**Prevalence and risk profile of retinopathy in non-diabetic
subjects: National Health and Nutrition Examination Survey
2005 to 2008**

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Short running title: Retinopathy in non-diabetic subjects

Received 8 March 2019; accepted 13 July 2019

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: [10.1111/ceo.13595](https://doi.org/10.1111/ceo.13595)

Funding sources / Financial disclosure: The present work was supported by Fundamental Research Funds of the State Key Laboratory in Ophthalmology. Prof. Mingguang He receives support from the University of Melbourne at Research Accelerator Program and the CERA Foundation. The Centre for Eye Research Australia receives Operational Infrastructure Support from the Victorian State Government. The sponsor or funding organization had no role in the design or conduct of this research. Conflict of interest: None

ABSTRACT

Importance: Recent U.S. national population-based data on the prevalence of retinopathy in non-diabetic participants is limited.

Background: To assess the prevalence and risk factors for retinopathy in a representative U.S. population without diabetes.

Design: Population-based, cross-sectional study.

Participants: A total of 4,354 non-diabetic participants 40 years and older with valid fundus photographs in the 2005 to 2008 National Health and Nutrition Examination Survey (NHANES).

Methods: Diabetes mellitus was defined as glycosylated hemoglobin $\geq 6.5\%$, physician diagnosis of diabetes mellitus, or use of diabetic medication. Retinopathy level was based on the Modified Airlie House adaptation from the Early Treatment Diabetic Retinopathy Study (ETDRS) protocol. Risk profile was assessed from standardized interviews, clinical examinations and laboratory measurements.

Main Outcome Measures: Prevalence and risk profile of retinopathy in non-diabetic participants.

Results: The overall weighted prevalence of retinopathy was 6.7% (n = 341). Among

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them, 98.2% (n = 331) had signs of minimal-to-mild non-proliferative retinopathy (ETDRS level 14-31) while only 1.8% (n = 10) had moderate-to-severe non-proliferative retinopathy (ETDRS level 41-51). After adjusting for multiple covariates, retinopathy signs in non-diabetic participants were associated with male gender (odds ratio[OR], 1.54; 95% Confidence Interval[CI], 1.22 to 1.93), systolic blood pressure (OR per 10 mmHg increase, 1.11; 95% CI, 1.03 to 1.19), HbA1c (OR per % increase, 1.43; 95% CI, 1.01 to 2.05), and history of stroke (OR, 2.39; 95% CI, 1.14 to 5.04).

Conclusions and relevance: Consistent with previous studies, signs of retinopathy are common in U.S. persons without diabetes. Risk factors for retinopathy signs include gender, blood pressure, HbA1c and history of stroke.

Keywords: retinopathy prevalence; non-diabetic subjects; risk profile.

1. INTRODUCTION

There is increasing evidence that lesions associated with retinopathy (e.g., microaneurysms, soft/hard exudates, and/or retinal hemorrhage) are frequently detected in persons without diabetes. According to previous studies,¹⁻⁴ up to 15% of non-diabetic persons showed retinopathy. Despite the documented prevalence of retinopathy in the U.S. non-diabetic population,^{1,5-7} these studies estimated the prevalence of retinopathy from specific ethnicity or several communities conducted in the late 1990s. However, recent national population-based data on the prevalence retinopathy in non-diabetic participants remains scarce.

Unlike established risk profiles for diabetic retinopathy, risk factors for retinopathy signs among participants without diabetes have not been consistent across diverse populations. Several studies have reported associations between retinopathy and various cardiovascular risk factors, such as hypertension^{5,8,9} and obesity.^{9,10} While other studies have shown independent risk factors for retinopathy in non-diabetic participants including increased serum glucose,¹⁰⁻¹⁴ increased urinary albumin excretion^{11,12} and systemic markers of inflammation.¹⁵

Therefore, in this study, we investigated the prevalence and risk profile in a recent nationally representative cohort of U.S. residents.

