.26	0.95	0.81	1.10
Life dissatisfied	1.60*	1.36	1.89	1.34*	1.08	1.67
Smoking	1.21*	1.04	1.42	1.29*	1.08	1.53
Drinker	1.12	0.91	1.37	1.28	1.00	1.64
ASTHMA	1.24*	1.10	1.40	1.11	0.95	1.30
Arthritis burden	1.41*	1.29	1.55	1.13	1.00	1.27
Any type of cancer	1.10	0.99	1.23	0.94	0.82	1.09
High blood pressure	2.20*	1.99	2.43	1.95*	1.72	2.22
One macro cardiovascular disease	1.48*	1.31	1.67	1.38*	1.19	1.61
Two macro cardiovascular disease	2.23*	1.91	2.59	2.00*	1.65	2.43
Three macro cardiovascular disease	2.52*	1.78	3.58	2.25*	1.53	3.33
Diabetes-related eye diseases	1.30*	1.15	1.46	1.16	0.98	1.36

Note: *p<0.05

[a] The raw odds ratio without any adjustment.

[b] Adjust for demographic characters, preventive care, other risk factors and other diseases.

3.3.3 Heart attack

From the raw estimate, the prevalence ratio of high blood pressure was highest among older age, longer duration, unemployed, married, divorced and widowed, male, lower education level,

lower income, more health plan access, had last checkup within one year, take insulin, check blood sugar per time two days, receive flu shot in the past 1 year, got cholesterol check within past one year, had a dilated eye exam within past month, consume fruits and vegetables less than 5 times per day, physical inactive, smoker, non-drinker, arthritis burden, cancer, high blood cholesterol, high blood pressure, angina or other coronary disease, stroke and diabetes-related eye disease. After adjustment, the following factors were independent correlates of hypertension among people with diagnosed diabetes: older age, less than high school, income between 20000-50000, take insulin, check blood sugar at least 1 time/2day, got cholesterol check within past 1 year, smoker, arthritis burden, angina or coronary heart diseases, stroke and diabetes-related eye disease.

Table 14 Odds ratio of all characteristics in type 2 diabetes population with heart attack

	Unadjusted OR [a]			**Adjusted OR [b]**		
	Point estimate	95% CI		Point estimate	95% CI	
Age	1.04*	1.03	1.04	1.02*	1.01	1.03
Duration	1.03*	1.03	1.04	1.00	1.00	1.01
Employed	0.34*	0.30	0.40	0.69*	0.56	0.86
Married versus unmarried	1.53*	1.20	1.95	1.09	0.81	1.48
Divorced versus unmarried	1.53*	1.20	1.95	1.20	0.85	1.67
Widowed versus unmarried	2.17*	1.69	2.78	1.14	0.80	1.63
Male versus female	1.62*	1.45	1.81	1.89*	1.58	2.26
Lower than high school versus college	1.83*	1.58	2.12	1.50*	1.17	1.92
High school versus college	1.11	0.98	1.26	1.07	0.89	1.28
Less than 20000 versus greater than 50000	2.00*	1.70	2.35	1.22	0.93	1.70
20000-50000 versus greater than 50000	1.70*	1.45	2.00	1.30*	1.05	1.62
Health plan versus no health plan	1.56*	1.19	2.05	1.01	0.71	1.44
Can not see doctor because of cost	0.99	0.83	1.18	1.15	0.87	1.52
Had last check up within 1year	1.36*	1.09	1.71	1.26	0.86	1.85

