5-3-2017

Differences Of Diabetes-Related Complications And Diabetes Preventive Health Care Utilization In Asian And White Using Multiple Years National Health Survey Data

Yonggang Li

DIFFERENCES OF DIABETES-RELATED COMPLICATIONS AND DIABETES PREVENTIVE HEALTH CARE UTILIZATION IN ASIAN AND WHITES USING MULTIPLE YEARS NATIONAL HEALTH SURVEY DATA

by

YONGGANG LI

Under the Direction of Gengsheng Qin Ph.D

ABSTRACT

The main purpose of this study is to examine the differences of preventive management utilizations and diabetes complications in Asian Americans and Non-Hispanic whites using multiple years (2002-2013) Behavioral Risk Factor Surveillance System (BRFSS). SAS for complex survey procedures were used to perform the data analysis. Odds ratios (OR) were calculated to compare the prevalence of diabetes complications and preventive management rate in Asian with white. Compared to white, the prevalence of diabetes retinopathy in Asians were higher, while the rates of neuropathy and cardiovascular complications, pneumonia shot, personally management as well as management diabetes with doctors were lower. The prevalence of routine checkup in Asian was not significantly different from the prevalence in white. More attentions should be paid on Asians for diabetes related retinopathy.

INDEX WORDS: BRFSS, Diabetes, Complications, Hypertension, Coronary heart disease, Retinopathy

DIFFERENCES OF DIABETES-RELATED COMPLICATIONS AND DIABETES PREVENTIVE HEALTH CARE UTILIZATION IN ASIAN AND WHITES USING MULTIPLE YEARS NATIONAL HEALTH SURVEY DATA

by

YONGGANG LI

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of

Master of Science

in the College of Arts and Sciences

Georgia State University

2017

DIFFERENCES OF DIABETES-RELATED COMPLICATIONS AND DIABETES PREVENTIVE HEALTH CARE UTILIZATION IN ASIAN AND WHITES USING MULTIPLE YEARS NATIONAL HEALTH SURVEY DATA

by

YONGGANG LI

Committee Chair: Gengsheng Qin

Committee: Gengsheng Qin

Xin Qi

Xiaoyi Min

Electronic Version Approved:

Office of Graduate Studies

College of Arts and Sciences

Georgia State University

April 2017

DEDICATION

My special thanks go to my wife, not only to thank her for her dedication, love and persistent confidence in me but being supportive and caring my kids. She really has taken the load off my shoulder.

ACKNOWLEDGEMENTS

It is my greatest pleasure to thank everyone who helped me with my research and my thesis. Without you all, this thesis can't be finished and presented.

In the first place, I would like to present my heartily thankful and appreciation to my awesome supervisor, Pro. Qin. Without his supervision, advice, support and guidance, this thesis can't be finish today. He is always eager to find best way for me to perform my thesis research. He showed me the centers for disease control website where I can successfully find the BRFSS data, the world largest telephone survey data including diabetes associated risk factors, complications and disease management. This thesis research provided me great knowledge of analyzing large survey data. His truly scientific sense has made him as a constant oasis of ideas and passions in science, which exceptionally inspire and enrich my growth as a student and a researcher.

It has been an extraordinarily fortunate for studying here at Georgia State University only because there are so many wonderful professors in Statistical department. I could never have started any part of my thesis without their prior teachings in linear and categorical data analysis, SAS programming, sampling technique, et al.

It is a great honor for me that Dr. Qin, Dr. Qi and Dr.Min would like to attend my defense and be my thesis committee members. Thanks for their time and commitment and the helpful comments to my thesis.

Finally, I would like to thank all my colleagues and friends who give me supports and help during my thesis proposal, analysis design, data analysis and thesis writing.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

1.1 Background and Significance

1.1.1 Diabetes Prevalence and Complications

Asian American populations have grown very fast in the United States which has grown from 11.9 million (4.2%) in 2000 to 19.4 million (6%) in 2013. According to Census Bureau's estimation, Asian Americans will increase to more than 40.6 million (9.2%) by 2050.[1, 2] The health related information in this population turns to be important because of the rapid population increase. Studies using Asian population have shown that the prevalence of diabetes have increased dramatically in most of the Asian countries.[3-10] Also study using National Health Interview Survey (NHIS) data also showed Asian Americans have higher prevalence of type 2 diabetes.[11] From the National Diabetes Statistics Report data released on June 2014, the diabetes prevalence in Asian American is 1.4 percent higher than Non-Hispanic White[12]. Based on 2014 data from the National Diabetes Statistics Report diabetes mellitus was estimated to be the seventh leading cause of death in the United States.[12] Diabetes is the leading cause of non-traumatic lower limb amputation, blindness and kidney failure.[13] Racial disparities of diabetes complication development between Asian Americans and Non-Hispanic whites were detected in several studies. All these results showed that Asian Americans were significantly more likely to develop end-stage renal disease and were less likely to develop myocardial diseases[14, 15]. Even though study using 2001 BRFSS data showed that among Americans with diabetes, Asian Americans have similar prevalence of hypertension, hypercholesterolemia, retinopathy and foot ulceration with white[14], research using 2006-2008 BRFSS data found out that Asian Americans/Pacific Islanders (AAPIs) had significantly higher prevalence of diabetic retinopathy compared with Non-Hispanic Whites[16]. These studies had results contradictory regarding the

diabetes complication between Asian Americans and Non-Hispanic whites. This may induce us to perform the diabetes complication comparison using multiple year survey data. Right now, no study has been focused on the diabetes related complication changes over time for Asian Americans as well as Non-Hispanic whites. Finding the trend of diabetic complications in these two groups as well as the racial differences can provide valuable information to understand the diabetic complication development and provide effective intervention to prevent the complications and related co-morbidities.

1.1.2 Preventive Health Care Utilizations

Effective diabetes self-management, including self-care, keeping diabetes care appointments and getting vaccinated against influenza and pneumonia, is very important in reducing diabetes related morbidity and mortality. There is evidence that by lifestyle modification, medication and self-monitoring of blood glucose, diabetes can be better controlled[17, 18]. The main goal of diabetes management is glycemic control and a reduction in diabetes related complications, morbidity and mortality. Self-management can benefit glycemic control as well as the diabetes management. Researchers have showed that diabetes self-management has great differences between racial and ethnic groups because of the socioeconomic status, disease knowledge and awareness, as well as access to healthcare which may influence the racial disparities of the diabetes outcomes.[19-25] Even though, no significant differences among whites, African Americans and Hispanic in HbA1c testing or examining feet for sores have been detected using 2000 Medical Expenditure Panel Survey (MEPS) data[26]. The recently completed research using 2009 BRFSS data[27] showed that compared to Whites, the Asian Americans were significantly less likely to check their blood sugar at least once a day, get flu shots and be vaccinated for pneumococcal disease. There are no differences between

these two groups for diabetes education, having seen professionals for diabetes within past year, having cholesterol or HbA1C checked in past year, and having an eye or foot exam in past year. Several trend analyses conducted using national data showed an increase rate of diabetes prevalence over past decade[11, 27]. Also there was a study revealing increased rate of preventive healthcare for diabetes both in Non-Hispanic white and Africa American[17]. To provide better intervention program and better control over the diabetes, there is a need of examining the preventive diabetes self-management changes over time as well as the racial differences. However, there is little information about the preventive health care trend over time period in Asian American population.

1.1.3 Effects of Preventive Health Care on Diabetes

The American Diabetes Association recommends annual measurements of HbA1c, lipids, cholesterol and urine protein; dilated eye and foot examinations; and biannual measurement of blood pressure[28]. These recommendations have been associated with the decreases of diabetes complications rate[29-33]. The diabetes complications rate is higher for minorities including Asian Americans than for whites[14, 34], as well as the preventive health care are less in minority including Asian Americans[17], racial disparities in preventive health care may contribute to the higher rate of diabetes-related complications and mortality.

1.2 Data Source

Behavioral Risk Factor Surveillance System (BRFSS) from Center for Disease Control and Prevention (CDC) was used for this study. This survey is a state-based system that is used to gather information through random digit dialing 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

Centers for Disease Control and Prevention (CDC). This survey collects preventive health practices and chronic disease data from individuals aged 18 and older[35].

The subgroups of non-Hispanic whites and Asian Americans who were surveyed between 2002 and 2013 were included in this study. Each survey respondent was weighted to account for the number of residential telephones in the household, the number of adults in the household, differences in probability of election, non-coverage and non-response. The each year of 12 years data was plotted to get first visualization and was examined in tabular forms. Then the 12 year data were combined. New variables that consider stratum, primary sampling unit and sampling weight were created in order to accommodate different sampling designs between 2002-2010 and 2011-2013.

1.2.1 Questionnaire and Data Collection

Each year's questionnaire has both English and Spanish version where three components are included: the core component, optional modules and state-added questions. All state health departments must ask the core component questions without modification. The core component questions are standard questions associated with 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 modules are about specific topics (e.g., cardiovascular disease, arthritis, women's health). State can choose to use these optional modules and also add its own questions. From 2002 to 2013, the core components varied in some topics. For example, the variable of firearms was only included in 2002 and 2004 and the hypertension and high cholesterol awareness were only included in odds year which makes our analysis for cardiovascular disease rate not consistent over the years while these information

were collected in the optional modules in year 2002 and 2004. And the routine checkup with the healthcare provider information was not collected in 2003 and 2004 in both core and optional modules.[36]

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.[36]

1.2.2 Sources of Error

The BRFSS is a complex telephone survey which would include statistical error in the data collection. Overall, four types of errors included in it: no-coverage error, sampling error, non-response error and measurement error.

Non-coverage Error: For year 2002-2010, because BRFSS didn't include the person who only has cellphone, the households without telephones make this a larger source of non-coverage error. Even though census data showed approximately 94% of U.S. households have telephones, the coverage differs across states and subgroups. For example, people living in the South[37],

minorities, and those in lower socioeconomic groups typically have lower telephone coverage. 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. After year 2011, CDC corrected this non-coverage error by including the cell phone into the survey. For the first half of 2011, the percentage of cell phone-only households was 31.6 percent[38]. This is an increase of 1.9 percent over the preceding 6-month period. In households where both landline and wireless phone service is available, there is a trend toward increased use of wireless communication. In 2011, BRFSS respondents who received 100 percent of their calls on cell phones were eligible for participation in the cell phone survey.

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[36].

Non-response Error: All surveillance data would be hard to avoid this error where two levels of non-response showed: unit non-response and item non-response. In BRFSS data, if a person refuse to participate or didn't respond or the person can't understand English and Spanish, then unit non-response occurs. Item non-response occurs when useful data are not obtained for all questionnaire items.

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[36].

1.2.3 Variables Related to Complex Survey Data Analysis

BRFSS survey is a complex survey data where variables related to complex survey were collected. Within our study, all these variables were checked for 12 years from 2002 to 2013. These variables include _PSU, _STSTR, _FINALWT and _LLCPWT.

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.

The weighting variable was _FINALWT in 2002-2010 while the weighting variable was _LLCPWT for year 2011-2013. FINAL WEIGHT = The design weight is raked to 8 margins (age group by gender, race/ethnicity, education, marital status, tenure, gender by race/ethnicity, age group by race/ethnicity, phone ownership). If geographic regions are included, four additional margins (region, region by age group, region by gender, region by race/ethnicity) are included. Post stratification weights are used in order to partially correct any bias caused by non-telephone coverage.

1.3 Purpose of Study

The purpose of this study is to examine the trend of preventive healthcare utilization and diabetes complications in both Asian American and Non-Hispanic white and try to find the racial differences between these two groups. 2002-2013 Behavioral Risk Factor Surveillance System

(BRFSS) data were used to perform our analysis. The BRFSS data is the largest telephone survey data 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. BRFSS data were consistently used to provide valid and reliable estimates compared with other national household survey.

1.4 Specific Aims

Specific Aim 1: The outcomes are preventive health care variables. Trend for each individual outcome in Asian Americans and Non-Hispanic whites as well as the racial disparities will be examined. All preventive health care variables will be determined from self-reported data.

Specific Aim 2: The outcomes are diabetes complications variables. Trend for each outcome in Asian Americans and Non-Hispanic whites as well as the racial disparities will be examined. All diabetes complications variables will be determined from self-reported data.

Specific Aim 3: The outcomes for this specific aim are diabetes complications. The main independent variables are preventive health care variables, group and year. The association between diabetes complications and the preventive health care utilization as well as the racial differences will be assessed.

If any of the preventive health care or diabetes complication outcomes was not measured in any year BRFSS data, it will be eliminated form that specific year.

2 METHODS AND PROCEDURES

2.1 Study Population

Data files were downloaded from the CDC website in SAS Transport format. Adults aged 18 years or older with type 2 diabetes from the 2002-2013 Behavior Risk Factor Surveillance system were utilized to do analysis. The variables with missing values exceeded 20% were excluded from the study measures. The separate dataset was analyzed for each and the combined data also was analyzed to examine the differences. Because same variable may have different measurement in different year, the related variables in each year were checked to make sure they are combinable.

