Original Article

Association of obesity and age-related macular degeneration in Indian population

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Purpose: The aim of this study was to establish the prevalence and association of age-related macular degeneration (AMD) and obesity which was not studied extensively in Indian population over 60 years of age. **Methods:** This was a cross-sectional, population-based study. A total of 4791 patients with gradable fundus photography were included. All patients underwent detailed ophthalmic examination and AMD was graded with retinal photographs. Grading of AMD was done according to the International ARM Epidemiological Study Group and staged based on grading in worse eye. The association of AMD severity and obesity (based on body mass index, waist–hip ratio, waist circumference, isolated abdominal obesity, isolated generalized obesity, and combined obesity) was assessed. The main outcome variable was an association between the presence and severity of AMD with different grades of obesity. **Results:** No direct significant association was noted between the presence and severity of AMD and any obesity indices. Subgroup analyses based on lifestyle patterns and common systemic pathologies in AMD population were done. Late AMD was significantly associated with tobacco consumption in population with combined obesity ($P = 0.033$ and odds ratio = 2.998). **Conclusion:** No direct association was noted between the presence or severity of AMD and obesity in South Indian population. However, indirect associations between the severity of AMD and combined obesity were found.

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Age-related macular degeneration (AMD) is a complex disease with genetic and environmental etiology and is the leading cause of irreversible blindness in developed countries and in a few developing countries in the elderly age group.[1] It is a progressive neurodegenerative ocular disease which affects the central portion of retina and choroid.[2] Although few treatments are available for AMD, including specific nutritional intake and dietary supplements for dry AMD and anti-vascular endothelial growth factor (VEGF) therapies for neovascular form, without new treatments or preventive strategies, the rates of vision loss are expected to rise in the future. For this reason, a better understanding of the pathogenesis is essential to develop preventive measures to reduce the burden of the disease.

Chronic low-grade inflammation state was found to be involved in the complex pathogenesis of AMD. Obesity being a pro-inflammatory state contributes to the disease process.[3] Previous studies have shown an association of both generalized and abdominal obesities with AMD.[4,5]

Studies had reported that waist-to-hip ratio (WHR), which is a measure of abdominal obesity, had a stronger relationship with AMD than body mass index (BMI), which is a measure of generalized obesity.[4,5] Evidence shows that the prevalence of obesity, abdominal, general, and combined, differs in various populations and ethnic groups.

It has been postulated that Asians are prone to visceral fat accumulation, which might be the reason for the greatest prosperity to develop diseases such as diabetes at relatively low BMI values.[6] To the best of our knowledge, no population-based studies had been done which show the association of various types of obesity and AMD in India. The aim of this study is to establish the association of both abdominal and generalized obesities with AMD in Indian population.

Methods

A population-based, cross-sectional study of 5495 persons from Indian population, above the age of 60 years, was done between 2009 and 2011. The study design and research methodology were described in detail elsewhere.[7] This study was approved by the institutional review board, a written consent was obtained from the participants following the Declaration of Helsinki.

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Of the 5495 patients, 4791 patients with gradable retinal photographs were included in the study. A detailed questionnaire enumerating the medical history, general physical examination, educational status, occupation, history of smoking, and consumption of tobacco and alcohol was admitted. The medical history data included the duration and treatment of diabetes mellitus, hypertension, and coronary artery disease. The ocular history included details of ocular complaints and past ocular treatment or surgery.

All the patients underwent a detailed ophthalmic evaluation, which includes assessment of visual acuity using modified Early Treatment Diabetic Retinopathy Study chart (Light House Low Vision Products, NY, USA), refraction, anterior-segment examination using a slit-lamp (Zeiss SL 130, Carl Zeiss, Jena, Germany), measurement of intraocular pressure (Zeiss AT 030 Applanation Tonometer; Carl Zeiss), and fundus examination using binocular indirect ophthalmoscope (Keeler Instruments Inc., Broomall, PA, USA).

