Published in final edited form as:
Ophthalmology. 2011 July ; 118(7): 1380–1385. doi:10.1016/j.ophtha.2010.11.007.

Prevalence and Risks factors of Age-Related Macular Degeneration in Oklahoma Indians: The Vision Keepers Study

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Abstract

Objective—To determine the prevalence of age-related macular degeneration (AMD) and indentify its risk factors in an Oklahoma Indian population.

Design—Cross sectional study design

Participants—A total of 1019 Oklahoma Indians who participated in baseline and second examinations of the Oklahoma Strong Heart Study were enrolled in Vision Keepers.

Methods—Retinal photographs of at least one eye were taken and graded for AMD by the University of Wisconsin Ocular Epidemiology Reading Center using the Wisconsin Age-Related Maculopathy Grading System. Retinal photographs of 986 participants were considered gradable and included in the study.

Main Outcome Measures—Age-related macular degeneration (early & late).

Results—The overall prevalence of any AMD in the Vision Keepers study was 35.2% including a prevalence of 0.81% for late AMD. The prevalence of early AMD increased from 30.6% in those aged 48–59 years to 46.1% in age group 70–82 years. When potential risk factor was considered individually in the univariate analyses, men with hypertension had significantly higher prevalence of AMD (p=0.02) than those without hypertension. In women high density lipoprotein-cholesterol and sun exposure were positively associated with the prevalence of AMD (p=0.01) while a history of using multivitamins was associated with lower AMD prevalence (p= 0.005). When multiple risk factors were considered simultaneously in the logistic regression analyses, only age showed significant association with AMD in both men (p=0.02) and women (p <0.0001)

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Conflict of interest: None

and was the only significant risk factor in men. In women, multivitamin use and total cholesterol had significant inverse association with AMD while sun exposure and high density lipoprotein cholesterol had positive association. When men and women are combined, age and high density lipoproteincholesterol had significant positive association while total cholesterol and multivitamin use and current alcohol use showed a significant inverse association with AMD.

Conclusion—This study was the first to report detailed prevalence of AMD in Oklahoma Indians and its risk factors. The prevalence appeared to be relatively high as compared to other ethnic groups. Some of the modifiable risk factors identified confirmed previous findings and can be used to design preventive programs to reduce the burden of AMD, though longitudinal data are still needed.

Introduction

Age-related macular degeneration (AMD) is the leading cause of irreversible severe visual loss in developed as well as developing countries among people over 55 years of age[1] and a major cause of severe loss of vision in people over 65 years.[2] According to one estimate in 2006, 29% of the United States population aged 75 years and older has signs of AMD.[3] The baby boom generation is aging, and the proportion of the United States population over the age of 64 years is projected to double in the next 25 years and likely so is the problem of AMD.

Several studies have identified risk factors associated with AMD, but the results have not been consistent.[4–7] (Hyman L HO, Grimson R, et al. Risk factors for age-related maculopathy. Invest Opthalmol Vis Sci 1992;33(suppl):801.) Aside from age[8] and cigarette smoking,[3, 9–11] previous findings of associations between AMD and hypertension,[6, 12] alcohol consumption,[13] systolic blood pressure,[14] sunlight exposure,[15–18] and cardiovascular disease[12, 19] have been inconsistent. The protective role of vitamin C & E, zinc supplements, multivitamins and dietary carotenoids have been investigated in different studies.[3, 6, 20, 21] While the epidemiology of AMD has been well described in whites, blacks and other racial groups, to date, population based data on the epidemiology of this condition in American Indians are lacking. There is a need to assess the burden that AMD poses to the American Indian community. This study reports the prevalence of AMD and its associated risk factors in an American Indian population in Oklahoma.

Methods

The Vision Keepers (VK) study has been described previously.[22] The VK study population was drawn from a cohort of adults who participated in the Strong Heart Study (SHS) in Oklahoma. Details of the SHS and its population have been discussed elsewhere.[23] Briefly, the SHS is a longitudinal study of cardiovascular disease and its risk factors in American Indians in three centers located in, Arizona, Oklahoma and North and South Dakota. Each center recruited at least 1,500 men and women, aged 45–74 years, who were enrolled members of one of the 13 Indian tribes or communities in the three geographical areas: the Gila River, Salt River and Ak-Chin communities in Arizona, the seven tribes of southwestern Oklahoma (Apache, Caddo, Comanche, Delaware, Fort Sill Apache, Kiowa and Wichita); the Oglala and Cheyenne River Sioux in south Dakota; and the Spirit Lake Tribe in the Fort Totten area of North Dakota. A total of 4549 eligible participants completed the baseline examination (1989–1991). Of these participants, 1527 were from Oklahoma, which constituted more than 62% of the total population in the 45–74 age group. Nonparticipants in the Strong Heart Study did not differ significantly from participants in age, body mass index or self-reported diabetes status.[24] The second and third examinations were conducted between 1992 and 1995 and between 1998 and 1999, respectively. Each of