2. METHODS

2.1 Sample and Population

National Health and Nutrition Examination Survey (NHANES) is a national representative survey including a comprehensive in-person interview and extensive examinations conducted every two years. The dataset obtained a representative

sample of the civilian and non-institutionalized U.S. population through a stratified multistage probability design with intentionally oversampling of certain age and racial/ethnicities.^{16 16 16} In the current analysis, we merged the dataset of the NHANES from 2005 to 2008. Written informed consent was obtained from all participants. This research adhered to the tenets of the Declaration of Helsinki, and ethics was approved by the National Center for Health Statistics research ethics review board.

2.2 Assessment of Retinopathy

Non-mydriatic retinal photography was performed using the Canon CR6-45NM Ophthalmic Digital Imaging System and a Canon EOS 10D digital camera (Canon USA Inc., One Canon Park, Melville, New York) for participants over 40 years of age. Fundus photographs were graded at the University of Wisconsin Ocular Epidemiologic Reading Center, Madison. Quality control of images capturing and grading has been described in detail elsewhere.¹⁷ Retinopathy severity was graded according to the Early Treatment Diabetic Retinopathy Study (ETDRS) grading standard: no retinopathy (level 10-13), minimal-to-mild non-proliferative retinopathy (level 14-31), moderate-to-severe retinopathy non-proliferative retinopathy (level 41-51), and proliferative retinopathy (level > 60).¹⁸ If retinal images were available for both eyes, we used the data from the eye with more severe disease status in our analysis.

2.3 Risk Profile Assessment

Risk profile assessment included demographic factors, health-related behaviors, and general health characteristics. Ethnicity was classified as Non-Hispanic White, Non-Hispanic Black, Mexican American, and other. Education level was classified as less than high school degree and equal to or more than high school diploma. Marital status was divided as unmarried and other, or married/with a partner. Poverty income

ratio (PIR) was categorized as below poverty (<1.00) and above poverty (≥ 1.00). Smoking status was defined as two groups: (1) never and (2) former/current smoker. Self-reported alcohol consumption was divided as lifetime abstainer/former drinker, current drinker with equal to or less than 3 drinks per week and those who consumed more than 3 drinks per week. The 2008 Physical Activity Guideline for Americans suggests at least 2.5 hours of moderate-intensity or 75 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate- and vigorous intensity aerobic activity for substantial health benefits.¹⁹ We categorized participants into two groups based on whether the 2008 Physical Activity Guidelines were met or not.

Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. A digital automatic blood pressure monitor was used to measure systolic blood pressure (SBP) and diastolic blood pressure (DBP) and the mean of three measurements was used for analysis. Hypertension was defined as an averaged $SBP \geq 140$ mm Hg, $DBP \geq 90$ mm Hg, physician diagnosis or use of antihypertensive medication.

Non-fasting blood samples and urine samples were collected and sent for analysis of glycosylated hemoglobin levels (HbA1c), glucose, creatinine and serum lipids [total cholesterol, and high-density lipoprotein (HDL)] to a central laboratory (White Sands Research Center, Alamogordo, NM). Diabetes mellitus was characterized as physician diagnosis or the use of insulin/diabetic tablets, or $HbA1c \geq 6.5\%$. Glycemia status was categorized as normoglycemia ($HbA1c < 5.7\%$) and prediabetes ($5.7\% \leq HbA1c \leq 6.49\%$). Individuals were diagnosed as having hyperlipidemia with the total serum cholesterol ≥ 240 mg/dL or the use of a lipid-lowering agent. Individuals with high C-reactive protein (CRP) level was based on a CRP of ≥ 1 mg/dL. Presence of chronic kidney disease (CKD) was defined as estimated glomerular filtration rate (eGFR) < 60

ml/min/1.73 m² or urine albumin-creatinine ratio (ACR) $\geq$ 30mg/g.

