

Original Article

Diabetes retinopathy and related health management in Asians versus whites using BRFSS 2005-2017 data

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Abstract: Purpose: Asian Americans had high rate of type 2 diabetes and less risk for diabetes complications compared to white. The purpose of this study was to examine diabetic retinopathy and related healthcare management among Asian American adults with diabetes. Materials and method: Asian and white type 2 diabetes participants from 2005-2017 Behavioral Risk Factor Surveillance System (BRFSS) data were used to perform the analysis. SAS 9.4 survey procedures were used to conduct the statistical test. Health care management variables (self-blood sugar check, eye check and HbA1C check with doctors, health care professional visit) were analyzed and compared between Asian and white. Results: During 2005-2017, diabetic retinopathy (DR) rate among Asian Americans was 10% higher than white, and Asian Americans was more than 100% more likely to develop DR compared to white. Asian Americans was less likely to check their blood sugar once a day ($P < 0.05$ for all years except 2005 and 2007) and more likely to see the health care professional and perform eye and HbA1C check even the relationship was not statistically significant. After adjusting all the demo-social factors and health care management factors, Asian still had higher rate of DR compared to white. Conclusion: Asian Americans had higher rate of DR rate compared to white. Asian and white all had low rate of selfcare of blood sugar. Interventions for DR need to apply among Asian population.

Keywords: Diabetes, diabetes retinopathy, health care management, Asian, white

Introduction

National Health and Nutrition Examination Survey (NHANES) data showed that total 28.2 million (12.5%) U.S. population aged 20 or older has diabetes [1, 2] and more than 61% of type 2 diabetes patients develops retinopathy eventually, where up to 21% have retinopathy at the time of first diagnosis of diabetes [3]. Diabetic retinopathy (DR), the most common diabetes complication, constitutes a serious cause of irreversible blindness. The same research showed that DR contributed 86% of blindness [4, 5]. Disparities on incidence of diabetes has been observed between whites (7.1%) and Asians (8.4%) [6]. The same study also showed that there was racial/ethnic disparity for diabetes complications. Asian Americans had lower risk for cardiovascular disease (CVD), higher risk of end-stage renal disease and lower risk of retinopathy compared to whites. And other research reported that minority such

as Non-Hispanic Black and Mexican Americans have higher rate of DR [7, 8]. Apparently, there was no consistent research findings for DR in Asian population. Some researchers reported that DR rate was 23% in mainland China which is lower than 34.6% globally [9, 10]. Furthermore, the U.K. Asian Diabetes Study (UKADS) [11] didn't find out significant difference of DR prevalence either. However, other studies [12-14] showed that South Asian is about 1.5 times more likely to have DR compare to Caucasians.

Several risk factors such as age and diabetes diagnostic age, health behaviors and health care access can contribute to the diabetes complications. Therefore, 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 complications and its mortality. Studies [4] showed

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that the risk factors for DR includes duration of the diabetes, glycemic control, blood pressure control as well as the eye care utilization. The onset age of diabetes and the duration of the diabetes is the strongest risk factor for DR. The U.K. Prospective Diabetes Study (UKPDS) [11] showed that intensive therapy to control blood glucose decreased the microvascular complication overall rate by 25% and the risk of microvascular complication reduced 35% for one unit decreasing in HbA1c. Randomized control trial [15] administered tight and less tight blood pressure control to diabetes patients with hypertension demonstrated that the patients with tight blood pressure control had 34% reduction in retinopathy with a median 8.4 years follow up. Later, other study [16] showed that the intensive blood pressure control didn't significantly reduce the DR compared to moderate blood pressure control. Our previous study [17] showed that Asian Americans were less likely to check their blood glucose every day. Other studies also showed that Asian Americans had lower insulin secretion and higher degree of insulin resistance [7, 18-20]. Additionally, compared to whites, minorities with diabetes were less likely to check their eyes [21].