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. Women who reported diabetes only when pregnant and respondents told they had pre-diabetes or borderline diabetes will be treated as non-diabetic individuals. Study participants 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[39, 40].

2.2.2 Race and Ethnicity

Race and ethnicity status were based on self-report data. Ethnicity was coded as Hispanic or non-Hispanic. Non-Hispanic participants were assigned one of the following racial categories: White, African American/Black, Asian, Native Hawaiian/Pacific Islander, American

Indian/Native Alaskan (Native American), other, or mixed race. We included non-Hispanic white and Asian in our study. Other socioeconomic status variable including age, gender, education, income, access to health care and US born also will be adjusted. If more than 5% missing values are observed for any socioeconomic status variable, the unknown level will be added for that variable.

2.2.3 Diabetes Complications

The diabetes complications include three aspects: 1) Diabetic retinopathy is defined from question 'Has a doctor ever told you that diabetes has affected your eyes or that you had retinopathy?' 2) Foot complication is determined from question 'Have you ever have any sores or irritations on your feet that took more than four weeks to heal?' 3) Neuropathy and cardiovascular disease will be defined if they reported at least one of the following cardiovascular disease or neuropathy: hypertension, angina, coronary heart attack, stroke, or other form of heart disease. All these disease status are from self-reported questions.

2.2.4 Preventive Care

The frequency for each individual outcome was presented first. Furthermore, the preventive health care variables were reclassified as three groups: 1) Personally manage their diabetes: if they reported checking their blood sugar levels at least once a day and if they checked their feet for sores or irritations at least once a day, they will be treated as personally manage their diabetes well. Otherwise, they were treated as no personally manage their diabetes. 2) Manage diabetes via healthcare provider: if they visited a healthcare professional for diabetes within past year, had their hemoglobin A1c checked at least twice a year, and had their feet checked for sores or irritations by doctor at least once a year, and checked eye by doctor within

past year, they were treated as manage diabetes well via healthcare provider. Otherwise, they were treated as no manage diabetes via healthcare provider. 3) Adequately vaccinated: if they received a flu vaccination in the past year and if they had ever got pneumonia vaccination, they would be treated as adequately vaccinated. Otherwise, they would be treated as no adequately vaccinated.

2.3 Statistical Analysis

Characteristics of Asians versus Non-Hispanic whites were compared over times which include age, gender, access to health care and U.S. born. In each time period, t tests was used to compare continuous variables and chi-square test was used to compare categorical variables.

In specific aim1 and aim2, for all the preventive health care utilization variables and diabetes complications variables, data were plotted for 12 years to get first visualization and examined in tabular forms in order to understand the general shape of the trend and identify any entry errors and outliers in the data and in order to be familiar with the numbers and percentages of each outcome being studied. Inspection of the data provided the basis for making subsequent analysis choices. The age adjusted percentage change for each outcome variable was presented for different year to check the trend of each outcome.

We assumed that the visual inspection would show a linear trend and that the percentage changes for all the outcomes over years would be statistically independent. The logistic regression model was constructed to assess the age adjusted percentage change of each outcome variable for each year period in each group and overall population. The model included age and year variables for overall population, Asian American only and Non-Hispanic whites only. The model was weighted to consider the complex survey design and different weight variables were

applied because of different survey design. Multivariate logistic regression models was used to determine if there was a linear trend in the outcome over the study time period in each race group and the percentage change in outcome prevalence over the study time period. The dependent variables are each preventive healthcare outcomes or diabetes complications. The model included year period, races and the interaction terms that are race multiplied by year period. The model also included other possible confounding effects such as age, socioeconomic status. All these variables were also derived from self-reported data. Wald chi-square probabilities were utilized to determine if there are significant linear trends over the study time period in the outcome variable in each race group. Models were solved for years to determine the percent change in outcome prevalence over the study time period for each race.

Finally, a logistic regression model including year, race year/race variables was used to determine if there are significantly different linear trend in outcome variables over the study time period between racial groups. Any statistically significant year/race variable indicates that there is a significant difference in the outcome's linear trend over the study time period between Asian Americans and Non-Hispanic whites.

For specific aim 3, chi-square test was used to check if there is any association between the preventive health care outcome and diabetes complications in overall population. The logistic regression model with outcome of each diabetes complication was used to examine the trend of preventive health care effect on complications within each group. Then the trend of this association was assessed by constructing multiple logistic regression models. The year and race effect were tested in this model.

All data management and analyses were performed using the SAS system (version 9.4; SAS institute; Cary, NC). The complex survey-specific procedures accounted for the complex survey design. P-value less than 0.05 were considered as statistically significant. No multiple comparisons were considered in this study.

3 RESULTS

3.1 Diabetes Prevalence

Shown from table 1, figure 1 and figure2, 6640 Asian Americans and 365892 Whites type II diabetes people were identified from the12 year data (2002-2013). The prevalence of diabetes in Asian American increased from year 2002 (5.48%) to year 2013 (8.34%) although decreased prevalence were observed in 2004 (4.55%) and 2005 (4.49%). The prevalence of diabetes in Whites increased steadily from 2002 (6.33%) to 2013 (9.45%). In 2004 and 2005, the diabetes prevalence in Asian is almost 40% less than Whites while the prevalence became only 20% less in Asian than in Whites in 2011 and 2012. The differences were all statistically significant. After adjusting age, gender and BMI level, the diabetes prevalence in Asian within 12 years was all higher than diabetes prevalence in white where the odd ratio was from 1.57 to 2.12. In other words, the diabetes prevalence in Asian was 50% - 110% higher than the diabetes prevalence in white and all odds ratios were statistically significant.

Table 1 Diabetes prevalence in Asian Americans and White from 2002-2013

Year	Asian	White	Raw odds ratio (95% CI)	Adjusted odds ratio (95% CI)	P-value
2002	5.48(0.89)	6.33(0.09)	0.86(0.61-1.20)	2.06(1.42-2.97)	0.3761
2003	5.40(0.86)	6.94(0.09)	0.76(0.55-1.06)	2.00(1.41-2.85)	0.1104
2004	4.55(0.74)	6.73(0.09)	0.66(0.47-0.92)	1.65(1.16-2.34)	0.0141
2005	4.49(0.57)	7.13(0.08)	0.61(0.47-0.80)	1.38(1.04-1.83)	0.0002
2006	6.07(0.66)	7.40(0.09)	0.81(0.64-1.02)	1.94(1.54-2.45)	0.0666
2007	6.29(0.59)	7.89(0.08)	0.78(0.64-0.95)	1.57(1.27-1.94)	0.0146
2008	7.28(0.60)	7.93(0.08)	0.91(0.77-1.09)	1.96(1.63-2.36)	0.2973

2009	7.61(0.53)	8.20(0.07)	0.92(0.79-1.07)	2.07(1.77-2.43)	0.2797
2010	6.86(0.46)	8.42(0.07)	0.80(0.70-0.92)	1.97(1.69-2.30)	0.0020
2011	7.73(0.53)	9.15(0.08)	0.83(0.72-0.96)	1.95(1.66-2.28)	0.0144
2012	7.91(0.70)	9.45(0.08)	0.82(0.68-0.99)	1.78(1.45-2.20)	0.0439
2013	8.34(0.63)	9.45(0.08)	0.87(0.74-1.03)	2.12(1.77-2.53)	0.0981

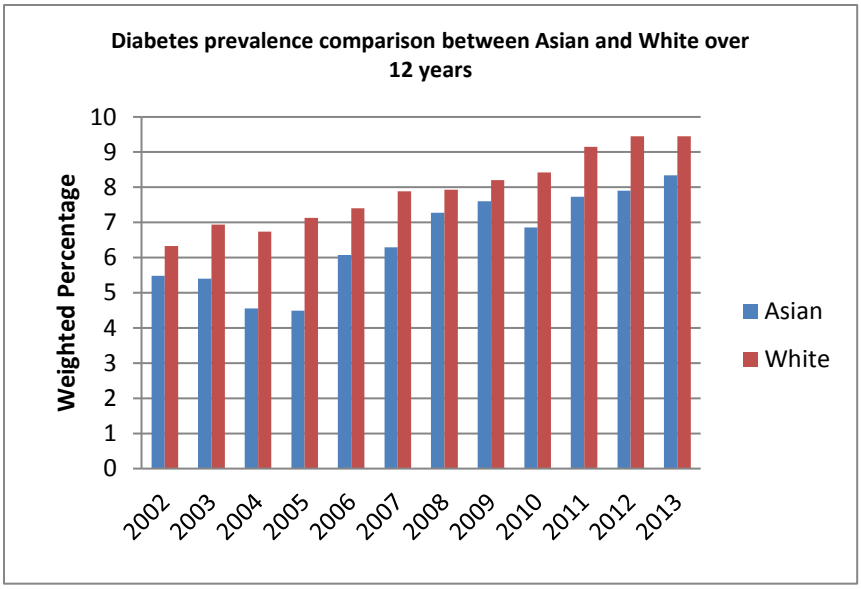

Figure 1 Bar chart for diabetes prevalence of Asian and White 2002-2013

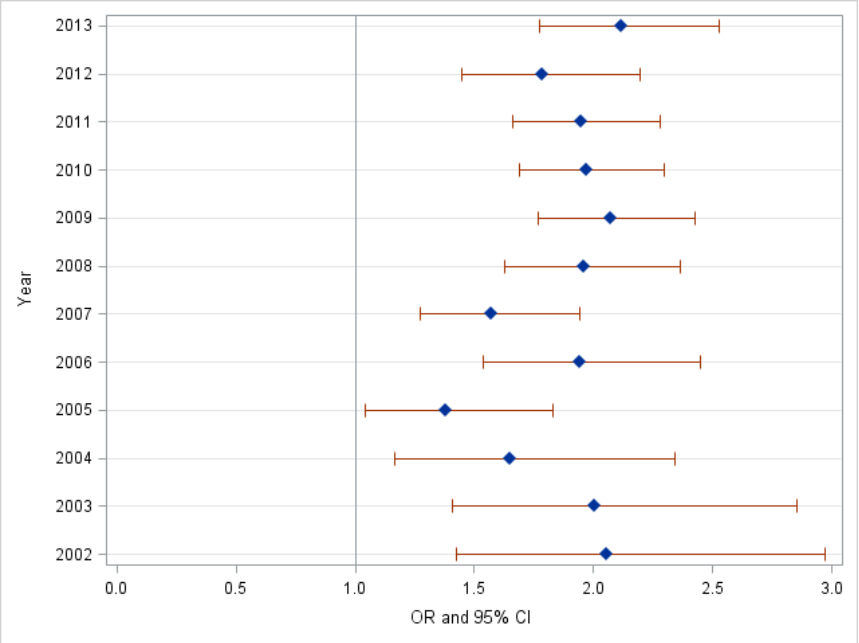

Figure 2 Adjusted Odds ratio of diabetes prevalence in Asian and White 2002-2013

3.2 Demographic Characteristics

The characteristics of all 12 year participants with type 2 diabetes are shown in Table 2. The percentage of Asian male participants with diabetes was higher than the percentage of White males for all these 12 years. Except in 2003, 2005, 2012 and 2013 (p=0.8922, 0.3074, 0.2433 and 0.2479 respectively), these differences were all statistically significant. For all 12 years, the percentages of who have some college or graduated from college in Asian were all significantly higher than the percentages in whites. At earlier years before 2008, the percentage of having income 50k or more in Asian Americans is higher than the percentage in Whites although there were no statistically significant differences. These percentages became significantly higher in Asians compare to whites after 2008. The percentages of employed and married in Asians were all significantly higher than percentages in whites except for 2002. The obese rates of 12 years in Asian increased from less than 10% to more than 20% while these rates in Whites increased from around 45% to almost 55%. Compared to whites, Asian Americans had much lower obese rate for all 12 years.