Grading of lens opacification was done using the Lens Opacities Classification System III (LOCS Chart III; Leo T Chylack, Harvard Medical School, Boston, MA, USA) by experienced ophthalmologists. A slit-lamp photography of the crystalline lens after dilatation was obtained in all patients for comparing it with LOCS chart III and grading was done accordingly. Retinal photographs were obtained after pupillary dilatation (Carl Zeiss fundus camera; FF-450, Germany). The grading of AMD was done by a single experienced (more than 5 years) vitreoretinal surgeon in accordance with the International ARM Epidemiological Study Group and staged based on the grading in the worst eye.[8]

Anthropometric measurements such as weight (to the nearest 0.5 kg), height, waist, and hip measurements using a nonstretchable measuring tape (to the nearest centimeter) were obtained using standardized techniques. Based on BMI, waist circumference (WC), and WHR, the type of obesities were classified.

Definitions

- Early AMD: It is defined as the presence of drusen as discrete whitish-yellow spots located external to the neuroretina or retinal pigmented epithelium (RPE) or the presence of drusen with RPE abnormalities seen as areas of hyperpigmentation or hypopigmentation[8]
- Late AMD: (a) Dry AMD: It is defined as the presence of geographic atrophy of the RPE in the absence of neovascularization. (b) Wet AMD: It is defined as the presence of RPE detachments, which may be associated with neurosensory retinal detachment, sub-RPE or subretinal neovascular membranes, and subpigment epithelial, subretinal, or intraretinal scar or glial tissue. Fibrin-like deposits and subretinal hemorrhages might be present which will not be related to other retinal vascular diseases[8]
- BMI: It is calculated using the following formula: weight (in kg)/height (in m^2)
- WC and hip circumference: The WC is the measurement of smallest horizontal circumference between the costal margins and the iliac crests at minimal respiration. And the greatest circumference, widest protrusion of the hip, was measured as hip girth
- WHR: It is calculated by dividing the WC (in cm) by the hip circumference (in cm)
- Obesity: According to the World Health Organization Expert Consultation guidelines, obesity is defined based on BMI alone (BMI ≥23 kg/m^2), WC alone (men ≥90 cm and women ≥80 cm), and WHR alone (men ≥0.90 and women ≥0.85)[9,10]
- Isolated generalized obesity: It is defined as increased BMI with normal WC (BMI ≥23 kg/m^2 and WC in men <90 cm and women <80 cm)
- Isolated abdominal obesity: It is defined as increased WC with normal BMI (WC in men ≥90 cm and women ≥80 cm and BMI ≤23 kg/m^2)
- Combined obesity: It is defined as both increased WC and BMI (BMI ≥23 kg/m^2 and WC in men ≥90 cm and women ≥80 cm).

Statistical analysis

Statistical analyses were carried out using SPSS statistical software for Windows, Version 21.0 (IBM Corp, Released 2013, Armonk, NY, USA) and Microsoft Excel 2013 (Microsoft Corp, Redmond, WA, USA). For the categorical variables, Chi-square test and logistic regression analysis with step-wise forward method were used to find the association between AMD and obesity. For continuous variables, to compare difference between independent groups, Student's *t*-test for parametric data and Mann–Whitney U-test for nonparametric data were done. $P < 0.05$ was considered statistically significant.

Results

Table 1a and b shows the demographic and baseline characteristics of both AMD and normal population. In Table 1a, the overall parameters of AMD population and normal population were compared. Statistically significant difference was noted between AMD and normal populations in parameters such as age, BMI in kg/m^2, hip and WC in centimeter, proportion of smoking, tobacco and alcohol consumption, diabetes, hypertension, and obesity indices such as obesity based on BMI, WC, and combined obesity. In Table 1b, the parameters of both the groups were compared between males and females. Statistically significant difference between males and females was noted in characteristics such as age, BMI in kg/m^2, hip circumference in centimeter, WHR, the proportion of smoking, alcohol consumption, hypertension, and all obesity indices with $P < 0.05$ in both the groups. The proportion of obesity indices was comparable between AMD and normal population.

Fig. 1 shows the graphical representation of prevalence of various obesity indices in AMD population. In our study population, the prevalence of obesity based on WHR was more compared to normal, whereas the prevalence of obesity based on BMI, isolated generalized obesity, isolated abdominal obesity, and combined obesity was less compared to normal proportion in each group.