This study was to examine the trend of DR from 2005 to 2017 in both Asian Americans and whites. We also checked the preventive healthcare utilization for DR in both Asian American and Non-Hispanic white and assessed racial/ethnic differences between these two groups. The 2005-2017 Behavioral Risk Factor Surveillance System (BRFSS) data were used to perform our analysis. BRFSS data were consistently used to provide valid and reliable estimates compared with other national household surveys.

Research methods

Data source

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. It gathered 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) [22]. The

participants aged 18 and older from 2005 to 2017 were included in this study and all the data are from self-reported responses. Finally, a total 502470 type 2 diabetic participants were used for our final analyses which included 9682 Asians and 492788 whites.

Variables

Ethnicity in BRFSS was coded as Hispanic or non-Hispanic and only non-Hispanic white and Asian Americans were included in this study. 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 [23, 24]. 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.

The preventive health care utilization for diabetes and DR included four parts: 1) Personally manage their diabetes by checking blood sugar every day: if they reported checking their blood sugar levels at least once a day. 2) If they visited a doctor, nurse or other healthcare professional for diabetes within past year, 3) If they checked eye by doctor within past year, and 4) If they checked their HbA1C less than twice a year.

Statistical analysis

Characteristics of Asians versus Non-Hispanic whites were compared overall which include age, gender, access to health care and U.S. born. Two samples t tests were used to compare continuous variables and Rao-Scott chi-square tests were used to compare categorical variables to accommodate the complex survey design. The logistic regression model was constructed to assess the age adjusted percentage change of DR and preventive healthcare use variables for each year period in each

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Table 1. Characteristics Comparison between Asians and Whites BRFSS 2005-2017

	Asian percentage (SE)	White percentage (SE)	P value*
Age	57.8 (0.4)	61.8 (0.1)	<0.0001
Diagnostic age	47.7 (0.4)	51.8 (0.1)	<0.0001
Marriage status			<0.0001
Married	73.1 (1.1)	59.9 (0.1)	
Never married	9.8 (0.7)	9.5 (0.1)	
Previously married	17.1 (0.9)	30.6 (0.1)	
Income			<0.0001
<25000	30.0 (1.2)	34.4 (0.1)	
25000-50000	21.4 (1.1)	29.08 (0.1)	
≥50000	48.6 (1.3)	36.6 (0.1)	
Education			<0.0001
<High school	8.4 (0.7)	13.5 (0.1)	
High school graduate	19.2 (1.0)	34.6 (0.1)	
Some college or more	72.4 (1.2)	51.9 (0.1)	
Employed	55.3 (1.2)	38.1 (0.1)	<0.0001
Obese yes	7.0 (0.6)	31.4 (0.1)	<0.0001
Drinker Yes	4.0 (0.5)	5.8 (0.1)	0.001
Smoke			<0.0001
Current	9.0 (0.7)	15.3 (0.1)	
Former	25.22 (1.1)	40.73 (0.1)	
None	65.8 (1.2)	44.0 (0.1)	

*P<0.05 was considered as statistically significant.

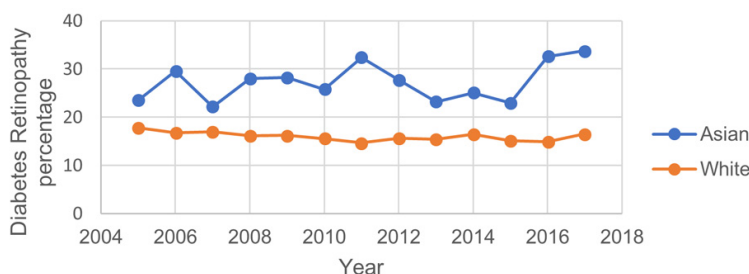


Figure 1. Diabetes retinopathy comparison between Asian and white 2005-2017.

group and overall population. The model was weighted to consider the complex survey design and different weight variables may be applied because of different survey design. Multivariate logistic regression models were constructed to determine if there is 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. SAS version 9.4 survey procedure was used for the data analyses and P<0.05 was defined as statistically significant.