2.4 Statistical Analysis

Stata (version 14.0; StataCorp., College Station, TX) was used for all statistical analysis. All analysis took the complex, stratified design of NHANES into account. Sampling weights for the present study were the four-year mobile examination center (MEC) weights. Basic characteristics of the study population with any retinopathy are presented as using means and standard errors (SE) for approximately normally distributed continuous variables and medians and interquartile range (IQR) for skewed continuous variables, and numbers and weighted percentages for categorical variables. We used the design-adjusted t-test or Mann-Whitney test, and Rao-Scott Pearson χ^2 for the comparison of continuous and categorical variables, respectively. Logistic regression models were used to estimate the odds ratios (OR) and 95% confidence intervals (CI) for associations between retinopathy and risk factors. Age and gender-adjusted logistic regression models were used to determine baseline characteristics significantly associated with the presence of any retinopathy. Covariates with $P < 0.1$ in logistic regression analysis considering age and gender were added to final multivariable models. The regression analysis in subgroups stratified by glycemia status and hypertension were repeated. All comparisons used a two-sided significance level of 5%.

3. RESULTS

A total of 6,797 participants aged 40 years or older participated in the NHANES 2005-2008. Among these individuals, 2,443 participants were excluded because of missing information on diabetes mellitus status ($n = 272$), diagnosis of diabetes

mellitus ($n = 1,424$), missing or ungradable photographs in both eyes ($n = 668$), those with advanced retinopathy that might be a result of diabetes status misclassification ($n = 0$), and retinopathy due to other specific non-diabetic disease ($n = 79$, e.g. retinal vein occlusion). This left a final sample of 4,354 (72.2%; 2163 [47.0%] men; 2517 [79.6%] white; mean [SE] age, 55.6 [0.4] years) participants for analysis. Compared with included participants, excluded participants were likely to be older, black ethnicity, less educated, unmarried, in lower income level, abstainer/former drinker and unhealthier. Demographic, health-related behaviors and characteristics of excluded and included subjects are shown in Supplement Table 1.

Table 1 illustrates the characteristics of non-diabetic participants by overall and retinopathy status. The weighted prevalence of any retinopathy was 6.7% (95% confidence interval [CI], 5.9% to 7.6%, $n = 341$). Among them, 331 (weighted prevalence: 98.2%; 95% CI, 96.4% to 99.1%) of these 341 participants had minimal-to-mild retinopathy, and only 10 (weighted prevalence: 1.8%; 95% CI, 0.9% to 3.6%) had moderate-to-severe retinopathy. Retinopathy signs were present in 5.9% (95% CI, 5.0% to 7.0%) of participants with normoglycemia and 8.8% (95% CI, 7.4% to 10.5%) of those with prediabetes. The weighted prevalence of any retinopathy was 5.4% (95% CI, 4.4% to 6.5%) and 8.5% (95% CI, 7.2% to 10.2%) for those without and with hypertension respectively. Figure 1 shows the weighted prevalence of retinopathy stratified by glycemia and hypertension status among persons without diabetes. The weighted prevalence of retinopathy in normotensive and normoglycemia group was approximately 5.4% (95% CI, 4.2% to 6.9%) and increased to 12.5% (95% CI, 9.7% to 16.0%) in the hypertensive and prediabetes group ($P_{\text{trend}} < 0.001$). Figure 2 illustrates the relationship between level of HbA1c (a) SBP (b) and retinopathy in participants without diabetes. The weighted prevalence of retinopathy for those with a HbA1c $\leq 4.5\%$ was 5.4% (95% CI, 2.0% to 13.3%) and

increased linearly ($P_{\text{trend}} = 0.007$). Similarly, the prevalence of retinopathy at SBP < 100mmHg was 2.7% (95% CI, 1.1% to 6.4%) and increased gradually with increasing levels of SBP ($P_{\text{trend}} < 0.001$).

Table 2 provides the age and gender adjusted logistic regression models. Retinopathy signs were associated with ethnicity, education level, hypertension, SBP, DBP, HbA1c, CKD and history of stroke. After adjusting for multiple covariates selected from age and gender adjusted models, male gender (OR, 1.54; 95% CI, 1.22 to 1.93), systolic blood pressure (OR per 10 mmHg increase, 1.11; 95% CI, 1.03 to 1.19), HbA1c (OR per % increase, 1.43; 95% CI, 1.01 to 2.05), and history of stroke (OR, 2.39; 95% CI, 1.14 to 5.04) were independently associated with retinopathy (Table 3). When data was stratified by hypertension or glycemia status the results remained consistent and showed male gender, BP and history of stroke were associated with retinopathy (Supplement Table 2).