Binary logistic regression analysis was done to obtain the odds ratio (OR) and *P* value and to find any association of obesity with various types of obesity. The results are summarized in Table 2a. A total of 4791 patients for whom AMD was gradable were included in this analysis. Out of 4791, 3802 patients had no AMD and 989 patients had either early or late stage of AMD. No statistically significant association was noted between the presence of AMD and any obesity indices. A subanalysis was done to find if the stage of AMD

Table 1a: Baseline characteristics of the study population (overall)

Baseline characteristics	Overall AMD population (*n*=989)	Overall normal population (*n*=3802)	*P*
Mean age (years), mean±SD	66.5±6.6	65.7±6.04	0.004
BMI (kg/m^2), mean±SD	22.1±4.6	22.6±4.7	0.001
Hip circumference (cm), mean±SD	87.3±11.3	89.2±11.9	<0.0001
WHR, mean±SD	0.90±0.06	0.9±0.1	0.142
WC (cm), mean±SD	78.2±12.0	80.1±12.6	<0.0001
History of smoking, *n* (%)	22 (2.2)	461 (12.1)	<0.0001
History of tobacco consumption, *n* (%)	25 (2.5)	1268 (33.4)	<0.0001
History of alcohol consumption, *n* (%)	145 (14.7)	452 (11.9)	0.019
Presence of diabetes, *n* (%)	186 (18.8)	1070 (28.1)	<0.0001
History of hypertension, *n* (%)	159 (16.1)	799 (21.0)	0.001
Obesity based on BMI, *n* (%)	376 (38.0)	1596 (42.0)	0.023
Obesity based on WC, *n* (%)	239 (24.2)	1081 (28.4)	0.008
Obesity based on WHR, *n* (%)	656 (66.3)	2630 (69.2)	0.086
Isolated generalized obesity, *n* (%)	137 (13.9)	515 (13.5)	0.802
Isolated abdominal obesity, *n* (%)	88 (8.9)	404 (10.6)	0.111
Combined obesity, *n* (%)	239 (24.2)	1081 (28.4)	0.007

SD: Standard deviation, BMI: Body mass index, WC: Waist circumference, WHR: Waist-to-hip ratio, AMD: Age-related macular degeneration

Table 1b: Baseline characteristics of the study population (male vs. female)

Baseline characteristics	AMD population			Normal population		
	Male (*n*=455)	Female (*n*=534)	*P*	Male (*n*=1655)	Female (*n*=2147)	P
Mean age (years), mean±SD	67.3±6.8	65.7±6.5	<0.0001	66.9±6.4	64.7±5.6	<0.0001
BMI (kg/m^2), mean±SD	21.5±4.3	22.5±4.7	0.002	21.8±4.2	23.2±5.0	<0.0001
Hip circumference (cm), mean±SD	86.6±10.9	88.0±11.6	0.032	87.9±11.0	90.1±12.6	<0.0001
WHR, mean±SD	0.90±0.07	0.89±0.06	0.019	0.9±0.1	0.9±0.1	<0.0001
WC (cm), mean±SD	77.9±12.0	78.4±12.1	0.441	80.0±12.1	80.1±13.0	0.97
History of smoking, *n* (%)	22 (4.8)	0	<0.0001	461 (27.9)	0	<0.0001
History of tobacco consumption, *n* (%)	14 (4.8)	11 (2.7)	0.147	701 (42.4)	567 (26.4)	<0.0001
History of alcohol consumption, *n* (%)	145 (31.9)	0	<0.0001	452 (27.3)	0	<0.0001
Presence of diabetes, *n* (%)	82 (18.0)	104 (19.5)	0.56	459 (27.7)	611 (28.5)	0.623
History of hypertension, *n* (%)	61 (13.4)	98 (18.4)	0.035	293 (17.7)	506 (23.6)	<0.0001
Obesity based on BMI, *n* (%)	157 (34.5)	219 (41.0)	0.036	588 (35.5)	1008 (46.9)	<0.0001
Obesity based on WC, *n* (%)	74 (16.3)	165 (30.9)	<0.0001	302 (18.2)	779 (36.3)	<0.0001
Obesity based on WHR, *n* (%)	256 (56.3)	400 (74.9)	<0.0001	1005 (60.7)	1625 (75.7)	<0.0001
Isolated generalized obesity, *n* (%)	83 (18.2)	54 (10.1)	<0.0001	286 (17.3)	229 (10.7)	<0.0001
Isolated abdominal obesity, *n* (%)	8 (1.8)	80 (15.0)	<0.0001	75 (4.5)	329 (15.3)	<0.0001
Combined obesity, *n* (%)	74 (16.3)	165 (30.9)	<0.0001	302 (18.2)	779 (36.3)	<0.0001