	Unadjusted OR [a]			Adjusted OR [b]		
Had last check up within 2 years	1.19	0.77	1.85	1.36	0.73	2.52
Take insulin	2.03*	1.80	2.28	1.56*	1.29	1.89
Check blood sugar at least 1 time/2 days	1.56*	1.36	1.79	1.23	1.00	1.51
Received a flu shot in the past year	1.41*	1.25	1.60	0.97	0.80	1.17
Got cholesterol checked within 1 year	3.28*	2.11	5.10	2.11*	1.12	3.98
Got cholesterol checked within 2 year	2.36*	1.25	4.47	1.03	0.47	2.22
Had a dilated eye exam within 1 month	1.19*	1.02	1.40	0.88	0.68	1.13
Had a dilated eye exam within 1 year	1.07	0.94	1.22	0.90	0.73	1.12
Seen health professional for diabetes	1.03	0.85	1.25	0.94	0.70	1.26
Hemoglobin A1C test	0.98	0.78	1.25	0.69*	0.49	0.97
Taken class for managing diabetes	0.91	0.81	1.02	0.82*	0.69	0.98
Overweight	0.96	0.82	1.14	0.93	0.70	1.23
Obese	0.86	0.73	1.01	0.98	0.73	1.31
Consumed fruits and vegetables less than 5 times per day	1.18*	1.03	1.35	0.95	0.78	1.17
Physical inactive	1.62*	1.43	1.83	1.04	0.86	1.26
Life dissatisfied	1.47*	1.22	1.78	1.05	0.77	1.43
Smoking	1.30*	1.11	1.51	1.50*	1.18	1.92
Drinker	0.71*	0.52	0.96	0.96	0.66	1.40
ASTHMA	1.30*	1.12	1.51	1.16	0.91	1.49
Arthritis burden	1.64*	1.46	1.85	1.21*	1.02	1.43
Any type of cancer	1.58*	1.39	1.80	1.06	0.87	1.30
High blood cholesterol	1.65*	1.44	1.88	1.14	0.94	1.38
High blood pressure	1.67*	1.44	1.93	1.18	0.96	1.44
Angina or other coronary heart disease	15.52*	13.69	17.61	11.53*	9.80	13.57
Stroke	4.09*	3.54	4.74	2.26*	1.75	2.90
Diabetes-related eye diseases	1.77*	1.56	2.01	1.28*	1.04	1.57

Note: *$p<0.05$

[a] The raw odds ratio without any adjustment.

[b] Adjust for demographic characters, preventive care, other risk factors and other diseases.

3.3.4 Angina or other coronary heart disease

From the raw estimate, the prevalence ratio of high blood pressure was highest among older age, longer duration, unemployed, married, divorced and widowed, male, lower than high school, lower income, more health plan access, had last checkup within one year, take insulin, check blood sugar per time two days, receive flu shot in the past 1 year, got cholesterol check within past two years, had a dilated eye exam within past year, see health professional for diabetes, A1c test within three months, taken class for managing diabetes, physical inactive, life dissatisfied, asthma, arthritis burden, cancer, high blood cholesterol, high blood pressure, heart attack,, stroke and diabetes-related eye disease. After adjustment, the following factors were independent correlates of hypertension among people with diagnosed diabetes: older age, male, received a flu shot in the past year, taken class for managing diabetes, consume fruits and vegetables more than 5 times per day, high blood cholesterol, heart attack, high blood pressure and diabetes-related eye disease.

Table 15 Odds ratio of all characteristics in type 2 diabetes population with coronary heart disease

	Unadjusted OR [a]			**Adjusted OR [b]**		
	Point estimate	95% CI		Point estimate	95% CI	
Age	1.04*	1.03	1.04	1.02*	1.01	1.03
Duration	1.03*	1.03	1.04	1.01	0.99	1.02
Employed	0.40*	0.35	0.45	0.76	0.55	1.04
Married versus unmarried	1.63*	1.34	2.00	1.13	0.71	1.79
Divorced versus unmarried	1.45*	1.14	1.84	0.99	0.59	1.66
Widowed versus unmarried	2.02*	1.63	2.50	1.14	0.69	1.90
Male versus female	1.46*	1.32	1.63	1.45*	1.11	1.88
Lower than high school versus college	1.30*	1.12	1.50	1.08	0.69	1.70
High school versus college	1.07	0.95	1.21	0.82	0.62	1.08