Results

Characteristics comparison between Asian and white (**Table 1**) showed that the mean age and type 2 diabetes diagnostic age in Asian Americans were 57.8 years and 47.7 years, respectively, while the age and type 2 diabetes diagnostic age in white were 61.8 years and 51.8 years, respectively. The proportion of married in Asians was 73.1% which was significantly higher than 60.0% in white (P<0.0001). Asians who were currently employed was 55.3% and 72.4% had some college or more compared to 38.1% and 51.9%, respectively for whites (P<0.0001). Overall, 48.6% of Asian had household income above \$50,000 compared to 37.0% of white (P<0.0001). Proportion of non-smoker among Asians was 66.0% compared to white (44.0%) (P<0.0001) and less than 4.0% of Asian was alcohol drinker while almost 6.0% of white defined themselves as alcohol drinker (P=0.001). Proportion of obesity in Asians was less than 7% compared to white (32.0%) (P<0.0001).

Figure 1 showed that Asian Americans had higher DR rate all over the 13 years compared to whites. **Table 2** showed that the overall DR rate in Asian within 13 years assessed was 27.0% while the overall DR rate in white was only less than 17.0%. Moreover, the Asian population was from 38.0% more (2007) likely to develop DR to 178.0% more (2011) likely to develop DR and the differences were statistically significant at most of the years. After adjusting the age, obese status and other demographic characteristics, the significant differences remain.

Figure 2 showed that Asian Americans with type 2 diabetes were less likely to check their blood sugar at least once a day compared to

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Table 2. The diabetes retinopathy comparison between asian and white BRFSS 2005-2017

Year	Asian	White	Raw Odds ratio (95% CI)	Adjusted odds ratio* (95% CI)	Adjusted odds ratio* (95% CI)
2005	23.5 (5.9)	17.8 (0.5)	1.4 (0.7-2.7)	1.9 (0.9-4.0)	1.7 (0.7-4.0)
2006	29.6 (5.8)	16.8 (0.5)	2.1 (1.2-3.6)	2.6 (1.4-4.9)	2.7 (1.4-5.1)
2007	22.1 (5.7)	17.0 (0.4)	1.4 (0.7-2.7)	1.7 (0.8-3.6)	1.1 (0.6-2.3)
2008	28.0 (5.6)	16.1 (0.4)	2.0 (1.2-3.5)	2.1 (1.2-3.8)	2.1 (1.2-3.9)
2009	28.3 (4.9)	16.3 (0.4)	2.0 (1.3-3.3)	2.4 (1.4-4.1)	2.1 (1.2-3.7)
2010	25.8 (4.5)	15.5 (0.4)	1.9 (1.2-3.0)	2.6 (1.6-4.2)	2.4 (1.5-4.1)
2011	32.4 (4.7)	14.7 (0.7)	2.8 (1.8-4.3)	3.5 (1.9-6.3)	2.9 (1.6-5.4)
2012	27.7 (4.2)	15.6 (0.4)	2.1 (1.4-3.1)	2.0 (1.2-3.4)	2.0 (1.2-3.4)
2013	23.2 (4.1)	15.4 (0.4)	1.7 (1.1-2.6)	2.4 (1.4-4.2)	3.1 (1.7-5.6)
2014	25.0 (4.5)	16.5 (0.5)	1.7 (1.1-2.7)	1.8 (1.0-3.5)	1.8 (0.9-3.7)
2015	23.0 (3.1)	15.1 (0.4)	1.7 (1.2-2.4)	2.3 (1.5-3.8)	2.4 (1.4-4.1)
2016	32.6 (10.1)	14.9 (0.8)	2.8 (1.1-6.9)	5.0 (1.5-16.8)	4.7 (1.3-17.2)
2017	33.9 (6.2)	16.6 (0.5)	2.6 (1.5-4.4)	2.3 (1.5-3.7)	2.5 (1.5-4.1)
Overall	27.1 (1.6)	16.2 (0.1)	1.9 (1.6-2.3)	2.3 (1.9-2.7)	2.2 (1.8-2.6)

*CI not including 1 was considered as statistically significant.