Table 2 Demographic Characters of Participants with type 2 2002-2013

		Asian (weighted percent or mean with SE)	White (weighted percent or mean with SE)	p-value
2002	Male	65.56(7.27)	49.94(0.71)	0.0414
	Education some college or graduate	89.01(2.66)	48.83(0.71)	<0.0001
	Income 50k or more	56.37(9.13)	26.16(0.71)	0.0002
	Employed	63.13(8.44)	40.86(0.70)	0.01
	Married	73.14(7.32)	63.17(0.66)	0.3848
	Obese	7.87(2.98)	47.04(0.73)	<0.0001
2003	Male	50.43(8.39)	51.55(0.71)	0.8922
	Education some college or graduate	69.20(9.44)	49.14(0.71)	0.0225
	Income 50k or more	42.77(6.93)	28.26(0.73)	0.0804
	Employed	53.36(8.63)	42.55(0.71)	0.2098
	Married	69.77(9.61)	63.91(0.66)	0.0037
	Obese	11.02(3.63)	49.02(0.73)	<0.0001
2004	Male	73.26(7.08)	51.28(0.67)	0.0062
	Education some	89.42(3.58)	50.10(0.67)	<0.0001

	college or graduate			
	Income 50k or more	41.93(8.24)	28.98(0.68)	0.2443
	Employed	60.31(8.98)	40.56(0.66)	0.0295
	Married	90.11(3.22)	63.50(0.63)	<0.0001
	Obese	14.60(6.38)	49.65(0.69)	<0.0001
2005	Male	57.45(6.42)	50.80(0.58)	0.3074
	Education some college or graduate	78.51(4.41)	51.19(0.58)	<0.0001
	Income 50k or more	40.31(7.06)	31.81(0.63)	0.4206
	Employed	63.98(6.01)	41.09(0.58)	0.0002
	Married	83.96(3.26)	64.05(0.53)	<0.0001
	Obese	12.30(2.60)	51.00(0.60)	<0.0001
2006	Male	69.02(4.78)	52.16(0.60)	0.0012
	Education some college or graduate	81.90(4.48)	51.95(0.60)	<0.0001
	Income 50k or more	41.22(5.55)	33.70(0.65)	0.2424
	Employed	63.29(5.38)	41.88(0.61)	0.0001
	Married	78.51(4.30)	63.34(0.57)	<0.0001
	Obese	22.67(4.71)	50.99(0.63)	<0.0001
2007	Male	65.35(4.62)	51.73(0.48)	0.0052
	Education some college or graduate	74.07(4.26)	53.00(0.48)	<0.0001
	Income 50k or more	40.49(4.98)	37.28(0.54)	0.0414
	Employed	52.49(4.89)	40.98(0.49)	0.0177
	Married	85.98(2.85)	63.79(0.45)	<0.0001
	Obese	19.09(3.95)	51.87(0.50)	<0.0001
2008	Male	67.81(3.62)	51.69(0.48)	<0.0001
	Education some college or graduate	75.00(3.48)	53.69(0.48)	<0.0001
	Income 50k or more	45.46(4.42)	37.11(0.53)	0.071
	Employed	54.17(4.19)	41.98(0.49)	0.0035
	Married	77.28(3.30)	63.38(0.46)	0.0008
	Obese	18.58(2.85)	53.07(0.50)	<0.0001
2009	Male	63.18(3.32)	51.78(0.46)	0.001
	Education some college or graduate	77.62(2.98)	53.80(0.46)	<0.0001
	Income 50k or more	50.51(3.82)	36.63(0.50)	0.0008
	Employed	55.68(3.53)	40.62(0.47)	<0.0001
	Married	80.05(2.79)	63.51(0.43)	<0.0001
	Obese	23.31(3.40)	52.77(0.47)	<0.0001
2010	Male	64.45(3.06)	52.72(0.44)	0.0003
	Education some college or graduate	79.21(2.65)	55.26(0.44)	<0.0001
	Income 50k or more	52.36(3.63)	37.27(0.49)	<0.0001
	Employed	57.71(3.37)	39.05(0.45)	<0.0001
	Married	81.98(2.17)	63.79(0.41)	<0.0001
	Obese	18.61(2.67)	53.82(0.46)	<0.0001
2011	Male	58.23(3.57)	50.72(0.45)	0.0393
	Education some college or graduate	76.91(3.16)	48.08(0.45)	<0.0001
	Income 50k or more	54.8(3.79)	33.48(0.47)	<0.0001
	Employed	59.47(3.40)	37.02(0.44)	<0.0001
	Married	70.19(3.22)	57.44(0.44)	0.0005
	Obese	23.73(3.11)	54.20(0.46)	<0.0001
2012	Male	57.37(4.56)	51.98(0.46)	0.2433
	Education some	71.44(4.72)	49.59(0.46)	0.0003

	college or graduate			
	Income 50k or more	47.49(4.79)	35.12(0.48)	0.0096
	Employed	53.55(4.75)	37.40(0.45)	0.0005
	Married	67.70(4.23)	56.99(0.46)	0.0052
	Obese	19.73(3.71)	53.48(0.47)	<0.0001
2013	Male	55.85(4.07)	51.08(0.46)	0.2479
	Education some college or graduate	68.25(4.05)	50.07(0.46)	0.0002
	Income 50k or more	46.53(4.45)	34.93(0.49)	0.0085
	Employed	55.31(4.04)	36.79(0.45)	<0.0001
	Married	68.21(3.94)	58.83(0.45)	0.0019
	Obese	23.22(3.45)	54.63(0.47)	<0.0001

3.3 Preventive Health Care Utilizations

3.3.1 Personally Diabetes Management

Table 3, 4 and 5 showed the results of personally diabetes management which included blood sugar self-checking, checking feet for sore or irritation by oneself as well as the combined personally diabetes management variable.

Table 3 showed the results of combined 12 years data as well as separate year data for blood sugar self-checking. Asians were significantly less likely to check their blood sugar at least one day by themselves compared to whites. The odds ratio equaled 0.53 with 95% confidence interval (0.44-0.62) which means that the Asian Americans are almost 50% less likely to check their blood sugar at least one day. After adjusting the possible covariates age, gender, income, education, marriage status as well as obese status, the Asians still remained almost 40% less likely to do it. For both Asian and whites, there were peak times during year 2004-2007. The Asian's blood sugar self-checking rate reached to 53% and the whites' rate had the highest 63%. The percentage of blood sugar self-checking at least once a day in Asians is around 45% and the percentage of blood sugar self-checking at least once a day in whites is around 60%. From the results showed in figure, the blood sugar self-checking at least once a day rates in Asians were significantly lower than that in whites except for year 2008, the odds ratios are from 0.31 to 0.66.

After adjusting for possible demographical risk factors as well as the obese status, almost half of the 12 years still had significantly difference between Asians and whites.

Table 3 Blood sugar self-checking in Asian and White

Year	Asian	White	Raw Odds ratio (95% CI)	Adjusted Odds ratio (95% CI)
2002	34.15(9.15)	56.62(0.82)	0.40(0.18-0.88)	0.43(0.19-0.99)
2003	30.17(7.42)	57.9(0.77)	0.31(0.16-0.62)	0.41(0.22-0.76)
2004	45.72(9.10)	59.55(0.74)	0.57(0.28-1.17)	0.77(0.35-1.69)
2005	52.97(8.57)	63.18(0.67)	0.66(0.34-1.28)	0.66(0.32-1.33)
2006	48.94(6.20)	62.49(0.67)	0.58(0.35-0.95)	0.77(0.46-1.28)
2007	51.94(6.09)	63.14(0.58)	0.63(0.39-1.03)	0.59(0.34-1.01)
2008	47.50(4.30)	62.10(0.60)	0.55(0.32-0.94)	0.85(0.46-1.56)
2009	48.30(4.93)	61.31(0.56)	0.59(0.38-0.91)	0.75(0.47-1.21)
2010	46.52(4.66)	61.97(0.55)	0.53(0.35-0.82)	0.57(0.36-0.91)
2011	45.76(4.14)	60.35(0.90)	0.55(0.39-0.80)	0.61(0.40-0.94)
2012	44.86(4.23)	61.31(0.54)	0.51(0.36-0.73)	0.59(0.38-0.90)
2013	48.80(3.31)	61.51(0.55)	0.60(0.41-0.87)	0.65(0.42-1.01)
Overall	45.19(2.11)	61.04(0.20)	0.53(0.44-0.62)	0.63(0.52-0.75)

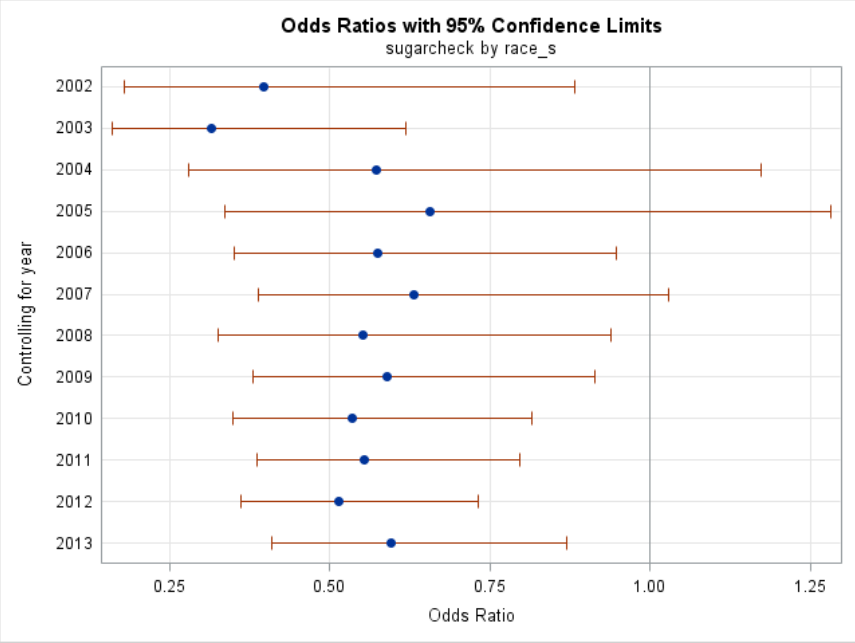

Figure 3 Odds ratio of sugar self-checking in Asian and White 2002-2013

Table 4 showed the results of combined 12 years data as well as separate year data for feet self-checking. Data of combined 12 years showed that Asians' self-checking feet for sore or irritation rate was 46% while this rate in whites was 66%. The Asians were almost 60% less likely to self-check their feet for sore or irritation compare to white (odds ratio=0.42(0.36-0.50)). After adjusting the possible covariates, this relationship still remain significant (odds ratio=0.46(0.38-0.55)). The feet self-checking rates in Asian had the lowest 34% in 2002 and the highest 60% in 2003. The other years had rate from 37% to 56%. The feet self-checking rates in white had the lowest 62% in 2011 and the highest 69% in 2002, 2003 and 2006. The other years had rate from 64% to 67%.

Compared to white, the feet self-checking rates in Asian were 30-75% lower and they were statistically significant except for year 2003. After adjusting the possible demographic characteristics and obese status, the Asian still were 25-75% less likely to check their feet for sore and irritation compare to white. The odds ratios in some years such as 2002, 2006 and 2008 turned to be not statistically significant.

Table 4 Feet self-checking for sores or irritations in Asian and White

Year	Asian	White	Raw Odds ratio (95% CI)	Adjusted Odds ratio (95% CI)
2002	33.54(8.03)	68.86(0.80)	0.23(0.11-0.46)	0.26(0.13-0.54)
2003	59.92(8.57)	68.49(0.74)	0.69(0.34-1.39)	0.54(0.28-1.02)
2004	42.06(9.10)	66.57(0.73)	0.36(0.17-0.76)	0.47(0.22-1.03)
2005	42.36(8.53)	68.18(0.68)	0.34(0.17-0.68)	0.27(0.12-0.57)
2006	56.46(6.42)	68.73(0.63)	0.59(0.36-0.97)	0.60(0.35-1.01)
2007	42.79(6.34)	67.41(0.59)	0.36(0.22-0.60)	0.45(0.26-0.77)
2008	50.35(6.86)	65.50(0.60)	0.53(0.31-0.92)	0.74(0.41-1.32)
2009	45.44(5.69)	65.42(0.56)	0.44(0.28-0.69)	0.50(0.31-0.81)
2010	45.02(5.29)	64.78(0.55)	0.45(0.29-0.68)	0.57(0.36-0.91)
2011	42.78(4.48)	62.22(0.91)	0.45(0.31-0.65)	0.46(0.30-0.70)
2012	43.64(4.68)	63.53(0.55)	0.44(0.31-0.65)	0.48(0.32-0.74)
2013	37.44(4.67)	64.09(0.54)	0.34(0.23-0.50)	0.36(0.23-0.55)
Overall	45.61(2.20)	66.42(0.19)	0.42(0.36-0.50)	0.46(0.38-0.55)

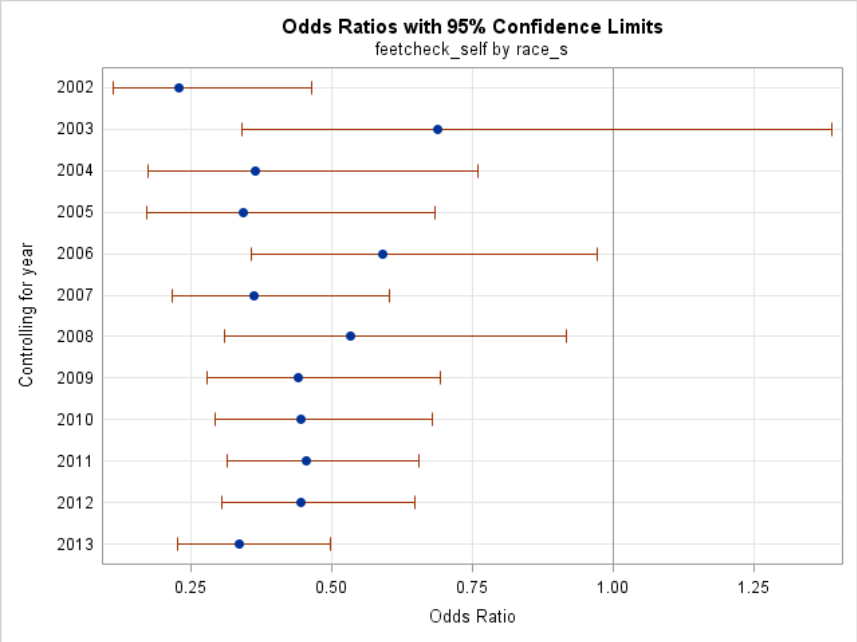

Figure 4 Odds ratio of feet self-checking for sore or irritation in Asian and White 2002-2013

Table 5 showed the results of combined 12 years data as well as separate year data for personally diabetes management. The results from the combined data showed that Asian's personally well diabetes management rate was 23% while this rate in white was 43%. Then Asian was 60% less likely to perform personally diabetes management well compare to white. After adjusting possible risk factors, this association still remained significant (odds ratio=0.50(0.40-0.61)). The separate year data showed that the Asian's well personally management rates were the lowest in 2002 of 10% and were the highest in 2008 of 35%. On the other hand, the white's well personally management rates were from 41% to 45% throughout the 12 year period. Compared to white, the Asian was 30% to 80% less likely to perform well personally diabetes management.