4. DISCUSSION

The results of this study showed that 6.7% of people aged 40 years and older in the U.S without diabetes showed signs of retinopathy with the majority having minimal-to-mild non-proliferative retinopathy. Male gender, SBP, HbA1c and history of stroke were independently associated with risk of retinopathy.

The frequent presence of retinopathy among those without diabetes in the U.S. population (6.7%) is consistent with prevalence reported by the Singapore Indian Eye Study (5.05%),¹² Singapore Malay Eye Study (6%),¹³ and Los Angeles Latino Eye Study (6.6%).⁵ In contrast, it was lower than some studies which have reported the prevalence of retinopathy to range between 7.3% and 14.8%.^{4,8-11,14,15,20-22} The difference in prevalence may arise from differences in population characteristics, study

period, diagnosis of clinical diabetes, method of capturing fundus photography and grading methods. Supplement Table 3 summarizes the prevalence of retinopathy in persons without diabetes from different studies.

In our study, higher HbA1c was significantly associated with retinopathy lesions, even when adjustments were made for covariates. Moreover, a positive relationship between higher HbA1c and retinopathy signs was observed. This finding was supported by previous studies,^{11-14,23-25} suggesting that microvascular damage in the retina was associated with impaired glucose metabolism. We also supported the previous evidence of a strong association between retinopathy and blood pressure^{8,11,15,26,27} and this significant association still persisted in participants with normoglycemia or with prediabetes. Similar to HbA1c, we also showed that prevalence of retinopathy increased in a positive linear pattern as SBP increased. These findings indicate that retinopathy signs might be associated with blood pressure dysfunction. However, in our study, retinopathy prevalence was as high as 5.4% in non-diabetic persons with normal blood pressure. These findings suggest that only a proportion of non-diabetic patients with retinopathy could be explained by blood pressure and glucose metabolism. Furthermore, we highlighted the contribution history of stroke has on the presence of retinopathy in non-diabetic persons. This observation was in line with other studies,^{2,8,13,22} indicating that retinopathy signs may signal adverse cardiovascular risk profile.

Our study also found that the prevalence of retinopathy in non-diabetic participants was significantly higher in men, which was consistent with previous reports from Los Angeles Latino Eye Study, Handan Eye Study, and Tromsø Eye Study.^{5,11,14} On the contrary to the several studies, we did not find significant associations between retinopathy and obesity,^{5,9,10,13,15} hyperlipidemia,¹⁵ serum creatinine¹² and inflammatory markers.²⁸ Summary of the risk profile found in the

previous studies have also shown in Supplement Table 3.

Although 98.2% of retinopathy in participants without diabetes was minimal-to-mild non-proliferative retinopathy, which may be transient and not sight-threatening,^{29,30} the frequency of retinopathy among participants without diabetes might challenge the current criteria for diabetes and hypertension. Recent studies documented that retinopathy signs may predict subsequent risk of clinical diabetes and hypertension.^{31,32} The Atherosclerosis Risk In Communities study indicated that retinopathy among non-diabetic participants with a family history of diabetes was an independent predictor of subsequent risk of clinical diabetes.³¹ Similarly, retinopathy signs were significantly associated with the incidence of hypertension and, in persons younger than 65 years, with the incidence of diabetes mellitus in the Beaver Dam Eye Study.³² Findings from this study have found an association between retinopathy and cardiovascular risk factors. In addition, this association of cardiovascular events and mortality³³⁻³⁸ has been found in previous studies which may have important clinical implications. For example, the presence of retinopathy signs may be a key indicator of microvascular dysfunction.³⁹⁻⁴² Further investigations on the clinical implication and pathophysiology of retinopathy among non-diabetic participants are warranted.