the examinations includes a personal interview for medical history and health habits (e.g., smoking and alcohol use), a physical examination including anthropometric measurements, blood pressure measurements, examination of the heart, lung, pulses and vessels for bruits, and a 12-lead electrocardiogram, blood specimens were obtained for plasma lipids, glucose, and lipoproteins after a 12-hour fast, and a morning urine was collected for measurements of albumin and creatinine.

All living participants in the second examination of the SHS in Oklahoma were invited to participate in the VK study. The baseline examination of the VK study began in September 1995 and concluded in March 1998. During this period of time participants were interviewed about their medical history, and an eye examination was conducted. The study was approved by the University of Oklahoma Health Sciences Center Institutional Review Board. Written informed consent was obtained from each participant before the examination began.

The VK eye examination included measurement of refraction, determination of best-corrected visual acuity, measurement of intraocular pressure, and a slit lamp evaluation. During the examination, pupils were dilated with phenylephrine and topicamide drops. Funduscopic examination was performed using indirect ophthalmoscopy with a 28-diopter lens.

Two Retinal photographs of each eye, centered on the disc and macula (between standard fields 1 and 2), were taken using a non-mydriatic Canon 45 degree CR-5 camera on 35mm slide film. The better photograph of the two taken of each eye was sent to the University of Wisconsin Ocular Epidemiology Reading Center (OERC) for evaluation and grading according to the Wisconsin Age-Related Maculopathy Grading System.[25] Early AMD was defined as being present if either of the following two criteria were met: (a) Presence of retinal pigment epithelium (RPE) depigmentation and/or increased retinal pigment and presence of soft and/or hard drusen (b) Presence of soft drusen in the absence of late AMD in at least one eye. Late AMD was characterized if pure geographic atrophy (geographic atrophy in the absence of any exudative AMD lesion) or exudative AMD (defined by the presence of sub-retinal hemorrhage, sub-retinal fibrous scarring, serous sensory retinal/ retinal pigment epithelium (SSR/RPE) detachment and/or photocoagulation treatment for AMD was present in at least one eye). Eyes were referred to, as “ungradable” if the entire field was ungradable for AMD lesions. The most severely affected eye was used for analysis. In estimating the prevalence of AMD we used participants whose eyes were considered gradable. For the purpose of risk factor identification in this study, early and late AMD were combined in statistical analyses because of the small number of participants with late AMD.

The VK medical history questionnaire was designed to collect information concerning past and current medical conditions related to eyes along with complete personal and family history. Information on age, cataract surgery, heart disease, stroke, sunlight exposure and use of multivitamins was self-reported and was collected during the VK interview and other risk factor data were obtained from the SHS examinations. However, the VK examination was conducted between the SHS 2nd and 3rd examinations. Only 17.3% of VK baseline examinations were within one year of either SHS 2nd or 3rd examination. To estimate the values of the potential AMD risk factors at the time of the VK examination, we had used different algorithms to determine whether to use the SHS 2nd examination data or 3rd examination data or the average of the two, depending on the time between the VK examination and the two SHS examinations. The results obtained from using slightly different algorithms were not substantially different and the results from using the following algorithm are reported in this paper. For continuous variables, if the VK examination of the

participant was within one year of the SHS 2nd examination, then the data were taken directly from the SHS 2nd examination (48 participants), and if the VK examination was within one year of the SHS 3rd examination, then the data were taken from the SHS 3rd examination (123 participants). If the VK examination was not within one year of the SHS 2nd or 3rd examination, then the average of the measurements of the two SHS examinations was used in the analysis (710 participants). If the SHS 3rd examination data were missing and the VK examination was more than one year from the SHS 2nd examination, the participant was excluded in the risk factor analysis. For categorical variables such as hypertension, history of chronic heart disease, stroke, cigarette smoking, albuminuria and alcohol use was taken directly from the SHS examination occurring closest to the VK examination, if both 2nd and 3rd SHS examination data were available. We excluded those participants whose 3rd SHS examination data are unavailable.