SD: Standard deviation, BMI: Body mass index, WC: Waist circumference, WHR: Waist-to-hip ratio, AMD: Age-related macular degeneration

was associated with either of the obesity indices, in overall population and in each gender. Table 2b shows the proportions of patients in each obesity index and their comparison between early AMD and late AMD. No significant associations were noted. The ORs were adjusted for age, diabetes status, smoking status, socioeconomic score, systolic blood pressure, and diastolic blood pressure.

Table 3 shows the combined association of stage of AMD with various obesity indices and risk factors, adjusting for age. The risk factors such as smoking, alcohol and tobacco consumption, diabetes, and hypertension were compared with the stage of AMD (early and late) in the population with each obesity indices. Consumption of tobacco was significantly associated with late AMD in the population with combined obesity, with P = 0.033 and OR being 2.998 (1.091–8.238). No significant association was noted for other risk factors.

Discussion

This study estimates the prevalence of various obesity indices in AMD patients and its association with severity and risk factors of AMD. The prevalence of obesity was more in women when compared to men, which was statistically significant. No significant association was noted between any obesity indices and presence or severity of AMD.

Association of AMD with obesity indices such as obesity based on BMI, WC, WHR, isolated generalized obesity, isolated abdominal obesity, and combined obesity was evaluated in our study. Previous studies had shown that the correlation of various obesity indices does not have a linear relationship. It was found that the correlation of BMI and central obesity varies from one individual to another. Age and gender have an influence on various obesity indices. Hence, we studied the association of AMD with possible obesity indices.

In our study, we adjusted for age, gender, smoking status, socioeconomic scoring, diabetes status, and blood pressure to find an association between the presence of various obesity indices and presence and severity of AMD. No statistically significant direct association was noted. Similar to our study, few case–control and cross-sectional studies had reported that there was no significant association between obesity and AMD.[11-13] However, many case–control or longitudinal studies[2,5,14-17] and few cross-sectional studies[3,13,18] had shown a significant association between AMD and either one of the obesity indices. Table 4 shows the summary of previous studies done to determine the association between AMD and obesity.

Zhang *et al*.[1] did a meta-analysis of prospective studies on the association of obesity and AMD. They concluded that excess body weight may act as a potential risk factor for AMD incidence. They postulated from the previous studies that the secretion of pro-inflammatory messengers, such

Table 2a: Association of age-related macular degeneration and various types of obesity

Presence versus absence of obesity	AMD versus no AMD	
	Adjusted OR* (95% CI)	*P*
Isolated abdominal obesity	0.78 (0.60-1.02)	0.073
Isolated generalized obesity	1.10 (0.86-1.42)	0.448
Obesity based on BMI	0.85 (0.70-1.04)	0.108
Obesity based on WHR	0.98 (0.82-1.12)	0.593

*Adjusted for age, gender, diabetes status, smoking status, socioeconomic scoring, and blood pressure. OR: Odds ratio, CI: Confidence interval, BMI: Body mass index, WHR: Waist-to-hip ratio, AMD: Age-related macular degeneration

Table 2b: Subanalysis of association between stages of age-related macular degeneration and obesity indices in men and women

	Early AMD (total=894), *n* (%)	Late AMD (total=95), *n* (%)	*P*	Men		Women	
				Adjusted OR* (95% CI)	*P*	Adjusted OR* (95% CI)	*P*
Isolated abdominal obesity	77 (8.6)	11 (11.6)	0.334	3.0 (0.6-16.6)	0.199	1.4 (0.6-3.0)	0.448
Isolated generalized obesity	125 (14.0)	12 (12.6)	0.717	1.0 (0.4-2.2)	0.908	0.8 (0.3-2.4)	0.716
Combined obesity	215 (24.0)	24 (25.3)	0.793	1.4 (0.6-3.3)	0.478	1.2 (0.6-2.4)	0.6
Obesity based on BMI	340 (38.0)	36 (37.9)	0.979	1.2 (0.6-2.2)	0.672	1.1 (0.6-2.1)	0.807
Obesity based on WHR	588 (65.8)	68 (71.6)	0.255	1.4 (0.7-2.7)	0.285	1.3 (0.6-2.6)	0.549