	Unadjusted OR [a]			Adjusted OR [b]		
Less than 20000 versus greater than 50000	1.52*	1.30	1.77	0.97	0.65	1.45
20000-50000 versus greater than 50000	1.38*	1.19	1.59	0.92	0.66	1.27
Health plan versus no health plan	2.26*	1.77	2.89	1.48	0.86	2.56
Can not see doctor because of cost	0.87	0.74	1.02	1.16	0.78	1.74
Had last check up within 1year	1.53*	1.21	1.93	0.99	0.62	1.56
Had last check up within 2 years	0.91	0.64	1.29	0.83	0.39	1.76
Take insulin	2.00*	1.78	2.24	1.18	0.87	1.59
Check blood sugar at least 1 time/2 days	1.52*	1.34	1.72	0.83	0.61	1.12
Received a flu shot in the past year	1.81*	1.61	2.02	1.55*	1.17	2.05
Got cholesterol checked within 1 year	3.19*	1.97	5.15	1.67	0.58	4.86
Got cholesterol checked within 2 year	1.94*	1.08	3.49	1.14	0.34	3.83
Had a dilated eye exam within 1 month	1.32*	1.13	1.54	0.74	0.52	1.06
Had a dilated eye exam within 1 year	1.20*	1.06	1.36	0.73*	0.54	0.97
Seen health professional for diabetes	1.31*	1.10	1.55	1.23	0.82	1.82
Hemoglobin A1C test	1.41*	1.13	1.75	0.76	0.47	1.24
Taken class for managing diabetes	1.23*	1.11	1.37	1.31*	1.02	1.69
Overweight	1.00	0.84	1.18	0.89	0.59	1.34
Obese	1.00	0.85	1.17	0.96	0.66	1.41
Consumed fruits and vegetables less than 5 times per day	1.05	0.92	1.19	0.73*	0.55	0.98
Physical inactive	1.64*	1.45	1.86	1.04	0.79	1.36
Life dissatisfied	1.52*	1.27	1.82	1.18	0.80	1.74
Smoking	0.95	0.82	1.10	1.30	0.87	1.93
Drinker	0.65*	0.47	0.89	0.69	0.39	1.22
ASTHMA	1.31*	1.16	1.49	1.08	0.79	1.48
Arthritis burden	1.83*	1.64	2.05	1.14	0.88	1.47
Any type of cancer	1.63*	1.44	1.85	1.12	0.84	1.47
High blood cholesterol	2.16*	1.92	2.43	1.40*	1.07	1.82
Heart attack	15.52*	13.69	17.61	11.20*	8.63	14.55
High blood pressure	2.28*	1.99	2.61	1.56*	1.15	2.11

	Unadjusted OR [a]			Adjusted OR [b]		
Stroke	3.05*	2.63	3.55	1.15	0.79	1.68
Diabetes-related eye diseases	1.64*	1.45	1.86	1.35*	1.01	1.80

Note: *p<0.05

[a] The raw odds ratio without any adjustment.

[b] Adjust for demographic characters, preventive care, other risk factors and other diseases.

3.3.5 Stroke

From the raw estimate, the prevalence ratio of high blood pressure was highest among older age, longer duration, unemployed, divorced and widowed, lower education level, lower income, more health plan access, take insulin, check blood sugar per time two days, receive flu shot in the past 1 year, got cholesterol check within past two years, had a dilated eye exam within past year, physical inactive, life dissatisfied, smoker, non-drinker, asthma, arthritis burden, cancer, high blood cholesterol, high blood pressure, angina or other coronary disease, heart attack and diabetes-related eye disease. After adjustment, the following factors were independent correlates of hypertension among people with diagnosed diabetes: older age, longer duration, unemployed, married and widowed, income less than 20000, did not get A1C test in past three months, life satisfied, smoker, asthma, high blood pressure, high blood cholesterol, angina or coronary heart diseases, heart attack and diabetes-related eye disease.

Table 16 Odds ratio of all characteristics in type 2 diabetes population with stroke

	Unadjusted PR [a]			Adjusted PR [b]		
	Point estimate	95% CI		Point estimate	95% CI	
Age	1.04*	1.03	1.04	1.02*	1.01	1.03
Duration	1.03*	1.02	1.04	1.01*	1.00	1.02
Employed	0.26*	0.21	0.31	0.42*	0.31	0.57