In the SHS, hypertension was classified into three categories, based on systolic blood pressure (SBP), diastolic blood pressure (DBP) and use of blood pressure lowering medication: normal- SBP/DBP <120/80 mmHg), pre-hypertensive (SBP/DBP>120/80 but <140/90 mmHg) and hypertensive (SBP/DBP≥ 140/90 mmHg or on anti-hypertension medications). In this analysis, we followed the above algorithm for categorical variables to determine hypertension status at the time of the VK examination. Albuminuria was defined as having the urinary albumin and creatinine ratio greater than 30 mg/g in the SHS. Similar to hypertension, we followed the algorithm for categorical variables to determine albuminuria status.

Data are available on the status of smoking and drinking and participants were classified as never, past, or current smokers or drinkers. However, data on the amount of smoking (pack-years) and drinking (number of drinks per week) were incomplete and therefore were not included in the analysis.

Participants were asked to provide information on the average number of hours per day spent outdoor in bright sunlight (not evening) on weekdays and weekends in winter (October through March) and summer (April through September) for most of their adult life. Outdoor summer and winter hours per week were calculated separately by adding number of hours spent outdoor on weekdays and weekends. Finally, sunlight exposure per week was calculated by adding summer and winter outdoor hours per week and then calculating their average. The frequency of greens (such as spinach, kale, collards, turnip or mustard greens) consumption was also collected by questionnaire.

Risk factors (or covariates) for AMD considered in the analysis were age, hypertension status, presence of coronary heart disease and stroke, status of cigarette smoking, alcohol drinking, sunlight exposure, frequency of green vegetable consumption, total cholesterol, high density lipoprotein-cholesterol, systolic blood pressure, diastolic blood pressure, multivitamin use, and albuminuria status.

Statistical methods

Each potential risk factor was categorized first and the prevalence proportions among the sub-categories were compared by the chi-square test. This method provided information on whether the sub-categories of an individual risk factor had significantly different prevalence of AMD When multiple risk factors are considered simultaneously, logistic regression with a stepwise selection procedure was used to evaluate the relative importance of the risk factors for AMD and identify the significant ones. Statistical significance level used in the chi-square tests and in the stepwise selection procedure for variable entry and variable retention was ≤ 0.05. Data were analyzed using the SAS, version 8.0 (SAS Institute, Cary, NC).

Results

Of the 1527 Oklahoma SHS participants, a total of 1,019 Oklahoma SHS participants (66.7%) who underwent the 2nd SHS examination participated in the VK exam. Women constituted 60.4% of all the VK participants. The overall age of the participants ranged from 48 to 82 years with a mean age of 62.1 years (± 8.2 years) and standard deviation 8.03. The participants were significantly younger than non-participants by age (mean of 60.0 years vs. 62.3years, p<.0001), and had significantly higher systolic blood pressure (131.2mmHg vs. 135.3mmHg, p<0.0001) and total serum cholesterol (mean of 195.9mg/dl vs. 190.9mg/dl, p=0.03). There was no significant difference between participants and nonparticipants in diastolic blood pressure, high density lipoprotein-cholesterol, hypertension status and smoking status. Retinal photographs of at least one eye for 986 participants were considered gradable by the OERC. The analysis reported in this paper is based on these 986 participants.

A descriptive summary of macular findings in the 986 VK participants by age and gender is summarized in Table 1. The prevalence of AMD in the VK study was 35.2% (347/986), including 34.4% with early AMD and 0.8% with late AMD. The prevalence increased with age. There was no statistically significant difference in prevalence between men (34.1%) and women (35.9%). Three of the eight persons with late AMD had pure geographic atrophy and five had exudative AMD, two of whom had received laser treatment. Hard and soft drusen were found in 84.9% (834/986) and 33.9% (334/986), respectively, of the participants. The prevalence of soft drusen increased significantly (p=0.0004) with age.