The strength of this study is the inclusion of a large population-based national sample, comprehensive assessment of risk profiles, a large proportion of gradable fundus images, diagnosis of retinopathy status for both eyes and use of standardized photographic grading protocols. There are several potential limitations which warrant consideration. Firstly, the healthy effect may be a concern in the current analysis. Supplement Table 1 suggested a healthy participant effect that might lead to underestimation of the retinopathy prevalence. Secondly, due to the cross-sectional design in our study, we could not evaluate the direction of causality. Furthermore, the

significant associations between retinopathy and risk factors need confirmation from further longitudinal studies.

In conclusion, 6.7% of the U.S. population without diabetes have retinopathy, mostly minimal-to-mild in severity. Male gender, SBP, HbA1c and history of stroke increased the odds for retinopathy signs in non-diabetic participants. Given the potential underlying adverse vascular risk profile of retinopathy, further studies are needed to clarify the natural history and underlying mechanisms of retinopathy among persons without diabetes.

Abbreviations and Acronyms

NHANES = National Health and Nutrition Examination Survey; **ETDRS** = Early Treatment Diabetic Retinopathy Study; **SBP** = systolic blood pressure; **DBP** = diastolic blood pressure; **HDL** = high-density lipoprotein; **HbA1c** = glycosylated hemoglobin levels; **BMI** = body mass index, **CRP** = C-reactive protein; **PIR** = poverty income ratio; **CKD** = chronic kidney disease; **eGFR** = estimated glomerular filtration rate; **ACR** = albumin-creatinine ratio; **MEC** = mobile examination center; **SE** = standard errors; **IQR** = interquartile range; **OR** = odds ratios; **CI** = confidence interval.

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FIGURES

Figure 1: The weighted prevalence of retinopathy stratified by glycemia and hypertension status among persons without diabetes. The weighted prevalence of retinopathy in normotensive and normoglycemia group was approximately 5.4% (95% CI, 4.2% to 6.9%) and increased to 12.5% (95% CI, 9.7% to 16.0%) in hypertensive and prediabetes group ($P_{\text{trend}} < 0.001$). Error bars represent ± 1 SEM.

Figure 2: Relation between level of HbA1c (A) or SBP (B) and retinopathy in participants without diabetes. The weighted prevalence of retinopathy at HbA1c $\leq 4.5\%$ is 5.4% (95% CI, 2.0% to 13.3%) and increases in a linear pattern ($P_{\text{trend}} = 0.007$). The prevalence of retinopathy at SBP $< 100\text{mmHg}$ is 2.7% (95% CI, 1.1% to 6.4%) and increases gradually with increasing levels of SBP ($P_{\text{trend}} < 0.001$). Error bars represent ± 1 SEM.

TABLES

Table 1: Demographic, Health-Related Behaviors and General Health Characteristics of Non-Diabetic Participants With and Without Retinopathy ^a