Except for 2004 and 2008, the other years were all statistically significant. After adjusting covariates, there were more years results became not significant, such as 2006, 2009 and 2010.

Table 5 Personally diabetes management in Asian and White

Year	Asian	White	Raw Odds ratio (95% CI)	Adjusted Odds ratio (95% CI)
2002	9.92(2.70)	40.95(0.80)	0.16(0.09-0.29)	0.17(0.08-0.33)
2003	18.55(5.79)	41.87(0.75)	0.32(0.15-0.67)	0.39(0.19-0.80)
2004	26.33(7.81)	42.27(0.73)	0.49(0.22-1.08)	0.65(0.26-1.60)
2005	23.19(7.38)	45.04(0.69)	0.37(0.16-0.83)	0.27(0.12-0.59)
2006	31.17(6.03)	44.55(0.67)	0.56(0.32-0.98)	0.68(0.38-1.22)
2007	20.59(5.56)	45.01(0.59)	0.32(0.16-0.62)	0.38(0.18-0.80)
2008	34.24(6.73)	43.10(0.58)	0.69(0.38-1.24)	1.10(0.58-2.09)
2009	24.94(4.64)	42.07(0.54)	0.46(0.28-0.75)	0.69(0.41-1.17)
2010	28.53(4.62)	42.66(0.55)	0.54(0.34-0.84)	0.75(0.46-1.22)
2011	22.68(3.47)	40.62(0.91)	0.43(0.29-0.64)	0.50(0.31-0.78)
2012	23.31(3.54)	40.80(0.54)	0.44(0.30-0.65)	0.53(0.34-0.84)
2013	17.79(3.53)	41.36(0.54)	0.31(0.19-0.49)	0.33(0.19-0.55)
Overall	23.05(1.67)	42.69(0.19)	0.40(0.33-0.48)	0.50(0.40-0.61)

Personally management was defined as check sugar at least once a day and check feet at least once a day.

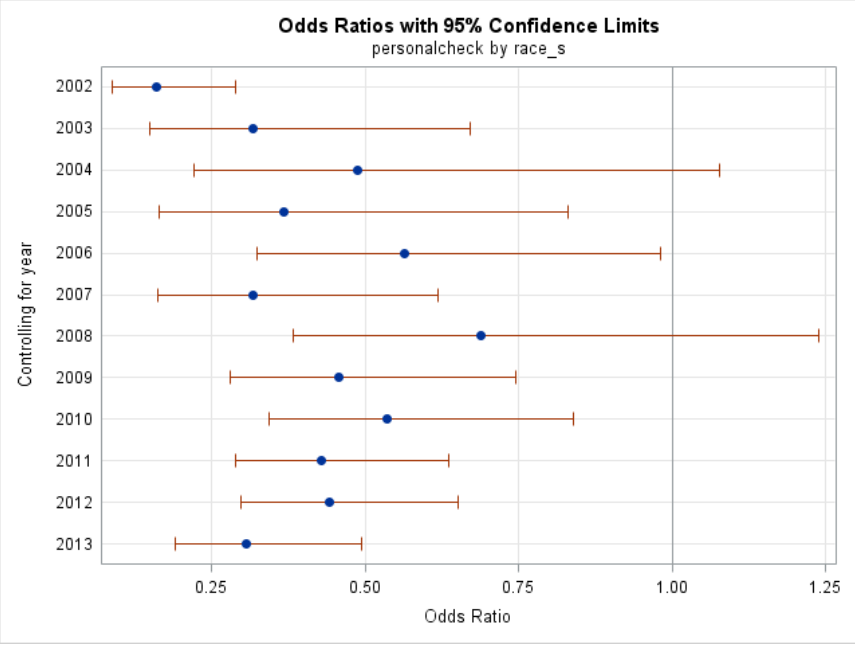

Figure 5 Odds ratio of personally management in Asian and White 2002-2013

3.3.2 Diabetes Management with Healthcare Providers

Table 6-10 showed the results of diabetes management with healthcare providers which included routine checkup, checking feet and eyes with doctors, checking HbA1C at least twice a year as well as the combined healthcare management variable.

Combined data in table 6 showed that the routine checkup rate within past year in Asian was 86% and this rate in white was 87%. No significantly differences were detected between Asian and white. Regarding the separate year data, there was no measure of routine checkup in year 2003 and 2004. The routine checkup rate in Asian and white over 12 years were all around 84-88%. There were also no statistically significant changes detected from either raw model or adjusted model. The figure showed a big range of 95% confidence interval for odds ratio between Asian and white in year 2002.

Table 6 Routine checkup with healthcare provider in Asian and White

Year	Asian	White	Raw Odds ratio (95% CI)	Adjusted Odds ratio (95% CI)
2002	93.30(6.07)	90.13(1.36)	1.53(0.22-10.48)	2.33(0.26-21.10)
2003	-	-	-	
2004	-	-	-	
2005	91.26(2.71)	87.04(0.43)	1.55(0.80-3.03)	1.76(0.82-3.80)
2006	89.13(3.24)	87.24(0.39)	1.20(0.62-2.32)	1.43(0.74-2.77)
2007	85.66(3.58)	86.82(0.35)	0.91(0.51-1.61)	0.86(0.48-1.55)
2008	86.04(2.87)	87.27(0.34)	0.90(0.56-1.44)	0.88(0.53-1.47)
2009	86.94(2.29)	87.03(0.34)	0.99(0.67-1.48)	1.04(0.67-1.62)
2010	85.14(2.57)	86.77(0.32)	0.87(0.58-1.31)	0.94(0.61-1.46)
2011	85.14(2.59)	86.33(0.33)	0.91(0.61-1.36)	1.07(0.67-1.70)
2012	83.80(3.10)	86.73(0.33)	0.79(0.50-1.24)	0.73(0.45-1.18)
2013	84.28(2.85)	88.06(0.31)	0.73(0.48-1.11)	0.82(0.50-1.34)
Overall	85.70(1.01)	87.05(0.12)	0.89(0.76-1.05)	0.94(0.78-1.12)

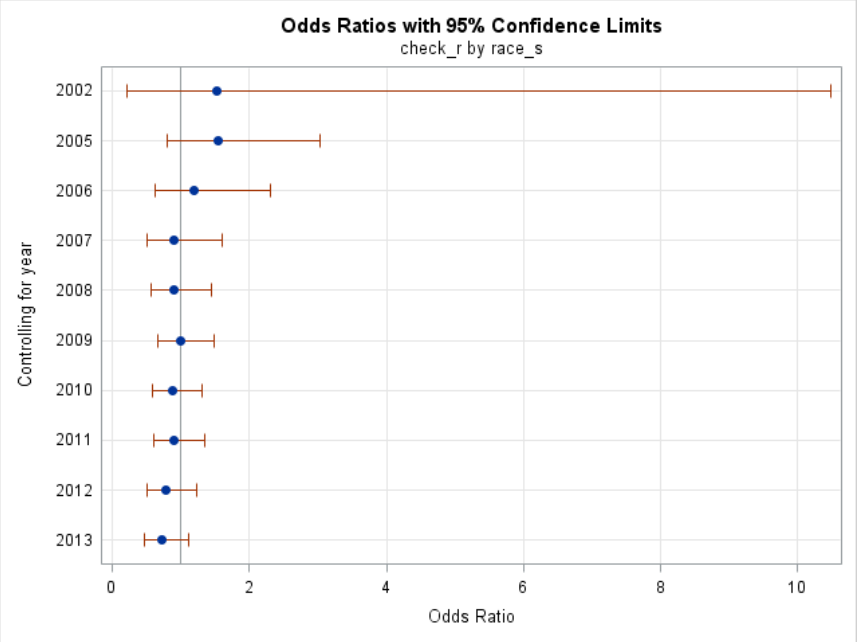

Figure 6 *Odds ratio of routine checkup in Asian and White 2002-2013*

The combined data results as well as the separate year results of checking feet for sore or irritation with doctors in past year were shown in Table 7. The overall rate of checking feet with doctors within past year in Asian was 63% and this rate in white was 71%. The Asian was almost 30% less likely to check their feet with doctors within past year compare to white. After adjusting the possible demographic risk factors, this odds ratio remained unchanged (odds ratio=0.74(0.60-0.91)). Focusing on each year, the checking rates in Asian ranged from 49% in 2002 to 75% in 2010 while these rates in white ranged from 67% in 2002 to 75% in 2011. Compare the Asian to white within each specific year, only significant differences were detected in year 2004 and 2007 (odds ratio=0.47(0.23-0.96) and 0.53(0.31-0.88) respectively). After adjusting the covariates, the significant difference only remained in 2007.

Results for rate of checking eye with doctors in past year in Asian and white were shown in Table 8. The overall rates of checking eye with doctors within past a year were very similar in Asian and white which was 70%. No significant difference was examined. Separate year data

Table 7 Checking feet with doctors for sore or irritation in Asian and White

	Asian	White	Raw Odds ratio (95% CI)	Adjusted Odds ratio (95% CI)
Year				
2002	49.12(9.88)	67.33(0.81)	0.47(0.22-1.02)	0.48(0.21-1.10)
2003	66.13(8.14)	69.05(0.72)	0.88(0.43-1.79)	0.66(0.34-1.29)
2004	49.31(9.2)	67.61(0.73)	0.47(0.23-0.96)	0.67(0.31-1.45)
2005	59.88(8.78)	69.24(0.65)	0.66(0.32-1.66)	0.69(0.31-1.51)
2006	69.77(5.74)	69.98(0.63)	0.99(0.58-1.69)	1.05(0.61-1.84)
2007	56.42(6.5)	71.15(0.55)	0.53(0.31-0.88)	0.56(0.32-0.99)
2008	69.88(6.36)	70.28(0.58)	0.98(0.54-1.78)	1.17(0.62-2.22)
2009	65.12(5.83)	72.91(0.50)	0.69(0.42-1.15)	0.62(0.35-1.09)
2010	74.47(5.26)	71.93(0.53)	1.14(0.66-1.96)	1.19(0.63-2.25)
2011	69.82(4.14)	75.15(0.80)	0.77(0.52-1.13)	0.68(0.44-1.06)
2012	64.44(4.75)	72.59(0.50)	0.68(0.45-1.03)	0.72(0.45-1.15)
2013	71.92(4.13)	72.27(0.52)	0.98(0.66-1.47)	1.01(0.66-1.52)
Overall	63.25(2.22)	70.55(0.18)	0.72(0.60-0.87)	0.74(0.60-0.91)

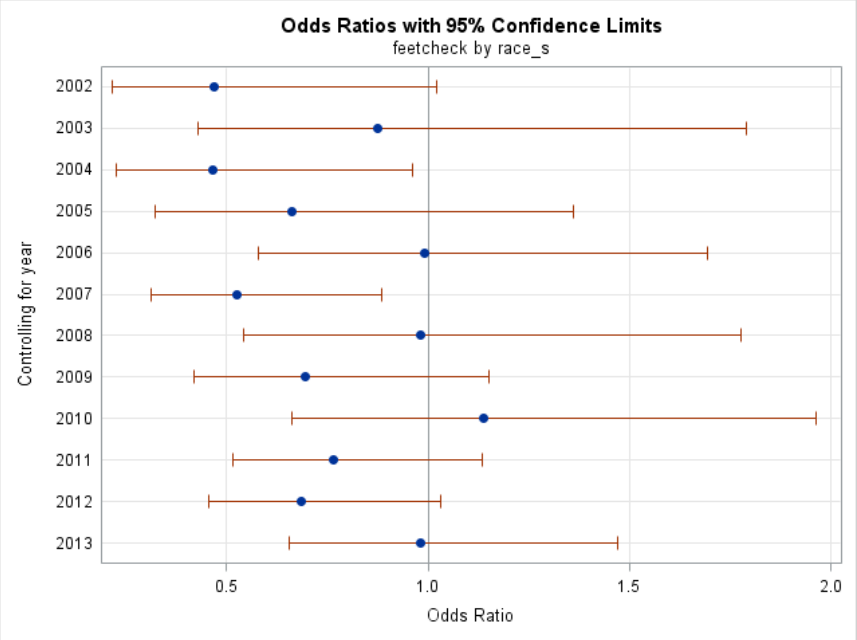

Figure 7 Odds ratio of checking feet for sore or irritation with doctor in Asian and White 2002-2013

results showed the similar findings. The eye checking rates in Asian ranged from 52% in 2002 to 77% in 2013 while these rates in white ranged from 68% in 2003 to 72% in 2002 and 2011.