Table 2 (available at http://aaojournal.org) shows the relationship of individual risk factors of the cohort to the presence of AMD. In women and overall, AMD was significantly related to age, alcohol drinking, high density lipoprotein-cholesterol and multivitamin use. There were no significant relationships between AMD and cigarette smoking status, blood pressure, hypertension status, total cholesterol, history of coronary heart disease, stroke, cataract surgery, albuminuria and body mass index (data for the last four covariates are not shown in Table 2). Among women and over all, use of multivitamin was inversely associated with the presence of AMD (p=0.005 and 0.02, respectively). Among men, the prevalence of AMD was significantly higher in participants with hypertension (41.2%) than those with pre-hypertension or without hypertension (25.9% or 26.8%, p=0.02). Similarly, high SBP was found to be positively associated with AMD among men (p=0.03). There was a borderline statistically significant association of age with AMD in men (p=0.07). The estimated average number of hours spent outdoor per week among the 934 participants who answer the sunlight exposure questions was 23 hours (standard deviation = 14.8 hours) and 50% of the participants reported to have an average of 20.5 hours of sunlight exposure. However, only in women, those who had AMD showed a significantly higher estimated average hour of sun exposure per week (19.0 hours) than those without AMD (16.8 hours). We divided the participants into tertiles according to their average hours of sun exposure, the prevalence proportion of AMD were 28%, 34.9% and 42.5% in the three sun exposure groups (<10.5, 10.5–21, and >21 hours) in women. The differences were statistically significant (p=0.02). Though not significant, men who had more sun exposure had a lower AMD prevalence. Albuminuria did not show any significant relationship with the prevalence of AMD. The self-reported frequency of greens consumption showed that only 25% of the 986 participants ate greens more than once a week. No significant relationship was found between AMD and frequency of greens consumption. These data are not included in Table 2 (available at http://aaojournal.org).

Table 3 shows the results from the logistic regression analysis. In this analysis, the following covariates were included as candidate variables: age, hypertension status, body mass index,

total cholesterol, high density lipoprotein-cholesterol, cigarette smoking status, alcohol use status, history of cataract surgery, history of chronic heart disease, history of stroke, albuminuria, sun exposure and multivitamin use. These covariates were selected either because they show significantly different prevalence proportions in subgroups (in Table 2, available at http://aaojournal.org) or because they have been reported as significant in other studies. In men, only age (p=0.02) showed significant positive association. For every one year increase in age, the odds of having AMD was 3% higher. Among women, age (p<0.0001), high density lipoprotein cholesterol (p<0.0001) and sun exposure (p=0.005) showed significant positive association with AMD and total cholesterol (p=0.019), and multivitamin use (p=0.000) showed significant negative association. However, multivitamin use showed significant protective effects for AMD [odds ratio=0.49, 95% confidence interval: (0.32, 0.74)]. Women who had a history of use of multivitamins had approximately 50% lower odds of having AMD. When men and women were combined in the regression analysis, age (p=0.0002), high density lipoprotein-cholesterol (p=0.0001) was positively associated with AMD while total cholesterol(p=0.03), current alcohol use (p=0.04) and multivitamin use (p=0.007) inversely associated with AMD. We also performed logistic regression analyses excluding the self-reported sun exposure data. The significant variables identified were exactly the same and the odds ratios were only slightly different.

Discussion

In this study the prevalence of AMD (early and late), based on grading of fundus photographs using a standard protocol, was 35.2% in 986 American Indians in Oklahoma age 48–82 years, and only 0.8% had late AMD. To our knowledge, these findings provide the first population-based estimates of AMD in American Indians based on grading of fundus photographs.

The prevalence of AMD in Oklahoma Indians was higher than that found in Northwest American Indians and Alaska Natives (18.3%).[26] The higher prevalence in our study may be partially due to the use of sensitive fundus photographs to assess the presence and severity of AMD and also from differences in definitions of AMD and in participant selection criteria used between studies. For example, definitions used for early AMD in the study of Northwest American Indians and Alaska Natives included “soft drusen > 125 microns”, which was not included in our definition. Participants in that study were younger (40% were between 40 and 49 years) than our participants (none was below 48 years). In addition, their participants must satisfy criteria such as having history of glaucoma, diabetes or eye abnormalities and visual acuity 20/40 or worse with best correction. The estimates in our cohort are similar to the prevalence reported in whites in the Beaver Dam Eye Study,[27] which used the same graders, grading system, and definitions.