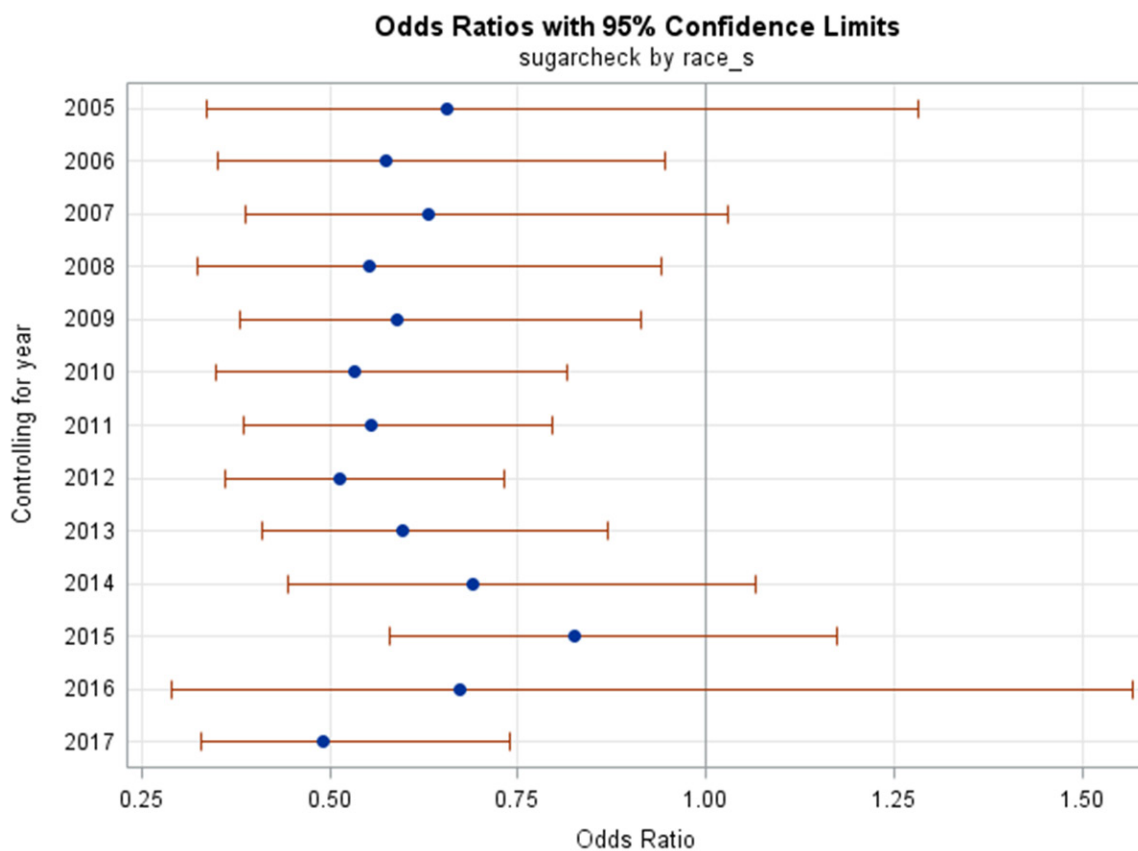


Figure 2. It showed the comparison of sugar check between Asian and white in BRFSS data from 2005 to 2017.

white. The odds ratio between Asian and white was from 0.5-0.8 and the odds ratio was significantly lower than 1 at 8 out of 13 years. **Figures**

3 and **4** showed that Asians were more likely to see doctors, nurses or other health care professionals and check their eyes with health pro-