Table 8 Checking eyes with doctors in Asian and White

	Asian	White	Raw Odds ratio (95% CI)	Adjusted Odds ratio (95% CI)
Year				
2002	51.65(9.96)	72.10(0.75)	0.41(0.19-0.91)	0.37(0.16-0.85)
2003	64.21(10.21)	67.90(0.75)	0.85(0.35-2.03)	1.29(0.63-2.61)
2004	69.00(9.08)	70.08(0.70)	0.95(0.41-2.19)	0.73(0.31-1.70)
2005	71.55(7.61)	69.71(0.64)	1.09(0.52-2.28)	1.17(0.53-2.60)
2006	79.64(5.04)	70.71(0.62)	1.62(0.88-2.99)	1.55(0.79-3.02)
2007	72.38(5.60)	71.73(0.55)	1.03(0.59-1.79)	0.93(0.51-1.69)
2008	64.63(7.25)	69.40(0.60)	0.81(0.43-1.50)	0.64(0.36-1.17)
2009	72.32(4.60)	70.19(0.53)	1.11(0.71-1.75)	0.96(0.58-1.60)
2010	69.92(5.33)	69.32(0.53)	1.03(0.62-1.70)	0.94(0.50-1.78)
2011	73.19(3.69)	71.55(0.85)	1.09(0.74-1.58)	1.11(0.73-1.69)
2012	70.45(4.64)	68.55(0.53)	1.09(0.70-1.70)	1.00(0.66-1.52)
2013	77.05(3.91)	67.74(0.53)	1.60(1.03-2.47)	1.44(0.90-2.29)
Overall	69.48(2.25)	69.81(0.18)	0.98(0.80-1.21)	0.92(0.74-1.14)

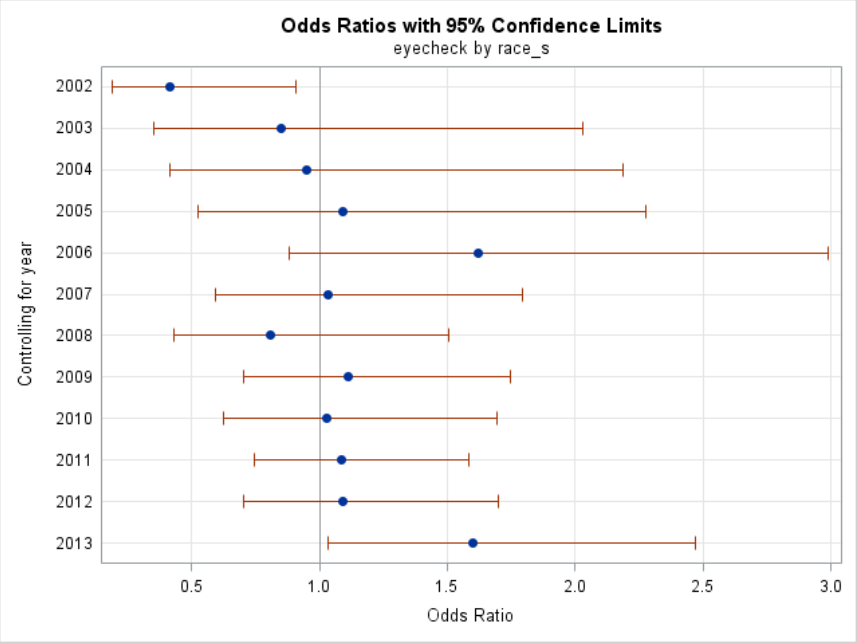

Figure 8 Odds ratio of checking eyes with doctors in Asian and White 2002-2013

Table 9 showed checking HbA1C with doctors at least twice a year in Asian and white for overall data and separate year data. Overall, the percentage of checking HbA1C with doctors at least twice a year in Asian was almost 88% while this rate in white was 90%. There was no

significant difference between Asian and white for both raw comparison and adjusting possible risk factors (odds ratio=0.74(0.51-1.08 and 0.96(0.68-1.36) respectively)). Taking look at the separate year results, the HbA1C checking at least twice a year rates within Asian were from 81% to 97% except 2003 which had a rate 67%. These rates in white were around 90%. There were no significant differences for each year of these 12 years.

Table 9 Checking HbA1C with doctors at least twice a year in Asian and White

	Asian	White	Raw Odds ratio (95% CI)	Adjusted Odds ratio (95% CI)
Year				
2002	84.62(9.19)	89.97(0.66)	0.61(0.15-2.47)	0.82(0.23-2.98)
2003	67.25(12.20)	90.07(0.55)	0.23(0.08-0.68)	0.45(0.16-1.27)
2004	97.15(1.45)	87.97(0.60)	4.67(1.67-13.06)	5.91(1.72-20.32)
2005	81.42(7.86)	88.71(0.51)	0.56(0.20-1.55)	0.59(0.24-1.44)
2006	90.47(3.97)	89.10(0.45)	1.17(0.47-2.88)	1.50(0.62-3.61)
2007	96.10(1.15)	91.52(0.32)	2.28(1.24-4.19)	2.87(1.38-6.00)
2008	81.01(6.25)	90.33(0.38)	0.46(0.20-1.02)	0.54(0.23-1.32)
2009	92.73(2.79)	91.78(0.33)	1.14(0.51-2.58)	2.14(0.93-4.88)
2010	91.21(2.78)	91.19(0.36)	1.00(0.51-1.99)	1.02(0.41-2.50)
2011	89.09(2.93)	92.01(0.56)	0.71(0.39-1.30)	0.69(0.34-1.38)
2012	92.03(2.06)	91.44(0.35)	1.08(0.62-1.89)	1.06(0.55-2.05)
2013	89.98(2.95)	92.21(0.36)	0.76(0.40-1.45)	0.72(0.35-1.49)
Overall	87.53(2.06)	90.44(0.13)	0.74(0.51-1.08)	0.96(0.68-1.36)

Diabetes management with healthcare providers combined routine checkup, feet and eye checking with doctors and HbA1C checking. These results were shown in table 10. Overall, only 17 % of Asian and 26% of white managed their diabetes with healthcare providers. Asian was more than 40% less likely to manage their diabetes via healthcare providers (odds ratio = 0.57 (0.50-0.65)). After adjusting the possible risk factors, this relationship remained unchanged (odds ratio=0.57(0.49-0.66)). Separate year results showed that the percentage differences of managing diabetes via healthcare providers between Asian and white mainly appeared in recent years.

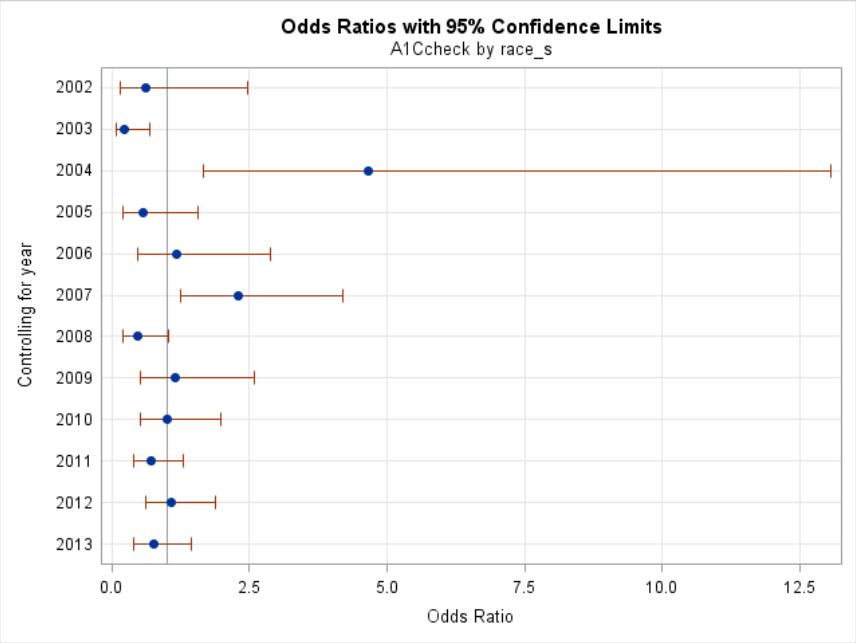

Figure 9 Odds ratio of checking HbA1C at least twice a year in Asian and White 2002-2013

Table 10 Diabetes management with healthcare providers in Asian and White

	Asian	White	Raw Odds ratio (95% CI)	Adjusted Odds ratio (95% CI)
Year				
2002	2.62(1.63)	3.74(0.21)	0.69(0.20-2.43)	0.91(0.26-3.16)
2003	36.18(7.55)	43.24(0.75)	0.74(0.39-1.42)	0.80(0.44-1.47)
2004	28.62(7.38)	40.46(0.73)	0.59(0.29-1.20)	0.72(0.33-1.54)
2005	27.84(6.27)	29.81(0.54)	0.91(0.49-1.68)	0.79(0.42-1.48)
2006	42.08(5.61)	34.35(0.59)	1.39(0.88-2.19)	1.25(0.77-2.03)
2007	26.23(4.22)	28.97(0.44)	0.87(0.57-1.34)	0.93(0.58-1.48)
2008	14.78(2.52)	25.98(0.40)	0.49(0.33-0.73)	0.52(0.34-0.79)
2009	15.70(2.68)	30.57(0.43)	0.42(0.28-0.63)	0.41(0.26-0.65)
2010	14.43(2.03)	26.65(0.38)	0.46(0.34-0.64)	0.49(0.33-0.70)
2011	7.14(1.06)	9.15(0.23)	0.76(0.56-1.05)	0.74(0.52-1.05)
2012	8.09(1.16)	20.54(0.31)	0.34(0.25-0.46)	0.38(0.27-0.53)
2013	12.34(1.88)	23.10(0.32)	0.47(0.33-0.66)	0.50(0.34-0.74)
Overall	16.62(0.93)	25.99(0.13)	0.57(0.50-0.65)	0.57(0.49-0.66)

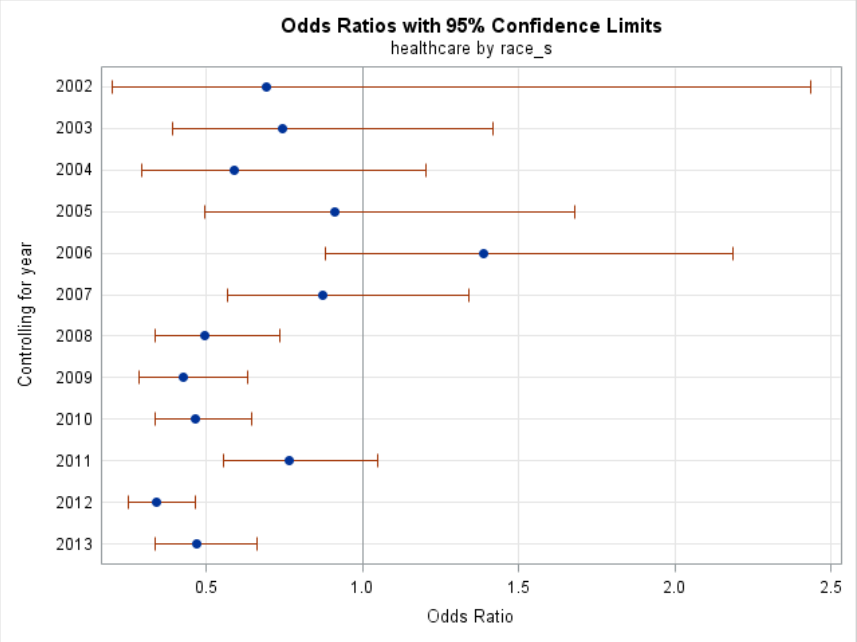

Figure 10 Odds ratio diabetes management with healthcare provider in Asian and White 2002-2013

3.3.3 Flu Vaccination and Pneumonia Shot or Pneumococcal Vaccine

Table 11 showed Flu vaccination and pneumonia shot or pneumococcal vaccine in Asian and white. Overall, 58% Asian got flu shot in past a year and 43% got pneumonia shot or pneumococcal vaccine while these rates in whites were 61% and 60%. Compare to white, Asian was 13% less like to get flu shot and 50% less likely to get pneumonia shot or pneumococcal vaccine (odds ratio=0.87(0.77-0.98) and 0.50(0.44-0.57) respectively). After adjusting possible risk factors, the flu shot rate in Asian changed (odds ratio=0.89(0.79-1.02) while the pneumonia shot or pneumococcal vaccine rate was still statistically significant (odds ratio=0.54(0.47-0.62)). The separate year data results showed that Asian had the lowest flu shot rate of 44% in 2003 and the highest rate of 64% in 2012 while Asian had the lowest pneumonia shot or vaccination rate of 30% in 2002 and the highest pneumonia shot or vaccination rate of 54% in 2013. The white had the lowest rate of 54% in 2005 and the highest rate of 67% in 2007 while they had the lowest pneumonia shot or vaccination rate of 53% in 2002 and the highest rate of 64% in 2013.Compare

to white, Asian's flu shot rate had no significant differences in most years except 2003, and 2013. After adjusting the demographic characteristics, the significant differences in 2003 and 2013 changed to not statistically significant. On the other hand, Asian was 33% to 63% less likely to get pneumonia shot or pneumococcal vaccination compare to white. After adjusting possible risk factors, these relationships remained unchanged except the relationship between Asian and white in 2003 and 2013.