Characteristics	Overall, N=4,354	No Retinopathy, n = 4,013 (%)	Any Retinopathy, n = 341 (%)	Unadjusted P Value ^b
Age mean±SE, yrs	55.6 ± 0.39	55.4 ± 0.38	58.7 ± 1.16	0.004
Male sex	2,163 (47.0)	1,969 (46.4)	194 (55.8)	0.003
Race				
Non-Hispanic white	2,517 (79.6)	2,343 (80.0)	174 (74.0)	0.23
Non-Hispanic black	761 (7.9)	685 (7.8)	76 (9.9)	
Mexican American	639 (5.0)	586 (4.9)	53 (5.9)	
Other	437 (7.5)	399 (7.3)	38 (10.2)	
High school and over education	3,206 (83.7)	2,977 (84.1)	229 (79.3)	0.01
Married/with a partner	2,806 (69.8)	2,584 (69.7)	222 (70.9)	0.65
Income at or above poverty	3,488 (91.5)	3,206 (91.4)	282 (93.1)	0.36
Former/current smoker	2,273 (51.1)	2,085 (50.7)	188 (56.4)	0.10
Alcohol consumption				
Abstainer/former drinker	958 (18.4)	870 (17.8)	88 (26.3)	0.01
Current drinker (≤3 drinks/week)	2,326 (55.8)	2,161 (56.5)	165 (45.9)	
Current drinker (>3 drinks/week)	987 (25.8)	905 (25.7)	82 (27.9)	
Meet PA recommendation	2,279 (70.2)	2,117 (70.2)	162 (69.7)	0.91
Blood pressure				
Hypertension	1,908 (39.2)	1,708 (38.4)	200 (50.8)	0.002
Systolic mean±SE, mmHg	125.2 ± 0.45	124.8 ± 0.46	130.3 ± 1.29	<0.001
Diastolic mean±SE, mmHg	72.9 ± 0.28	72.8 ± 0.28	73.5 ± 0.77	0.40
Serum lipids				
Hyperlipidemia	1,537 (35.2)	1,415 (35.1)	122 (35.7)	0.83
Total cholesterol mean±SE, mg/dL	206.4 ± 0.80	206.7 ± 0.81	201.1 ± 3.54	0.13
HDL mean±SE, mg/dL	55.0 ± 0.39	55.0 ± 0.40	54.1 ± 0.97	0.38
HbA1c median (IQR), %	5.4 (5.2-5.7)	5.4 (5.2-5.7)	5.5 (5.2-5.7)	0.003

Nonfasting glucose <u>median (IQR)</u> , mg/dL	93 (86-101)	92 (86-101)	93 (86-103)	0.38
Body Mass Index mean $\pm$ SE, kg/m ²	28.5 $\pm$ 0.14	28.5 $\pm$ 0.15	28.4 $\pm$ 0.35	0.79
Waist circumference mean $\pm$ SE, cm	98.7 $\pm$ 0.37	98.7 $\pm$ 0.39	99.6 $\pm$ 1.04	0.43
High CRP	436 (9.3)	401 (9.4)	35 (7.7)	0.28
Self-reported				
Congestive heart failure	127 (2.1)	114 (2.1)	13 (2.9)	0.35
coronary heart disease	194 (3.7)	168 (3.5)	26 (6.2)	0.09
angina	134 (2.6)	118 (2.5)	16 (4.0)	0.15
heart attack	203 (3.6)	180 (3.5)	23 (4.7)	0.36
stroke	165 (2.9)	135 (2.6)	30 (7.4)	0.02
Renal function				
Serum creatinine <u>median (IQR)</u> , mg/dL	0.9 (0.8-1.02)	0.9 (0.8-1.01)	0.9 (0.8-1.07)	0.001
CKD	863 (15.6)	766 (15.1)	97 (23.3)	0.006

Abbreviations: SE, standard error; IQR, interquartile range; PA, physical activity; HDL, high-density lipoprotein cholesterol; CRP, C-reactive protein; CKD, chronic kidney disease. Boldface indicates statistical significance ($P < 0.05$).

^a All proportions are weighted estimates of the US population characteristics, taking into account the complex sampling design of the National Health and Nutrition Examination Survey.

^b All P values were calculated using t-test for continuous variables and the design-adjusted Rao-Scott Pearson χ^2 test for categorical variables.

Table 2: Age- and Gender-Adjusted Logistic Regression Models for Non-Diabetic Participants ^a