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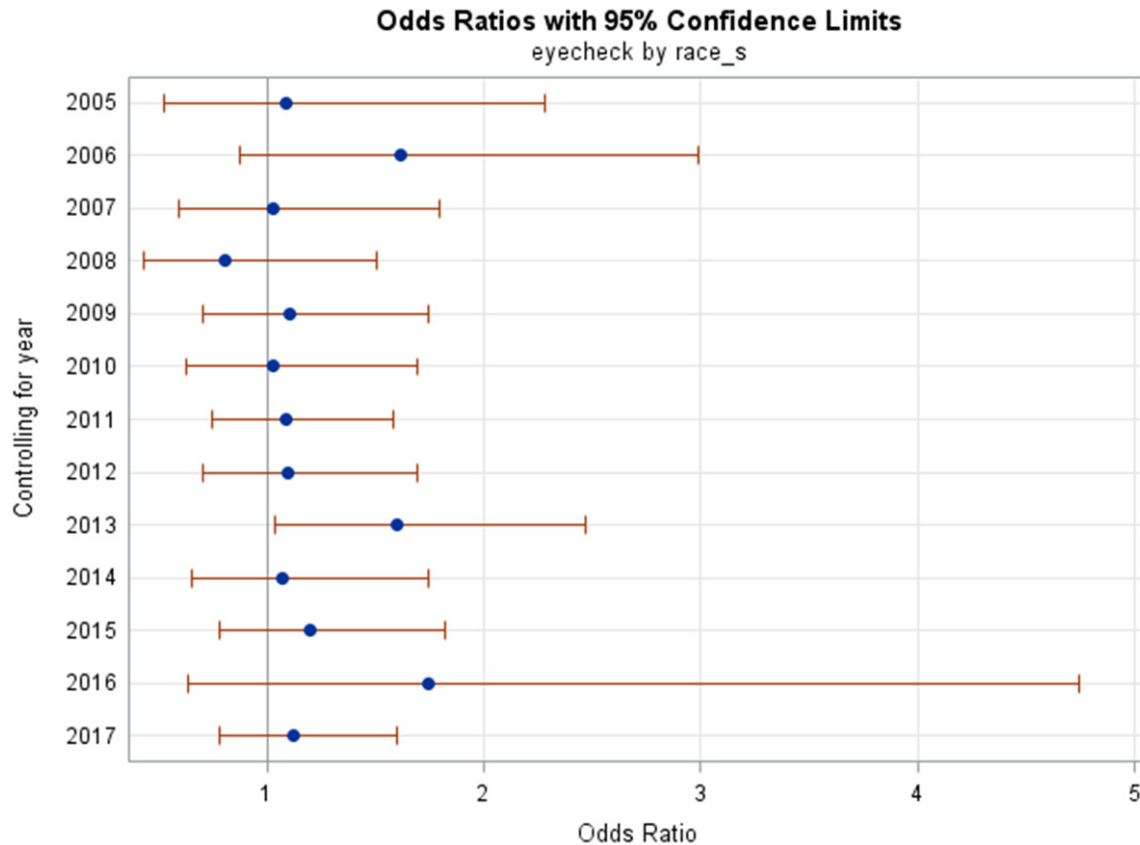


Figure 3. It showed the comparison of eye check between Asian and white in BRFSS data from 2005 to 2017.

professionals at most of the year while the differences between Asian and white were not significant. **Figure 5** showed the comparison between Asian and white if the participants check their HbA1C at least twice a year. No significant differences were found for HbA1C check. **Table 2** also showed that the DR rate differences between Asian and white stayed the same trend after the personal or professional health care prevention utilization.

Discussion and recommendation

This study using the latest BRFSS data provided the knowledge on trend of DR in Asian Americans in US national level. There were no significant rate changes in DR from 2005 to 2017 in both Asian Americans and whites. Surprisingly, an increase trend was observed in 2016 and 2017 in Asian Americans. One study [25] found a decrease trend of DR in African Americans using same dataset and this outcome may result from the improved eye problem treatment and detection. Another possible reason is the local intervention application.

North Carolina has been very actively and productively to improve the eye care access [26-29]. To our knowledge, our study is the first one to assess the DR trend in Asian Americans. The reasons for the increase trend in Asian Americans need to be further examined. Our study also showed that the DR raw rate in Asian was more than 10% higher than white and the Asian Americans were 93% more likely to develop DR compare to White. After adjusting the demographic characteristics and obese status as well as the health care preventive variables, Asian Americans were even more likely to develop DR compare to white. Our findings were not consistent with the findings from the study in United Kingdom where Asians had lower risk of DR compare to white even after adjusting for all the DR risk factors [8]. The possible reason may attribute to the different population composition. The same study showed that the DR prevalence in the minorities with diabetes in non-US counties were lower compared to diabetic minorities in US.