Table 11 Flu vaccination & pneumonia shot in Asian and White from 2002-2013

		Asian	White	Raw Odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Received flu vaccination within past year	Year				
	2002	55.88(8.43)	61.14(0.69)	0.80(0.41-1.58)	0.87(0.43-1.76)
	2003	43.76(7.86)	61.30(0.71)	0.49(0.26-0.92)	0.64(0.35-1.17)
	2004	52.83(8.33)	61.39(0.66)	0.70(0.37-1.36)	0.88(0.45-1.73)
	2005	50.35(6.54)	54.61(0.59)	0.84(0.50-4.41)	0.78(0.43-1.41)
	2006	56.63(5.65)	61.86(0.61)	0.81(0.51-1.27)	0.74(0.44-1.24)
	2007	57.92(4.87)	66.31(0.47)	0.70(0.47-1.04)	0.72(0.46-1.14)
	2008	57.27(4.38)	64.40(0.49)	0.74(0.52-1.05)	0.82(0.55-1.21)
	2009	57.68(3.75)	64.68(0.46)	0.74(0.55-1.01)	0.75(0.53-1.05)
	2010	57.65(3.49)	63.87(0.45)	0.77(0.58-1.02)	0.77(0.55-1.07)
	2011	57.99(3.78)	57.16(0.47)	1.03(0.76-1.41)	1.03(0.73-1.44)
	2012	64.07(4.62)	57.91(0.46)	1.30(0.87-1.92)	1.43(0.98-2.10)
	2013	61.28(4.13)	58.29(0.48)	1.13(0.80-1.60)	1.06(0.72-1.56)
	Overall	57.60(1.51)	61.03(0.15)	0.87(0.77-0.98)	0.89(0.79-1.02)
A pneumonia shot or pneumococcal vaccine					
	2002	29.66(6.66)	53.47(0.72)	0.37(0.20-0.69)	0.45(0.23-0.89)
	2003	31.40(6.78)	54.42(0.72)	0.38(0.21-0.71)	0.56(0.27-1.14)
	2004	32.95(8.85)	56.88(0.68)	0.37(0.17-0.82)	0.27(0.11-0.64)
	2005	31.73(6.36)	55.71(0.60)	0.47(0.27-0.80)	0.41(0.24-0.70)
	2006	37.63(5.44)	58.82(0.63)	0.42(0.27-0.67)	0.37(0.21-0.63)
	2007	37.42(4.94)	59.53(0.50)	0.41(0.27-0.62)	0.44(0.27-0.70)
	2008	40.64(4.34)	58.50(0.49)	0.49(0.34-0.69)	0.46(0.30-0.69)
	2009	44.19(3.77)	60.38(0.47)	0.52(0.38-0.70)	0.48(0.34-0.67)

2010	36.08(3.35)	61.29(0.46)	0.36(0.27-0.48)	0.47(0.34-0.65)
2011	47.13(3.95)	63.65(0.47)	0.51(0.37-0.70)	0.57(0.40-0.83)
2012	51.34(5.27)	63.17(0.47)	0.62(0.41-0.93)	0.60(0.39-0.90)
2013	53.95(4.45)	63.61(0.49)	0.67(0.47-0.95)	0.83(0.56-1.23)
Overall	42.51(1.54)	59.53(0.16)	0.50(0.44-0.57)	0.54(0.47-0.62)

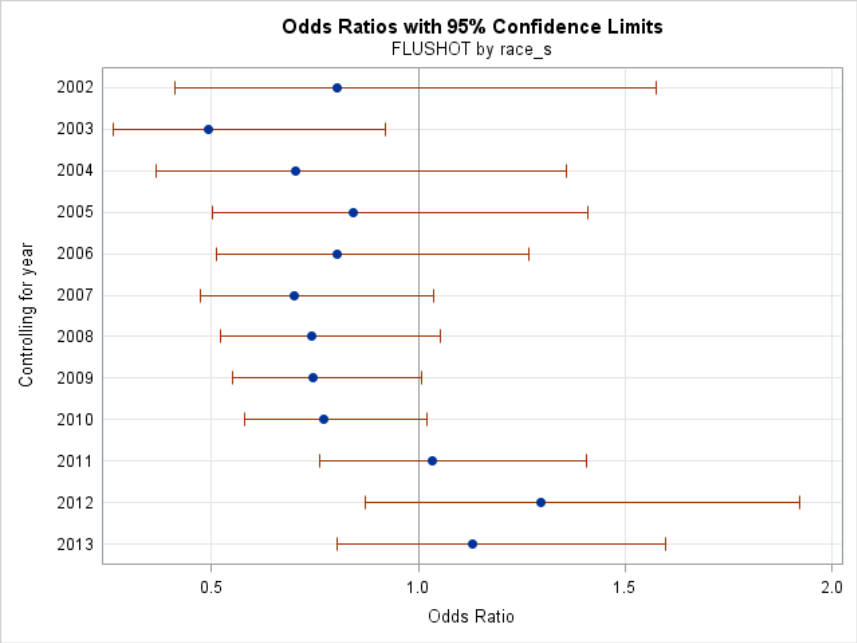

Figure 11 *Odds ratio of flu shot in Asian and White 2002-2013*

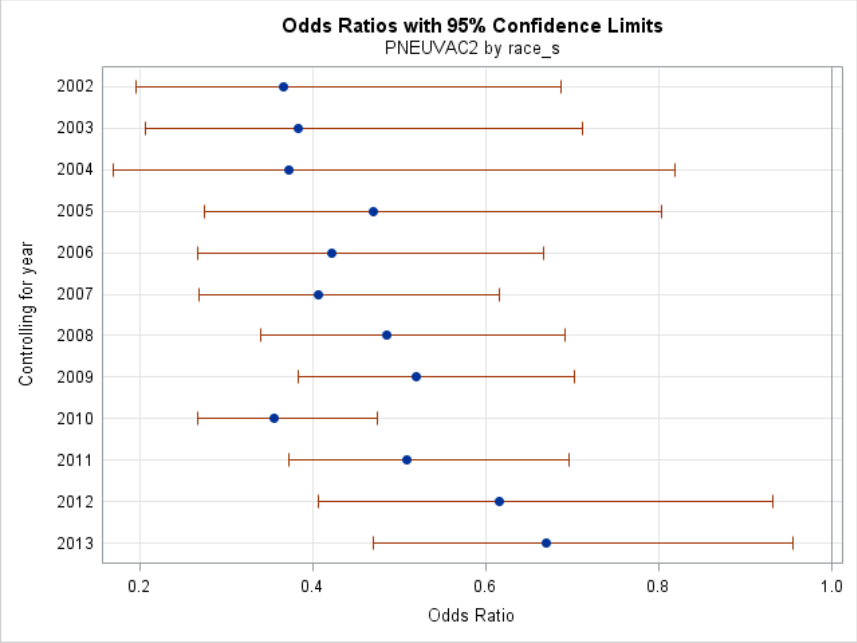

Figure 12 *Odds ratio of pneumonia shot in Asian and White 2002-2013*

3.4 Diabetes Complications

3.4.1 Diabetes Retinopathy

Table 12 showed the diabetes retinopathy complication in Asian and white. The combined data results showed that the diabetes retinopathy rate in Asian was 28% while this rate in white was 17%. The difference between these two groups was statistically significant (odds ratio=1.86(1.54-2.26)). After adjusting the demographic characteristics and obese status, Asian was almost 150% more likely to develop diabetes retinopathy compare to white. There was no apparent increase or decrease trend over the 12 year period for both Asian and white. The diabetes retinopathy rates in Asian were significantly higher than white in most years except 2003, 2005 and 2007. The highest difference was presented in year 2011 where Asian was almost 180% more likely to develop diabetes retinopathy. After adjusting the possible risk factors for each year, the differences between these two groups remained the same trend.

Table 12 Diabetes retinopathy in Asian and White from 2002-2013

Year	Asian	White	Raw Odds ratio (95% CI)	Adjusted odds ratio (95% CI)
2002	39.38(10.13)	21.14(0.70)	2.42(1.05-5.59)	3.55(1.72-7.36)
2003	19.06(5.92)	17.89(0.58)	1.08(0.51-2.30)	1.81(0.88-3.75)
2004	36.82(9.67)	19.27(0.59)	2.44(1.11-5.35)	3.96(1.81-8.67)
2005	23.48(5.93)	17.79(0.50)	1.42(0.74-2.72)	1.67(0.77-3.63)
2006	29.55(5.78)	16.82(0.49)	2.07(1.20-3.59)	2.73(1.52-4.92)
2007	22.12(5.67)	17.02(0.43)	1.38(0.72-2.65)	1.74(0.81-3.75)
2008	28.04(5.60)	16.14(0.44)	2.02(1.17-3.50)	2.18(1.24-3.86)
2009	28.27(4.91)	16.30(0.42)	2.02(1.25-3.27)	2.57(1.52-4.35)
2010	25.79(4.52)	15.54(0.40)	1.89(1.18-3.01)	2.96(1.77-4.95)
2011	32.40(4.69)	14.72(0.65)	2.78(1.80-4.28)	3.08(1.82-5.22)
2012	27.71(4.15)	15.64(0.41)	2.07(1.37-3.12)	1.80(1.13-2.88)
2013	23.18(4.06)	15.38(0.40)	1.66(1.06-2.61)	2.42(1.47-3.98)
Overall	27.72(1.97)	17.06(0.15)	1.86(1.54-2.26)	2.46(2.00-3.04)

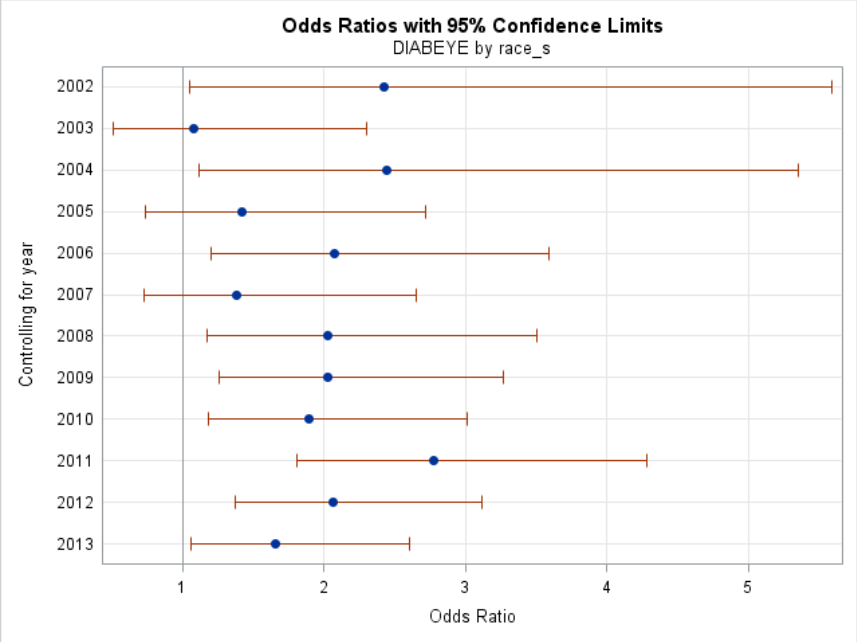

Figure 13 Odds ratio of diabetes retinopathy in Asian and White 2002-2013

3.4.2 Feet Sore or Irritation

The feet sore or irritation complications in participants were only measured in 2002-2007. The combined data result showed that Asian have a rate of 9% while white had a rate of 11%. This difference was not statistically significant for raw and adjusted model (odds ratio=0.81(0.42-1.59) and 0.68(0.38-1.22) respectively). The rates of feet sore or irritation in Asian were not consistent with these six year period while the rates in white were steady at 10-11%.