Many of the associations found in our cohort, such as with age, status of alcohol consumption, multivitamin use were similar to those previously reported by others in other ethnic groups. The influence of age seemed to be more pronounced in women than men. The result is consistent with other published data,[2, 5, 8, 28, 29] (Hyman L HO, Grimson R, et al. Risk factors for age-related maculopathy. Invest Opthalmol Vis Sci 1992;33(suppl):801) including the meta-analysis results reported by Evans[30] that older women were at highest risk of developing AMD. In our study, we found that women and men over 70 years of age had much higher prevalence of AMD than those who were younger (overall 47% vs. 32%). We also found that current alcohol users had 33% lower odds of AMD than those who never use alcohol. Alcohol use has been shown to have both protective and deleterious effects in the development of AMD. Cho et al.[4, 13] found a modest increased risk of AMD in women drinkers who consumed 30g or more alcohol per day. In the Beaver Dam Eye Study,[31] beer consumption was associated with increased incidence of AMD while in the National Health

and Nutritional Examination Survey,[32] wine drinking had a cross-sectional protective effect. We did not differentiate the types of alcohol beverage used in our study.

Smoking status was not associated with the prevalence of AMD. This is inconsistent with data from most other studies and in some other ethnic groups, in which smoking was found to be positively related to the incidence and progression of AMD, possibly due to oxidative effects, effects in decreasing macular pigment density, alteration of choroidal blood flow, by impairing retinal pigment epithelium function or direct effect of nicotine to activate pro-inflammatory mediators.[2, 3, 8, 9, 11, 33] Reasons for the inconsistencies are not clear. One of the possibilities may be due to the estimated smoking status taking from either the SHS 2nd or the 3rd examinations since some of the participants might have quit smoking between the two SHS examinations.

Findings regarding the relationship of AMD and serum lipid levels have not been consistent. Our findings of positive association of high density lipoprotein cholesterol are consistent with the cross-sectional association reported from the Rotterdam Study and Beaver Dam Study[27] but not the Blue Mountains Eye Study.[27] Several previous population studies[6, 34, 35] found significant inverse association between serum total cholesterol and AMD. Our results in women and in overall population are consistent with those findings. Dashti et al. have speculated that the cholesterol in drusen and Bruch's membrane may not be directly deposited from the circulation, but may come from the lipids that are locally produced in the retinal pigment epithelium.[36] The complex interrelationships of lipid metabolism in the RPE, Bruchs membrane and choroidal and systemic circulation and their hypothesized role in the pathogenesis of drusen and AMD have recently been reviewed by Curcio et al.[37]

The findings regarding the protective effect of multivitamin use for AMD is consistent with the findings of Age-Related Eye Disease Study[38] where it was found that high dietary intake of lutein/zeaxanthin was associated with the decrease incidence of AMD. Although other studies found that dietary intake of fish and leafy greens protects against AMD,[3, 20], (Mitchell P, Smith W, Cumming RG, et al. Nutritional factors in the development of age-related eye disease. Asia Pac J Clin Nutr 2003;12 Suppl:S5) we did not find any relationship between AMD and greens consumption. This may have been due to the lack of precision of our data and the results may not have been accurate. We found that sunlight exposure was related to the prevalence of AMD in women only. Association between sunlight exposure and AMD has been studied in the past with mixed results.[15, 17, 18, 39, 40, 41] Young, in his research[40, 41] to find modifiable risk factor to reduce the burden of eye diseases, suggested that high energy visible light (violet and blue) can damage the retina, and the damage done to the layer of retina affected in AMD is directly proportional to photon energy. Since our data on sunlight exposure were self-reported, the lack of precision may have contributed to the inconsistent findings between men and women.

While there are many strengths of our study, such as use of a population-based sample and grading of fundus photographs to determine the presence of AMD, there are also limitations. First, self-reported data of green vegetables and sunlight exposure are imprecise and therefore the results presented are preliminary. Also, we used estimates or average values for participants whose VK examination was not within one year of either the SHS 2nd or 3rd examination. Only 17.3% of VK baseline examinations were within one year of either SHS 2nd or 3rd examination. This can also introduce potential bias in our results. Prevalences of some risk factors are significantly different between participants and non-participants, which can also be a source of bias to reflect true association of these risk factors. For example, nonparticipants being significantly older than participants may have led to an underestimated prevalence of AMD and lower degree of association between age and the

prevalence of AMD. Another limitation is the very small late AMD cases, which also may have introduced bias.

In conclusion, we are the first to report detailed data on the prevalence of AMD and its significant risk factors in Oklahoma Indians. Most of the risk factors identified in this study confirmed previous findings and the modifiable risk factors can be used to design preventive strategies. However, longitudinal data are still needed to examine the risk of incidence and progression of AMD to further understand the disease and its risk factors.