	Unadjusted PR [a]			Adjusted PR [b]		
Married versus unmarried	1.18	0.93	1.51	1.47*	1.05	2.06
Divorced versus unmarried	1.86*	1.39	2.48	1.49	0.96	2.31
Widowed versus unmarried	2.26*	1.76	2.90	1.49*	1.01	2.19
Male versus female	0.97	0.85	1.11	1.07	0.87	1.31
Lower than high school versus college	1.85*	1.53	2.22	0.75	0.54	1.05
High school versus college	1.30*	1.11	1.51	0.92	0.72	1.16
Less than 20000 versus greater than 50000	3.83*	3.05	4.81	2.08*	1.45	3.00
20000-50000 versus greater than 50000	2.03*	1.62	2.54	1.21	0.92	1.59
Health plan versus no health plan	1.52*	1.10	2.10	1.22	0.74	2.00
Can not see doctor because of cost	1.07	0.86	1.32	1.10	0.81	1.50
Had last check up within 1year	1.21	0.83	1.76	1.13	0.71	1.80
Had last check up within 2 years	0.73	0.46	1.17	0.68	0.37	1.23
Take insulin	1.67*	1.45	1.92	1.03	0.81	1.32
Check blood sugar at least 1 time/2 days	1.30*	1.10	1.52	0.95	0.73	1.23
Received a flu shot in the past year	1.26*	1.09	1.46	0.96	0.78	1.19
Got cholesterol checked within 1 year	2.08*	1.26	3.45	1.43	0.71	2.88
Got cholesterol checked within 2 year	2.07*	1.06	4.02	1.69	0.78	3.70
Had a dilated eye exam within 1 month	1.16	0.96	1.41	0.87	0.64	1.17
Had a dilated eye exam within 1 year	1.25*	1.05	1.48	1.19	0.94	1.50
Seen health professional for diabetes	0.97	0.79	1.19	1.09	0.78	1.53
Hemoglobin A1C test	0.74*	0.56	0.97	0.64*	0.43	0.94
Taken class for managing diabetes	0.92	0.80	1.05	0.98	0.79	1.22
Overweight	1.03	0.85	1.24	1.01	0.76	1.33
Obese	0.88	0.73	1.05	0.99	0.79	1.24
Consumed fruits and vegetables less than 5 times per day	1.13	0.97	1.33	1.11	0.89	1.38
Physical inactive	2.06*	1.76	2.40	0.94	0.74	1.19
Life dissatisfied	1.97*	1.59	2.44	0.63*	0.46	0.87
Smoking	1.32*	1.09	1.59	1.50*	1.14	1.96
Drinker	0.58*	0.37	0.92	0.96	0.49	1.88

	Unadjusted PR [a]			Adjusted PR [b]		
ASTHMA	1.61*	1.37	1.89	1.30*	1.02	1.65
Arthritis burden	1.78*	1.54	2.05	1.00	0.81	1.23
Any type of cancer	1.52*	1.29	1.78	1.22	0.96	1.55
High blood cholesterol	1.44*	1.24	1.68	1.30*	1.06	1.61
Heart attack	4.09*	3.54	4.74	2.24*	1.74	2.88
High blood pressure	2.32*	1.92	2.80	1.53*	1.17	2.00
Angina or coronary heart disease	3.05*	2.63	3.55	1.33*	1.05	1.67
Diabetes-related eye diseases	2.13*	1.81	2.50	1.68*	1.32	2.13

Note: *p<0.05

[a] The raw odds ratio without any adjustment.

[b] Adjust for demographic characters, preventive care, other risk factors and other diseases.

3.3.6 Retinopathy

From the raw estimate, the prevalence ratio of high blood pressure was highest among older age, longer duration, unemployed, male, lower education level, lower income, cannot see a doctor because of medical cost, take insulin, check blood sugar per time two days, had a dilated eye exam within past year, see health professional for diabetes, taken class for managing diabetes, physical inactive, life dissatisfied, arthritis burden, high blood cholesterol, high blood pressure, one or more macro-cardiovascular diseases and diabetes-related eye disease. After adjustment, the following factors were independent correlates of hypertension among people with diagnosed diabetes: older age, longer duration, male, lower than high school, lower income, cannot see doctor because of medical cost, take insulin, check blood sugar per time two days, had a dilated eye exam within past month, got A1C test in past three months, normal weight, high blood pressure and one or more macro cardiovascular disease.

Table 17 Odds ratio of all characteristics in type 2 diabetes population with retinopathy