Table 13 Feet sore or irritation in Asian and White from 2002-2013

	Asian	White	Raw Odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Year				
2002	7.40(5.88)	10.68(0.50)	0.67(0.12-3.60)	0.80(0.17-3.75)
2003	18.68(11.30)	11.12(0.52)	1.84(0.43-7.92)	0.64(0.16-2.58)
2004	9.38(6.49)	10.83(0.49)	0.85(0.19-3.82)	1.25(0.27-5.79)
2005	6.34(3.14)	10.42(0.41)	0.58(0.21-1.65)	0.45(0.12-1.71)
2006	9.07(3.56)	10.66(0.50)	0.84(0.36-1.96)	0.96(0.40-2.30)
2007	2.10(0.91)	10.21(0.37)	0.19(0.08-0.45)	0.22(0.09-0.57)

Overall	8.86(2.75)	10.66(0.19)	0.81(0.42-1.59)	0.68(0.38-1.22)

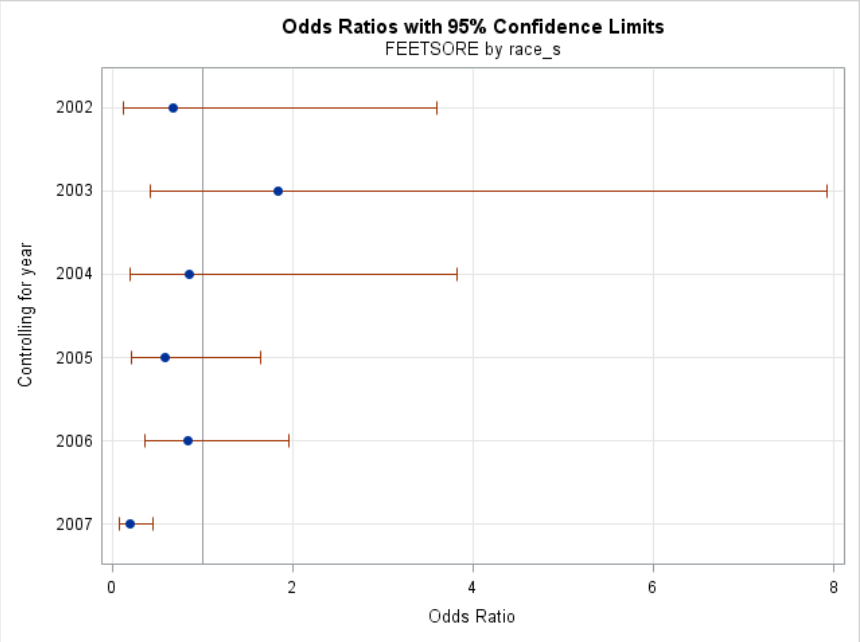

Figure 14 Odds ratio of feet sore in Asian and White 2002-2013

3.4.3 Neuropathy and Cardiovascular Diseases

The neuropathy and cardiovascular complications were combined variable which considered hypertension, angina, coronary heart attack, stroke, or other form of heart disease. The combined data showed that Asian had 45% of this complication while white had 56% of it. The Asian was more than 35% less likely to develop this complication compare to white. After adjusting the covariates, Asian still was almost 15% less likely to develop neuropathy and cardiovascular complications. For year 2006, 2008, 2010 and 2012, the high blood pressure as well as the high blood cholesterol didn't get measured. Comparison of these years' data showed that there were no significant changes in both Asian and white. Comparison of other years' data showed that the neuropathy and cardiovascular disease complications were increased both in Asian and white.

Table 14 neuropathy and cardiovascular complications in Asian and White from 2002-2013

	Asian	White	Raw Odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Year				
2002	20.15(11.45)	58.83(1.21)	0.18(0.04-0.71)	0.49(0.10-2.34)
2003	40.50(7.50)	67.10(0.68)	0.33(0.18-0.62)	0.590.34-1.03)
2004	42.75(15.09)	59.61(1.17)	0.51(0.15-1.70)	1.08(0.33-3.47)
2005	62.78(6.56)	72.74(0.52)	0.63(0.36-1.10)	1.23(0.68-2.23)
2006	19.29(4.64)	30.23(0.57)	0.55(0.31-0.99)	0.61(0.31-1.19)
2007	56.44(4.84)	74.54(0.43)	0.44(0.30-0.65)	0.53(0.34-0.83)
2008	22.37(3.71)	28.05(0.41)	0.74(0.49-1.13)	0.76(0.48-1.21)
2009	58.38(3.56)	73.95(0.43)	0.49(0.37-0.66)	0.78(0.55-1.11)
2010	14.28(2.22)	28.00(0.38)	0.43(0.30-0.61)	0.51(0.34-0.76)
2011	70.91(3.26)	76.95(0.41)	0.73(0.53-0.99)	1.13(0.79-1.62)
2012	18.90(4.54)	28.12(0.40)	0.60(0.33-1.07)	0.74(0.39-1.38)
2013	71.70(3.17)	77.47(0.39)	0.74(0.54-1.00)	1.06(0.73-1.53)
Overall	44.70(1.47)	55.74(0.16)	0.64(0.57-0.72)	0.85(0.75-0.97)

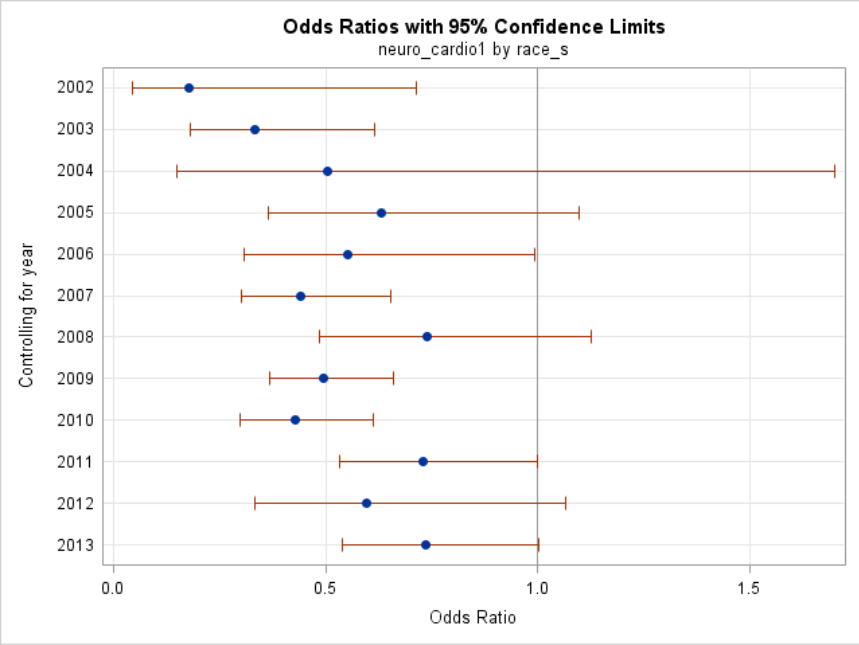

Figure 15 Odds ratio of neuropathy and cardio-vascular diseases in Asian and White 2002-2013

4 DISCUSSION

The type II diabetes disproportionally distributed among different races/ethnicities and minorities possessed higher rate of diabetes compared to white[41]. In this study, the 12 year

BRFSS data were utilized to compare the diabetes complications and diabetes preventive health care utilizations. The results showed that the prevalence of diabetes in Asian was lower than prevalence in white before adjusting age, gender and BMI which is not consistent with the report from American Diabetes Association, where they reported that the Asian population had higher type II diabetes prevalence compared to their white counterparts[42]. This may be due to the telephone survey sampling of Asian population. After adjusting with age, gender and BMI levels, the diabetes prevalence in Asian in 12 years was 50% - 110% higher than the diabetes prevalence in white and all odds ratios were statistically significant. So our data well coincide with the previous studies. Several studies explained the possible reasons for this difference [43-49] which formed the foundation for our study. The reason includes environmental risks as well as the race factors. Using same criterion of obesity for Asian population, the obesity rate in Asian is significantly lower than white while this difference is not statistically significant if different criterion were applied as mentioned by WHO expert consultation[50]. After adjusted with BMI, the diabetes prevalence in Asian was much higher than the prevalence in white at the same BMI level.

A number of diabetes associated health complications including cardiovascular disease, retinopathy and limb amputation have been reported by several studies[41, 51, 52]. In this study, the prevalence of neuropathy and cardiovascular complications in Non-Hispanic White adults with diagnosed type 2 diabetes was much higher than the prevalence in Asian American even after adjusting the possible demographic risk factors and BMI level. These findings coincide with the lower incidence of all these diseases observed in Asian or Pacific Islander in other studies[53, 54]. For year 2006, 2008, 2010 and 2012, the high blood pressure as well as the high blood cholesterol didn't get measured. Comparison of these years' data showed that there were no

significant changes in both Asian and white. Comparison of other years' data showed that the neuropathy and cardiovascular disease complications were increased both in Asian and white. 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[55, 56]. The subgroups, Pacific Islander and other Asian such as Japanese American had lower proportion of recent immigrants. Six years data of feet sore complication showed that the feet sore rate in both Asian and white was lower than 10% and there was no significant difference between these two groups. Our finding is different from the study performed by Abbott where they concluded that South Asians with diabetes in the U.K. have about one-third the risk of foot ulcers of Europeans[57].

The diabetes retinopathy rate in Asian was almost 10% higher than white. After adjusting the demographic characteristics and obese status, Asian was almost 150% more likely to develop diabetes retinopathy compare to white. Our finding was different from other research that Asian American and African American has a similar prevalence of retinopathy to that in white[58]. But, another report showed that the prevalence of retinopathy related with diabetes was twice in other racial/ethnic backgrounds than in non-Hispanic white[59]. Our findings were from multiple year data which have more power to illustrate the retinopathy issue. Further study need to perform to examine the reason of the higher diabetes retinopathy rate in Asian. There was no apparent increase or decrease trend over the 12 year period for both Asian and white implied that issue persisted along 12 year period which need more attention to address.

Proper preventive diabetes management can reduce the diabetes mortality and morbidity. Study using 2008-2012 BRFSS data showed us that there were racial disparity of health care services between Black and white among adults 65 years or older with diabetes[60]. Our results

proved that Asian Americans were significantly less likely to check their blood sugar. These differences remained unchanged even after adjusting possible demographic risk factors. Blood sugar is the major factor to affect the process of diabetes. The reduced blood sugar check may lead to worse diabetes outcome, such as diabetes retinopathy. The good parts found from this study was both Asian and white had an increase trend of performing preventive health care over 12 year period. Results from previous study showed that the more cardiovascular disease the person had, the more possibly to develop retinopathy which seems conflict with our finding where Asian had less cardiovascular disease with higher rate of retinopathy. The possible reason may be genetics difference. Our studies also showed that Asian population was more likely to check their eyes compare to their white counterparts. One possibility is that the people who suffered from diabetes retinopathy badly were more likely to check their eyes with doctors. Those who have more cardiovascular disease complications were more likely to get severe situation which makes them more to check blood sugar once a day, check HbA1C at least twice a year and more likely to perform routine checkup. Results from this study showed that both Asian and white had higher checkup rate with health care provider while the self-management rates were lower. Half of the participants didn't report self-management for blood sugar check as well as the eyes and feet check. Some researchers found out that Asian were the least race to get recommended diabetes screening which may contribute to the lower rate of blood sugar self-checking[61]. In our study, we considered the complex survey design of BRFSS data and related statistical test also was modified. The modified Chi-square test for categorical data was based the method proposed by Rao[62, 63, 64] which better accommodated the design and produced reliable results.

5 STUDY LIMITATIONS

Several limitations in this study need to be improved: first, all the variables included in this study such as the type 2 diabetes status are based on self-reported results and there is no way to verify by medical record review. Secondly, the sample size in Asian and white had a big difference which may result some analysis bias. Even we considered the sampling design using survey procedure in SAS, this sample size difference might still contribute some estimation error. This error can be corrected in one way: draw random sample with similar sample size from white population and analyze the data using the subgroup.

On the other hand, those individuals with severe physical disease, such as heart attack, stroke 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[65].

Another limitation came from the BRFSS data collection which excludes people without telephone and those with cell phone only before year 2011. The excluded people may be minority in majority and they may have higher cardiovascular disease which may lower the coverage of cardiovascular disease in Asian.

The last limitation may be from the questionnaire design. The questionnaire only include English version and Spanish version. Some Asians especially older Asian can't understand both languages, which may reduce the Asian population with Diabetes. In the Kaiser study, Asian Americans who had difficulty communicating in English had a lower frequency of home glucose

monitoring[66] relating to poor glucose control[67] and then led to the occurrence of diabetes and its complications.

6 CONCLUSIONS

Compared to non-Hispanic white, the Asian Americans were more likely to experience diabetes while less likely to develop neuropathy and cardiovascular disease over 12 year period. The diabetes prevalence increased in both Asian and white populations in 12 years. Similarly, Asians were also more likely to become diabetes associated retinopathy. Asians have lower rate in blood sugar self-checking compared with white. The blood sugar self-checking rate in both Asian and white were consistent within 12 year period. There was no increase trends observed in both races groups. There was no significant difference of feet sore complication and the feet self-checking as well as the feet checking with healthcare provider. The feet checking rate kept at low level in both Asian and white for all 12 years. No significant differences were observed in routine checkup and checking HbA1C at least twice a year between Asian and white.