To further examine what factors may have contributed to the high rate of DR in Asian

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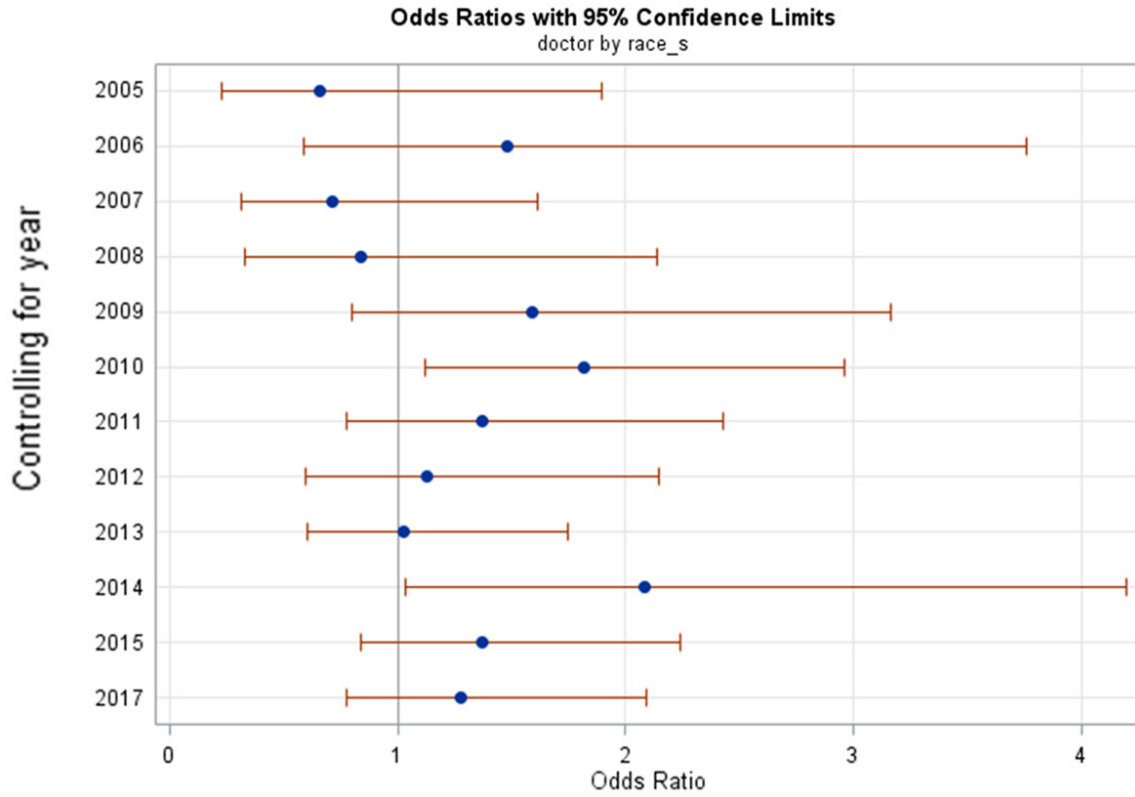


Figure 4. It showed the comparison of seeing health professionals between Asian and white in BRFSS data from 2005 to 2017.