	Unadjusted PR [a]			Adjusted PR [b]		
	Point estimate	95% CI		Point estimate	95% CI	
Age	1.01	1.00	1.01	0.98*	0.97	0.99
Duration	1.04*	1.04	1.05	1.05*	1.04	1.05
Employed	0.58*	0.52	0.66	0.85	0.70	1.02
Married versus unmarried	0.86	0.72	1.03	1.04	0.82	1.32
Divorced versus unmarried	1.10	0.89	1.36	1.07	0.81	1.41
Widowed versus unmarried	0.89	0.73	1.08	0.78	0.59	1.03
Male versus female	1.36*	1.22	1.51	1.46*	1.24	1.73
Lower than high school versus college	1.92*	1.65	2.23	1.36*	1.06	1.74
High school versus college	1.27*	1.12	1.43	1.15	0.98	1.35
Less than 20000 versus greater than 50000	2.58*	2.20	3.03	1.82*	1.40	2.37
20000-50000 versus greater than 50000	1.66*	1.43	1.94	1.41*	1.16	1.73
Health plan versus no health plan	0.85	0.69	1.04	0.99	0.73	1.32
Can not see doctor because of cost	1.69*	1.43	2.00	1.49*	1.14	1.95
Had last check up within 1year	0.87	0.67	1.12	0.78	0.56	1.08
Had last check up within 2 years	1.00	0.69	1.43	1.04	0.65	1.64
Take insulin	3.00*	2.67	3.36	2.18 *	1.84	2.58
Check blood sugar at least 1 time/2 days	1.77*	1.55	2.02	1.26*	1.04	1.51
Received a flu shot in the past year	1.02	0.90	1.14	1.00	0.84	1.18
Got cholesterol checked within 1 year	1.12	0.64	1.95	0.82	0.49	1.39
Got cholesterol checked within 2 year	1.10	0.60	2.03	0.90	0.50	1.64
Had a dilated eye exam within 1 month	1.70*	1.46	1.98	1.61 *	1.30	1.99
Had a dilated eye exam within 1 year	1.20*	1.05	1.38	1.14	0.94	1.38
Seen health professional for diabetes	1.79*	1.48	2.17	1.17	0.88	1.55
Hemoglobin A1C test	1.20	0.97	1.49	1.45*	1.04	2.02
Taken class for managing diabetes	1.31*	1.18	1.46	1.13	0.96	1.31
Overweight	1.03	0.86	1.22	0.77*	0.61	0.98

	Unadjusted PR [a]			Adjusted PR [b]		
Obese	0.94	0.80	1.10	0.70*	0.55	0.88
Consumed fruits and vegetables less than 5 times per day	1.06	0.93	1.21	1.12	0.94	1.33
Physical inactive	1.45*	1.28	1.65	1.10	0.91	1.34
Life dissatisfied	1.53*	1.27	1.85	1.15	0.89	1.49
Smoking	1.08	0.93	1.25	0.99	0.80	1.23
Drinker	0.81	0.64	1.03	1.05	0.77	1.42
ASTHMA	1.04	0.91	1.20	0.82	0.67	1.01
Arthritis burden	1.13*	1.01	1.26	0.99	0.84	1.16
Any type of cancer	0.98	0.86	1.13	1.20	0.99	1.45
High blood cholesterol	1.30*	1.15	1.46	1.13	0.96	1.33
High blood pressure	1.46*	1.29	1.65	1.31*	1.09	1.57
One macro cardiovascular disease	1.59*	1.38	1.84	1.30*	1.07	1.58
Two macro cardiovascular disease	1.96*	1.67	2.30	1.55*	1.26	1.90
Three macro cardiovascular disease	3.08*	2.23	4.24	2.40*	1.55	3.72

Note: *p<0.05

[a] The raw odds ratio without any adjustment.

[b] Adjust for demographic characters, preventive care, other risk factors and other diseases.

CHAPTER4 DISCUSSIONS

Our results, based on the latest BRFSS data, showed that the prevalence of high blood pressure, stroke and retinopathy among African American adults with diagnosed type 2 diabetes were far more than prevalence among Non-Hispanic White even after adjusting all considered confounders. These findings were consistent with the previous conclusion that minorities with diabetes have been shown to be more likely to develop micro- or macro-vascular disease complications (Carter, et al. 1996, Black, et al. 1999, Hamel, et al. 1999). On the other hand, the prevalence of heart attack and coronary heart disease in African Americans with diagnosed type

2 diabetes were all less than prevalence in Non-Hispanic White which was contradictory to the Carter's research. It is easier to understand that the prevalence of heart attack and coronary heart disease were at the same direction because the main reason for heart attack is coronary heart disease. In 2010, the statistic summary from American Heart Association proved that the prevalence of coronary heart disease in African American was lower than prevalence in Non-Hispanic White On the basis of data from NHANES 2003 to 2006 (American Heart Association 2010). But for type2 diabetes population, no research showed that prevalence of heart attack in African American is less than prevalence in white. Also, most studies have proved that stroke in African American is popular than that in white no matter in regular population or diabetes population (American Heart Association 2010). One explanation for our results is a selection bias that precluded the enrollment of African Americans with more prevalence of heart attack and stroke. Besides, from our results, the male persons were more likely to develop heart attack and coronary heart disease. In 2009 BRFSS, the proportion of male African American is 42% which may lead to the lower prevalence of heart attack and coronary heart disease.