*Adjusted for age, diabetes status, smoking status, socioeconomic score, systolic blood pressure, and diastolic blood pressure, OR: Odds ratio, CI: Confidence interval, AMD: Age-related macular degeneration, BMI: Body mass index, WHR: Waist-to-hip ratio

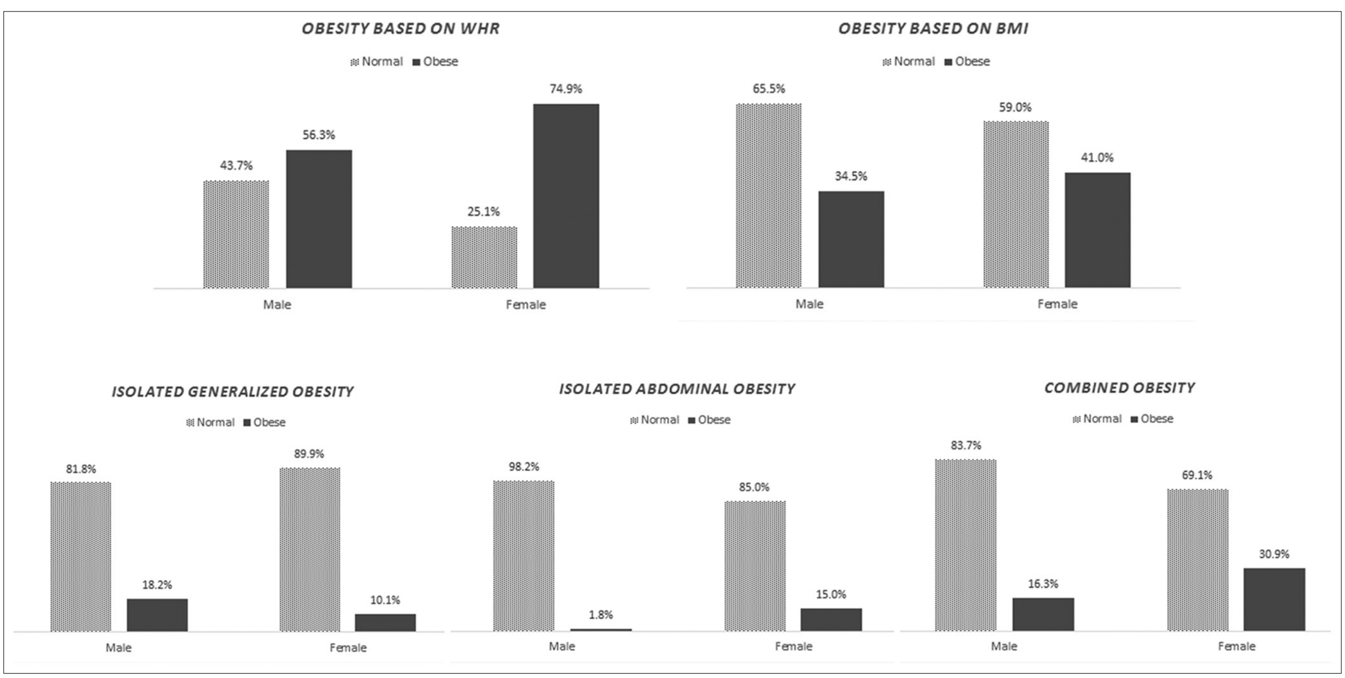

Figure 1: Prevalence of obesity indices in age-related macular degeneration and normal populations (over 60 years of age)

Table 3: Association between obesity indices, risk factors, and age-related macular degeneration