Précis

The overall prevalence of age-related macular degeneration in Oklahoma Indians was 35.2%, which poses a significant threat of blindness. Some of the identified risk factors can be used to develop preventive strategies.

Acknowledgments

Financial Disclosure The Vision Keeper (VK) Study was supported by grant EY-09898 from the National Eye Institute, National Institutes of Health, Bethesda, Md; and the Strong Heart Study (SHS) was supported by grant U01-HL041654 from the National Heart, Lung, and Blood Institute, Bethesda.

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Table 1

Macular Findings (Number & %) by Age and Gender

Gender Age group, yr	N	Soft Drusen	Hard Drusen	RPE Depigmentation	Increased Retinal Pigmentation	Early AMD	Exudative / Neovascular AMD	Pure Geographic Atrophy	Late AMD
Females									
48–59	242	72 (29.7)	217 (90.0)	1 (0.4)	5 (2.1)	73 (30.2)	3 (1.2)	1 (0.4)	2 (0.8)
60–69	225	75 (33.5)	184 (82.1)	3 (1.4)	6 (2.7)	77 (34.2)	1 (0.4)	0 (0)	1 (0.4)
70–82	126	57 (45.2)	105 (83.3)	2 (1.6)	5 (4.0)	58 (46.0)	2 (1.6)	0 (0)	2 (1.6)
Total	593	204 (34.5)	506 (85.6)	6 (1.0)	16 (2.7)	208 (35.1)	6 (1.0)	1 (0.2)	5 (0.84)
Males									
48–59	186	58 (31.2)	160 (86.0)	7 (3.8)	9 (4.8)	58 (31.2)	1 (0.5)	1 (0.5)	1 (0.5)
60–69	140	42 (30.0)	115 (83.3)	3 (2.1)	5 (3.6)	42 (30.0)	3 (2.1)	1 (0.7)	2 (1.4)
70–82	67	30 (44.8)	53 (79.1)	4 (6.1)	3 (4.5)	31 (46.3)	0 (0)	0 (0)	0 (0)
Total	393	130 (33.1)	328 (83.9)	14 (3.6)	17 (4.3)	131 (33.3)	4 (1.1)	2 (0.5)	3 (0.76)
Overall									
48–59	428	130 (30.1)	377 (88.3)	8 (1.9)	14 (3.3)	131 (30.6)	4 (0.9)	2 (0.5)	3 (0.7)
60–69	365	117 (32.1)	299 (82.6)	6 (1.6)	11 (3.0)	119 (32.6)	4 (1.1)	1 (0.3)	3 (0.8)
70–82	193	87 (45.1)	158 (81.9)	6 (3.1)	8 (4.2)	89 (46.1)	2 (1.0)	0 (0)	2 (1.04)
Total	986	334 (33.9)	834 (84.9)	20 (2.0)	33 (3.4)	339 (34.4)	10 (1.0)	3 (0.3)	8 (0.81)

RPE - Retinal Pigment Epithelial; AMD-Age related macular degeneration; N = Number of participants

Table 2

Prevalence of Age-Related Maculopathy by potential risk factors in Oklahoma Indians

	Women		Men		Overall	
	Proportion	**P-value**	**Proportion**	**P-value**	**Proportion**	**P-value**
Age group (Years)						
48–59	31.0 (75/242)	0.006	31.7 (59/186)	0.07	31.3 (134/428)	0.0004
60–69	34.7 (78/225)		31.4 (44/140)		33.4 (122/365)	
70+	47.6 (60/126)		46.3 (31/67)		47.2 (91/193)	
Hypertension						
Yes	32.3 (91/282)	0.27	41.2 (73/177)	0.02	35.7 (164/459)	0.6
Pre	32.0 (8/25)		25.9 (7/27)		28.8 (15/52)	
No	39.0 (87/223)		26.8 (37/138)		34.3 (124/361)	
Coronary Heart Disease						
Yes	41.3 (52/126)	0.16	36.0 (27/75)	0.69	39.3 (79/201)	0.17
No	34.5 (161/467)		33.6 (107/318)		34.1 (268/785)	
Cigarette smoking						
Never*	38.2 (84/220)	0.47	37.8 (31/82)	0.31	38.1 (115/302)	0.17
Past	34.7 (61/176)		35.9 (60/167)		35.3 (121/343)	
Current	31.8 (42/132)		28.0 (26/93)		30.2 (68/225)	
Alcohol drinking						
Never	39.5 (135/342)	0.04	36.7 (61/166)	0.18	38.6 (196/508)	0.02
Past	28.2 (31/110)		37.3 (28/75)		31.9 (59/185)	
Current	29.1 (23/79)		26.5 (26/98)		27.7 (49/177)	
Total cholesterol (mg/dl)						
<200	39.1 (113/289)	0.23	35.7 (76/213)	0.52	37.6 (189/502)	0.21
200 – 239	32.9 (57/173)		29.6 (29/98)		31.7 (86/271)	
≥ 240	28.6 (12/42)		38.9 (7/18)		31.7 (19/60)	
HDL-C¶¶ (mg/dL)						