Characteristics	Age- and Gender-Adjusted OR (95% CI)	P Value
Age, per 1 yrs increase	1.02 (1.01-1.04)	0.002
Male vs female	1.50 (1.18-1.90)	0.002
Race		
Non-Hispanic white	1.00	0.01
Non-Hispanic black	1.52 (1.02-2.27)	
Mexican American	1.48 (1.00-2.21)	
Other	1.69 (0.97-2.92)	
High school and over education vs less	0.79 (0.61-1.01)	0.06
Married/with a partner vs unmarried or other	1.07 (0.81-1.42)	0.61
Income at or above poverty vs below poverty	1.21 (0.68-2.14)	0.51
Former/current smoker vs non-smoker	1.16 (0.86-1.56)	0.32
Alcohol consumption		
Abstainer/former drinker	1.00	0.30
Current drinker (≤ 3 drinks/week)	0.56 (0.41-0.79)	
Current drinker (> 3 drinks/week)	0.71 (0.42-1.20)	
Meet PA recommendation vs not meet	0.96 (0.60-1.55)	0.88
Blood pressure		
Hypertension vs normotension	1.46 (1.07-1.99)	0.02
Systolic, per 10 mmHg increase	1.13 (1.06-1.21)	0.001
Diastolic, per 10 mmHg increase	1.11 (0.99-1.25)	0.08
Serum lipids		
Hyperlipidemia vs normolipidemia	0.92 (0.72-1.18)	0.50
Total cholesterol, per 1 mg/dL increase	1.00 (0.99-1.00)	0.27
HDL, per 1 mg/dL increase	1.00 (0.99-1.01)	0.92
HbA1c, per 1% increase	1.50 (1.04-2.16)	0.03

Nonfasting glucose, per 1 mg/dL increase	1.00 (0.99-1.01)	0.74
Body Mass Index, per 1kg/m ² increase	1.00 (0.98-1.02)	0.99
Waist circumference, per 1 cm increase	1.00 (0.99-1.01)	0.97
High CRP vs normal CRP	0.84 (0.55-1.31)	0.44
Self-reported		
Congestive heart failure vs absent	1.05 (0.56-1.94)	0.88
coronary heart disease vs absent	1.26 (0.74-2.15)	0.38
angina vs absent	1.26 (0.69-2.31)	0.44
heart attack vs absent	0.98 (0.60-1.59)	0.93
stroke vs absent	2.50 (1.30-4.81)	0.007
Renal function		
Serum creatinine, per 1 mg/dL increase	1.15 (0.89-1.49)	0.28
CKD vs absent	1.43 (1.04-1.97)	0.03

Abbreviations: OR, odds ratio; PA, physical activity; HDL, high-density lipoprotein cholesterol; CRP, C-reactive protein; CKD, chronic kidney disease. Boldface indicates statistical significance (P<0.1).

^a All proportions are weighted estimates of the US population characteristics, taking into account the complex sampling design of the National Health and Nutrition Examination Survey.

Table 3: Multiple Adjusted Logistic Regression Models for Non-Diabetic Participants ^a

Characteristics	Multiple Adjusted OR (95% CI)	P Value
Age, per 1 yrs increase	1.01 (0.99-1.02)	0.43
Male vs female	1.54 (1.22-1.93)	0.001
Race		
Non-Hispanic white	1.00	
Non-Hispanic black	1.24 (0.87-1.77)	0.23
Mexican American	1.33 (0.86-2.03)	0.19
Other	1.54 (0.87-2.74)	0.13
High school and over education vs less	0.91 (0.68-1.21)	0.49
Hypertension vs normotension	1.13 (0.78-1.64)	0.49
Systolic, per 10 mmHg increase	1.11 (1.03-1.19)	0.006
Diastolic, per 10 mmHg increase	1.00 (0.89-1.13)	0.99
HbA1c, per 1 % increase	1.43 (1.01-2.05)	0.05
Self-reported stroke vs absent	2.39 (1.14-5.04)	0.02
CKD vs absent	1.34 (0.96-1.87)	0.09

Abbreviations: OR, odds ratio; CKD, chronic kidney disease. Boldface indicates statistical significance ($P < 0.05$).

^a All proportions are weighted estimates of the US population characteristics, taking into account the complex sampling design of the National Health and Nutrition Examination Survey.

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Title:

Prevalence and risk profile of retinopathy in non-diabetic subjects: National Health and Nutrition Examination Survey 2005 to 2008

Date:

2019-08-02

Citation:

Zhu, Z., Wang, W., Scheetz, J., Zhang, J. & He, M. (2019). Prevalence and risk profile of retinopathy in non-diabetic subjects: National Health and Nutrition Examination Survey 2005 to 2008. CLINICAL AND EXPERIMENTAL OPHTHALMOLOGY, 47 (9), pp.1173-1181. <https://doi.org/10.1111/ceo.13595>.

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