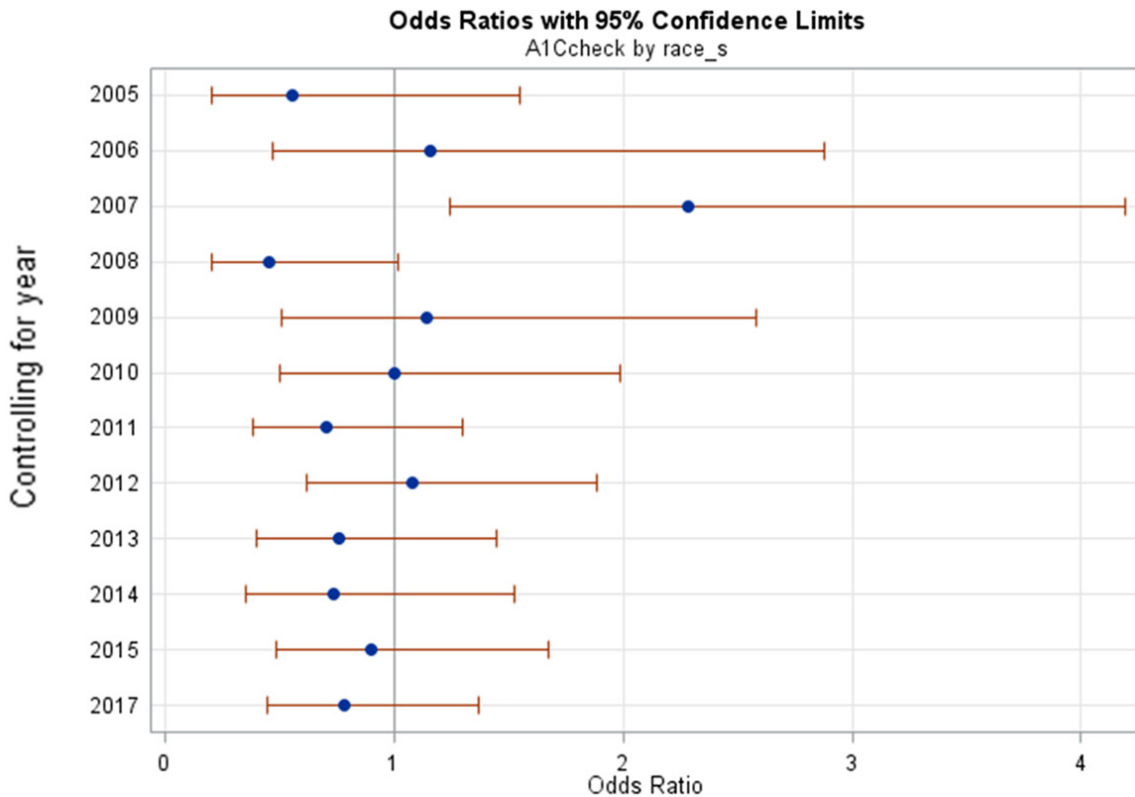


Figure 5. It showed the comparison of HbA1C check between Asian and white in BRFSS data from 2005 to 2017.

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Americans, we examined some possible health care utilization and compared with whites. The results implied that Asian Americans were less likely to check their blood sugar every day. The blood sugar everyday checking rate in Asian Americans was around 45% compared to 55% in whites. Almost 50% of the type 2 diabetes participants didn't check their blood sugar once a day. The results showed that more than 90% of both Asian and white were checking their HbA1C at least twice a year from 2006 to 2017. Blood sugar level is a short-term sign to measure the diabetes management which can affect the diabetes complications. Intervention strategy are needed to improve the everyday blood sugar checking and reduce the related diabetes complications. Our study also showed that the eye check rate within a year was around 70% in both Asiana and White and Asian population was more likely to check their eyes or go to health care professionals compare to their white counterparts. One possibility is that the people who suffered from DR badly were more likely to check their eyes with doctors. After adjusted all the health care utilization factors, the DR rate was still higher than white. To our knowledge. Very few studies [17, 30, 31] had focused on the healthcare utilization in Asian diabetes population and examine the effect of these health care utilization on DR. Our study can provide useful information to further examine all possible risk factors of DR in Asian and develop effective intervention to lower DR rate among Asian American population.

Limitation

First, all the variables included in this study such as the type 2 diabetes status are based on self-reported responses and did not verify by medical record. Secondly, the sample size for Asian and white had a big difference which may result in bias of estimation. Large Asian sample data needs to be used to examine the DR rate and its related risk factors. Thirdly, the Asian race in BRFSS data included multiple races such as South Asian and East Asian and the diabetes and diabetes complications rate had been reported differently distributed between South Asian and East Asian.

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Disclosure of conflict of interest

None.

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