	Women		Men		Overall	
	Proportion	**P-value**	**Proportion**	**P-value**	**Proportion**	**P-value**
< 40	30.0 (58/193)	0.01	31.1 (71/228)	0.19	30.6 (129/421)	0.004
40 – 49	33.1 (53/160)		41.4 (29/70)		35.6 (82/230)	
≥ 50	44.7 (76/170)		41.0 (16/39)		44.0 (92/209)	
DBP[¶] (mmHg)						
< 80	36.8 (155/421)	0.07	32.7 (72/220)	0.61	35.4 (227/641)	0.44
80–89	29.8 (25/84)		38.2 (39/102)		34.4 (64/186)	
≥ 90	15.0 (3/20)		37.5 (6/16)		25.0 (9/36)	
SBP[¶] (mmHg)						
< 120	41.7 (83/199)	0.10	29.4 (40/136)	0.03	36.7 (123/335)	0.2
120–139	32.1 (76/237)		32.0 (56/175)		32.0 (132/412)	
≥ 140	34.4 (54/157)		46.3 (38/82)		38.5 (92/239)	
Multivitamin Use						
Yes	29.5 (75/254)	0.005	33.0 (36/109)	0.78	30.6 (111/363)	0.02
No	40.8 (138/338)		34.5 (98/284)		37.9 (236/622)	
Sun Exposure[#] (hrs/week)						
1st Tertile	28.8 (53/184)	0.02	42.3 (55/130)	0.06	33.2 (107/322)	0.63
2ndTertile	34.9 (67/192)		33.1 (42/127)		36.9 (114/309)	
3rd Tertile	42.5 (74/174)		28.5 (36/127)		35.0 (106/303)	

Chi-square test was used to calculate p-values.

[*] The difference between never & none category of cigarette smoking and pack per year is due to the reason that for categorical variable the data was used from closest Strong Heart Study phase and for continuous variables average from two Strong Heart Study phases was used.

[#] Sunlight Exposure Tertile cutpoints: Females (10.5, 21) Males (22, 37.5) All (14, 27.5)

[¶] DBP= Diastolic Blood pressure, SBP=Systolic Blood Pressure.

[¶¶] High Density Lipoprotein Cholesterol.

Table 3

Multivariate Logistic Regression Analysis of Risks Factors for Developing Age-Related Macular Degeneration

Variable	Coefficients	P-value	Odds Ratio (OR)	95% CI of OR
Men				
Age (yrs)	0.034	0.020	1.03	(1.00, 1.06)
Women				
Age (yrs)	0.054	< 0.0001	1.05	(1.03, 1.08)
HDL-C (mg/dl)	0.035	< 0.0001	1.03	(1.02, 1.05)
TC (mg/dl)	− 0.007	0.019	0.99	(0.98, 0.99)
Multivitamin use	−0.712	0.0007	0.48	(0.32, 0.74)
Sun Exposure (hrs/week)	0.026	0.005	1.03	(1.01, 1.04)
All				
Age (yrs)	0.035	0.0002	1.04	(1.02, 1.06)
HDL-C (mg/dl)	0.024	0.0001	1.02	(1.01, 1.04)
Multivitamin use	− 0.436	0.007	0.65	(0.47, 0.89)
TC (mg/dl)	−0.005	0.033	0.99	(0.99, 1.00)
Current-Alcohol use[1]	− 0.426	0.038	0.65	(0.44, 0.98)

TC-Total Cholesterol; HDL-C high density lipoprotein in cholesterol, OR=odds ratio, CI=confidence interval

[1]Compared to never user.