Without any adjustments, Asian American or Pacific Islanders tended to have a lower prevalence of high blood pressure, high blood cholesterol, coronary heart disease and stroke compared with non-Hispanic whites. These trends coincide with the lower incidence of all these diseases observed in Asian or Pacific Islander in other studies (Karter, Ferrara and Liu 2002). After Adjusting demographic characteristics and other risk factors or preventive care, the prevalence of heart attack in Asian or Pacific Islander became more than white, while it still did not reach the significant level. This result may be because of the complex component included in this group. There was research showed that the prevalence of coronary heart disease and high blood cholesterol in Asian increase with the adoption of more Westernized lifestyle (Reed, et al. 1982,

Woo, et al. 1999). The subgroups, Pacific Islander and other Asian such as Japanese American had lower proportion of recent immigrants.

Compared to non-Hispanic White, our results showed that the prevalence of retinopathy in African American, Asian American or Pacific Islander and Hispanic people were all significantly higher which was different from Marguertie's research that Asian American and African American has a similar prevalence of retinopathy to that in white (McNeely and Boyko 2005a). But, another report showed that the prevalence of retinopathy related with diabetes was twice in other racial/ethnic backgrounds than in non-Hispanic white (Saaddine, et al. 1999). Our results proved that male persons with longer diabetes duration, ever reported that cannot see a doctor because of medical cost within past 12 months, taking insulin or check blood sugar at least 1 time/2 days or had a dilated eye exam within past month or took hemoglobin A1C test in past 12 months were more likely to develop diabetes related retinopathy. Persons with high blood pressure or cardiovascular disease also were easily to be eye-affected by diabetes. These findings were consistent with previous results that the prevalence of diabetic retinopathy was twofold higher risk associated with the incident of CHD events (Cheung, et al. 2007). From our results, the more cardiovascular disease the person had, the more possibly to develop retinopathy. We cannot explain why the prevalence of retinopathy in people who were taking insulin or check blood sugar at least 1 time/2 days or had a dilated eye exam within past month or took hemoglobin A1C test in past 12 months were higher. One possibility is that the people who suffered from diabetes badly are more likely to check blood sugar and take hemoglobin A1C test and those who have symptoms in eyes are more likely to take dilated eye exam. Also, those who cannot keep normal blood sugar level through exercise and food control chose to take insulin.

CHAPTER5 STUDY LIMITATIONS

There are several limitations to this study: first, the type 2 diabetes status and all the independent variables are based on self-reported results were not verified by medical record review. Those individuals with severe physical disease, such as heart attack, stroke, or mental health problems might not have been able to complete the survey. Although a previous research showed relatively high agreement of determining the diabetes status based on self-reports and those based on clinical diagnoses (kappa=0.76; sensitivity=75%), bias may occur due to the misclassification of diabetes and other variables status (Bowlin, et al. 1993). The second limitation came from the BRFSS data collection where exclude people without telephone and those with cell phone only. Most persons without phone or only have cell phone were in minority groups where the heart disease and coronary heart disease rates were high. This bias will lower the coverage of heart disease. Another limitation to this study is because the BRFSS questionnaire only has English version and Spanish version. In the Kaiser study, Asian American who had difficulty to communicate in English had a lower frequency of home glucose monitoring (Karter, Ferara, Darbinian, Ackerson and Selby 2000) which related to poorer glucose control (Karter, et al. 2001) then led to the occurrence of diabetes and its complications.

CHAPTER 6 CONCLUSIONS

Compared to non-Hispanic white, the African Americans were more likely to experience high blood pressure, stroke and retinopathy while less likely to develop coronary heart disease and heart attack. Similarly, Asian or Pacific Islander and Hispanics were also more likely to become retinopathy related with diabetes. Asians or Pacific Islanders have very low prevalence rate in stroke compared with white. Hispanic Americans were less likely to experience

hypercholesterolemia and coronary heart disease. There were no significant difference of these diabetes-related diseases between Native American and White American.

The correlates of high blood pressure includes aging, lower education level, overweight or obese, check A1C hemoglobin within last 12 months, non-smoker, binge drinker, had arthritis burden, one or more macro-vascular disease and retinopathy. Similarly, older age, lower education level, overweight or obese, check A1C hemoglobin within last 12 months, received flu shot in past year also contribute to hypercholesterolemia, stroke and retinopathy. Male persons with smoking were more likely to develop heart attack, coronary heart disease and retinopathy. Life dissatisfaction and fewer fruit and vegetable consumption also related to the occurrence of high blood cholesterol. Different preventive ways need to apply according to different type of races and ethnicities.

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