REFERENCES

1. Barnes, Jessica S.; Bennett, Claudette E. (February 2002). "The Asian Population: 2000". Census 2000. United States Census Bureau. Retrieved October 20, 2014.
2. Humes, Karen R.; Jones, Nicholas A.; Ramirez, Roberto R. (March 2011). "Overview of Race and Hispanic Origin: 2010". United States Census Bureau. United States Department of Commerce. Retrieved October 20, 2014.
3. Dong Y, Gao W, Nan H, Yu H, Li F, Duan W, Wang Y, Sun B, Qian R, Tuomilehto J, et al. Prevalence of Type 2 diabetes in urban and rural Chinese populations in Qingdao, China. Diabet Med. 2005; 22:1427–1433.

4. Yang W, Lu J, Weng J, Jia W, Ji L, Xiao J, Shan Z, Liu J, Tian H, Ji Q, et al. Prevalence of diabetes among men and women in China. N Engl J Med. 2010; 362:1090–1101.
5. Ramachandran A, Mary S, Yamuna A, Murugesan N, Snehalatha C. High prevalence of diabetes and cardiovascular risk factors associated with urbanization in India. Diabetes Care. 2008; 31:893–898.
6. Song KH, Nam-Goomg IS, Han SM, Kim MS, Lee EJ, Lee YS, Lee MS, Yoon S, Lee KU, Park JY. Change in prevalence and 6-year incidence of diabetes and impaired fasting glucose in Korean subjects living in a rural area. Diabetes Res Clin Pract. 2007; 78:378–384.
7. Singh DL, Bhattarai MD. High prevalence of diabetes and impaired fasting glycaemia in urban Nepal. Diabet Med. 2003; 20:170–171.
8. Shera AS, Jawad F, Maqsood A. Prevalence of diabetes in Pakistan. Diabetes Res Clin Pract. 2007; 76:219–222.
9. Baltazar JC, Ancheta CA, Aban IB, Fernando RE, Baquilod MM. Prevalence and correlates of diabetes mellitus and impaired glucose tolerance among adults in Luzon, Philippines. Diabetes Res Clin Pract. 2004; 64:107–115.
10. Gao WG, Dong YH, Pang ZC, Nan HR, Zhang L, Wang SJ, Ren J, Ning F, Qiao Q. Increasing trend in the prevalence of Type 2 diabetes and pre-diabetes in the Chinese rural and urban population in Qingdao, China. Diabet Med. 2009; 26:1220–1227.
11. Lee JW, Brancati FL, Yeh HC. Trends in the prevalence of type 2 diabetes in Asians versus whites: results from the United States National Health Interview Survey, 1997-2008. Diabetes Care. 2011 Feb; 34(2):353-7.
12. Centers for Disease Control and Prevention. National Diabetes Statistics Report: Estimates of Diabetes and Its Burden in the United States, 2014. Atlanta, GA: U.S. Department of Health and Human Services; 2014.

13. Centers for Disease Control and Prevention. National diabetes fact sheet: national estimates and general information on diabetes and prediabetes in the United States, 2011. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2011.
14. McNeely MJ, Boyko EJ. Diabetes-related comorbidities in Asian Americans results of national health survey. Journal of Diabetes and Its Complications. 2005; 19:101-106.
15. Karter AJ, Ferrara A, Liu JY, et.al. Ethnic disparities in diabetic complications in an insured population. JAMA. 2002; 287:2519-2527.
16. Li Y, Liao Y, Fan A, Zhang X, Balluz L.Asian American/Pacific Islander paradox in diabetic retinopathy: findings from the Behavioral Risk Factor Surveillance System, 2006-2008. Ethn Dis. 2010; 20(2):111-117.
17. Hardman K, Hunt KJ, Cater RE, Jenkins C, Hill R, Lackland DT. Diabetes management and vaccination rates in the southeast United States, 2000 through 2007. Ethn Dis. 2011; 21(1):13-19.
18. Mohan V, Seedat YK, Pradeepa R. The rising burden of diabetes and hypertension in southeast Asian and African regions: need for effective strategies for prevention and control in primary health care settings. Int J Hypertens. 2013, Article ID 409083, 14 pages, 2013. doi:10.1155/2013/409083.
19. Oladele CRW, Barnett E. Racial/Ethnic and social class differences in preventive care practices among persons with diabetes. BMC Public Health. 2006; 6:259-267.
20. Harris M. Racial and ethnic differences in health care access and health outcomes for adults with type 2 diabetes. Diabetes Care. 2001; 24 (3):454–459.
21. Chou AF, Brown AF, Jensen RE, Shih S, Pawlson G, Scholle SH. Gender and racial disparities in the management of diabetes mellitus among Medicare patients. Women's Health Issues. 2007; 17 (3):150–161.

22. Nwasuraba C, Khan M, Egede LE. Racial/Ethnic differences in multiple self-care behaviors in adults with diabetes. Journal of General Internal Medicine. 2007; 22:115–120.
23. Egede L, Zheng M. Racial/Ethnic differences in adult vaccination among individuals with diabetes. American Journal of Public Health. 2003; 93 (2):324–329.
24. Egede L, Zheng M. Racial/Ethnic differences in influenza vaccination coverage in high-risk adults. American Journal of Public Health. 2003; 93 (12):2074–2079.
25. CDC Preventive-care practices among persons with diabetes--United States, 1995 and 2001. MMWR - Morbidity & Mortality Weekly Report. 2002; 51(43):965–969.
26. Lee JA, Liu CF, Sales AE. Racial and Ethnic Differences in Diabetes Care and Health Care Use and Costs Prev Chronic Dis. 2006; 3(3): A85.
27. Yan F, Guo JF, Cui X. Racial disparity of the preventive health care and behavior risk factors among Type 2 Diabetes. Ethnicity & Disease. 2014 Nov accepted.
28. Lin C, Li C, Hsiao CY, et,al. Time trend analysis of the prevalence and incidence of diagnosed type 2 diabetes among adults in Taiwan from 2000 to 2007: a population-based study. BMC Public Health. 2013; 13:318-327
29. American Diabetes Association. Standards of medical care in diabetes. Diabetes Care. 2004; 27(Suppl 1):S15–S35.
30. Harris MI. Health care and health status and outcomes for patients with type 2 diabetes. Diabetes Care. 2000; 23(6):754–758.
31. Huang ES, Gleason S, Gaudette R, Cagliero E, Murphy-Sheehy P, Nathan DM, et al. Health care resource utilization associated with a diabetes center and a general medicine clinic. J Gen Intern Med. 2004; 19(1):28–35.
32. Meigs JB, Stafford RS. Cardiovascular disease prevention practices by U.S. physicians for patients with diabetes. J Gen Intern Med. 2000; 15(4):220–228.

33. Saaddine JB, Engelgau MM, Beckles GL, Gregg EW, Thompson TJ, Narayan KM. A diabetes report card for the United States: quality of care in the 1990s. Ann Intern Med. 2002; 136(8):565–574.
34. The effect of intensive diabetes therapy on the development and progression of neuropathy. The Diabetes Control and Complications Trial Research Group. Ann Intern Med. 1995; 122(8):561–568.
35. Heisler M, Smith DM, Hayward RA, Krein SL, Kerr EA. Racial disparities in diabetes care processes, outcomes, and treatment intensity. Med Care. 2003; 41(11):1221–1232.
36. Centers for Disease Control and Prevention (CDC). *Behavioral Risk Factor Surveillance System Survey Questionnaire*. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.
37. *Bureau of the Census. (1994), "Phoneless in America. ," Statistical Brief 94-16.*
38. Blumberg SJ, Luke JV. Wireless substitution: Early release of estimates from the National Health Interview Survey, January–June 2011. National Center for Health Statistics. December 2011. Available from: http://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless201112.htm
39. CDC. Behavioral Risk Factor Surveillance System. Available from: http://www.cdc.gov/brfss/index.htm Accessed 11/6/2014
40. World Health Organization Study Group. Prevention of diabetes mellitus, report of a who study group. World Health Organ Tech. Rep. Ser. 1994; 844, 1-100.
41. Beckles G, Engelgau MM, and Narayan KM. Population-based assessment of the level of care among adults with diabetes in the U.S. Diabetes Care. 1998; 21: 1432-1438.
42. Chan JC, Malik V, Jia W, et al. Diabetes in Asia: epidemiology, risk factors, and pathophysiology. JAMA. 2009;301(20):2129-2140

43. Malik V, Willett WC, Hu FB. Global obesity: trends, risk factors and policy implications. Nat Rev Endocrinol. 2013;9(1):13-27

44. Yajnik CS, Lubree HG, Rege SS, et al. Adiposity and hyperinsulinemia in Indians are present at birth. J Clin Endocrinol Metab. 2002;87(12):5575-5580.

45. Huxley R, James WP, Barzi F, et al. Ethnic comparisons of the cross-sectional relationships between measures of body size with diabetes and hypertension. Obes Rev. 2008;9 Suppl 1:53-61.

46. BMI Calculator. Asian American Diabetes Initiative Web site. http://aadi.joslin.org/content/bmi-calculator. Accessed January 12, 2017

47. Hu FB. Globalization of diabetes: The role of diet, lifestyle, and genes. Diabetes Care. 2011;34(6):1249-1257.

48. Li Y, He Y, Qi L, et al. Exposure to the Chinese famine in early life and the risk of hyperglycemia and type 2 diabetes in adulthood. Diabetes. 2010;59:2400-2406.

49. Pearson JF, Bachireddy C, Shyamprasad S, Goldfine AB, Brownstein JS. Association between fine particulate matter and diabetes prevalence in the U.S. Diabetes Care. 2010;33(10):2196-2201.

50. WHO expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. THE LANCET • Vol 363 • January 10, 2004

51. Haffner, S. M. (1998), "Epidemiology of Type 2 Diabetes: Risk Factors.," Diabetes Care., 21 C3-6.

52. Hamel, H., Rodriguez-Saidana, J., Flaherty, J., and Miller, D. (1999), "Diabetes Mellitus among Ethnic Seniors: Contrasts with Diabetes in Whites.," Clin Geriat Med, 15, 14.

53. Cheung, N., et al. (2007), "Diabetic Retinopathy and the Risk of Coronary Heart Disease the Atherosclerosis Risk in Communities Study. ," Diabetes Care, 30, 1742-1746.

54. Karter, A. J., Ferrara, A., and Liu, J. Y. (2002), "Ethnic Disparities in Diabetic Complications in an Insured Population.," JAMA., 287, 2519-2527.

55. Reed, D., et al. (1982), "Acculturation and Coronary Heart Disease among Japanese Men in Hawaii.," American Journal of Epidemiology, 115, 894-905.

56. Woo, K. S., et al. (1999), "Westernization of Chinese Adults and Increased Subclinical Atherosclerosis. ," Arteriosclerosis, Thrombosis, and Vascular Biology,, 19, 2487-2493.

57. Abbott CA1, Garrow AP, Carrington AL, et.al. Foot ulcer risk is lower in South-Asian and African-Caribbean compared with European diabetic patients in the U.K.: the North-West diabetes foot care study. Diabetes Care. 2005 Aug;28(8):1869-75.

58. McNeely, M. J., and Boyko, E. J. (2005a), "Diabetes-Related Comorbidities in Asian Americans Results of a National Health Survey," Journal of Diabetes and Its Complications, 19, 7.

59. Saaddine, J. B., et al. (1999), "Prevalence of Self-Rated Visal Impairment among Adults with Diabetes," Am J Public Health, 89, 1200-1205.

60. Raeven Faye Chandler and Shannon M. Monnat. Racial/Ethnic Differences in Use of Health Care Services for Diabetes Management. Health Educ Behav. 2015; 42(6): 783-792

61. Tung EL, Baig AA, Huang ES, et.al. Racial and Ethnic Disparities in Diabetes Screening Between Asian Americans and Other Adults: BRFSS 2012-2014. J Gen Intern Med. 2016 Nov 15.

62. Rao, J. N. K., and Scott, A. J. (1981), "The Analysis of Categorical Data from Complex Sample Surveys: Chi-Squared Tests for Goodness-of-Fit and Independence in Two-Way Tables.," Journal of the American Statistical Association, 76, 221-230.

63. Rao, J. N. K., and Scott, A. J. (1984), "On Chi-Squared Tests for Multi-Way Tables with Cell Proportions Estimated from Survey Data.," Annals of Statistics, 12, 46-60.

64. Rao, J. N. K., and Scott, A. J. (1987), "On Simple Adjustments to Chi-Squared Tests with Survey Data.," Annals of Statistics, 15, 385-397.

65. Bowlin, S., et al. (1993), "Validity of Cardiovascular Disease Risk Factors Assessed by Telephone Survey: The Behavioral Risk Factor Survey.," *J Clin Epidemiol*, 46, 561-571.

66. Karter, A. J., Ferara, A., Darbinian, J. A., Ackerson, L. M., and Selby, J. V. (2000), "Self-Monitoring of Blood Glucose: Language and Financial Barriers in a Managed Care Population with Diabetes.," *Diabetes Care*, 23, 477-483.

67. Karter, A. J., et al. (2001), Self-Monitoring of Blood Glucose Levels and Glycemic Control: The Northern California Kaiser Permanente Diabetes Registry. *Am J Med*, 111, 1-9.