	Isolated generalized obesity		Combined obesity		Obesity based on WHR		Isolated abdominal obesity		Obesity based on BMI	
	Adjusted OR* (95% CI)	*P*	Adjusted OR* (95% CI)	*P*	Adjusted OR* (95% CI)	*P*	Adjusted OR* (95% CI)	*P*	Adjusted OR* (95% CI)	*P*
Smoking	1.417 (0.209-9.621)	0.721	0.221 (0.021-2.375)	0.213	1.317 (0.485-3.574)	0.589	NS		NS	
Tobacco consumption	3.001 (0.774-11.632)	0.112	2.998 (1.091-8.238)	0.033**	1.335 (0.742-2.405)	0.335	2.021 (0.533-7.664)	0.301	5.022 (0.695-36.275)	0.11
Alcohol consumption	0.000	0.998	2.047 (0.497-8.441)	0.321	0.672 (0.255-1.766)	0.420	NS		0.000	0.999
Diabetes	0.000	0.998	1.386 (0.534-3.597)	0.502	0.743 (0.371-1.486)	0.400	0.746 (0.139-3.995)	0.732	1.211 (0.104-14.104)	0.879
Hypertension	1.629 (0.145-18.329)	0.693	1.040 (0.983-1.101)	0.842	1.093 (0.541-2.210)	0.804	1.265 (0.237-6.765)	0.783	3.087 (0.273-34.957)	0.363

*OR adjusted for age, ***P*<0.05. NS: No samples, OR: Odds ratio, CI: Confidence interval, AMD: Age-related macular degeneration, early AMD was kept as reference to calculate OR of late AMD, BMI: Body mass index, WHR: Waist-to-hip ratio

Table 4: Summary on studies on association of obesity indices and age-related macular degeneration

Authors	Year published	Title of the article	Study design	*n*, study place	Statistically significant association (yes/no)	Result
Smith *et al.*[18]	1998	Plasma fibrinogen levels, other cardiovascular risk factors, and age-related maculopathy. The Blue Mountain Eye Study	Population based, cross sectional	3654, Australia	Yes	OR for obese is 1.78 when compared with normal BMI for early AMD, 1.92 for underweight, and 1.44 for overweight. No significant association for late AMD
Age-related Eye Disease Study Research Group[10]	2000	Risk Factors Associated with Age-Related Macular Degeneration: A Case-Control Study in the Age-Related Eye Disease Study: Age-Related Eye Disease Study- Report No. 3	Hospital based, case control	4757, US	Yes	Increased BMI noted in persons with neovascular AMD with OR=1.43
Schaumberg *et al.*[2]	2001	BMI and the incidence of visually significant age-related maculopathy in men	Prospective, longitudinal study done in the US physicians	22,071, Boston, US	Yes	Compared with men with a normal BMI, RR of AMD in lean=1.43, overweight=1.24, and obese=2.15
Oshima *et al.*[11]	2001	Prevalence of age-related maculopathy in a representative Japanese population: The Hisayama study	Population based, cross sectional	1486, Hisayama, Japan	No	BMI was not related to the presence of AMD
Seddon *et al.*[5]	2003	Progression of age-related macular degeneration: association with BMI, waist circumference, and WHR	Hospital based, prospective, longitudinal	261, Boston	Yes	Increased risk for AMD progression with higher levels of BMI. RR for BMI of 25-29 kg/m^2=2.32 and for BMI of 30 kg/m^2 or more=2.35

Contd...

Table 4: Contd...

Authors	Year published	Title of the article	Study design	*n*, study place	Statistically significant association (yes/no)	Result
Moeini *et al*.[12]	2005	A study of the relation between BMI and the incidence of age-related macular degeneration	Hospital based, case control	130, Iran	No	No significant difference in mean of BMI between cases and controls
Paunksnis *et al*.[15]	2005	Early age-related maculopathy and risk factors of cardiovascular disease in middle-aged Lithuanian urban population	Population based, case control	1337, Lithuania, Europe	Yes	Higher BMI noted in AMD cases with significant difference between cases and controls
Age-Related Eye Disease Study Research Group[14]	2005	Risk Factors for the Incidence of Advanced Age-Related Macular Degeneration in the AREDS Report No. 19	Clinic based, prospective, longitudinal	4757, US	Yes	OR of incidence of central geographic atrophy in obese was 1.93 when compared to that of nonobese
Peeters *et al*.[19]	2008	Changes in abdominal obesity and age-related macular degeneration: The Atherosclerosis Risk in Communities Study	Population based, cross sectional	12,506, 4 US communities, Australia	Yes	OR per 1-SD change in WHR of any AMD=1.09, early AMD=1.08, late AMD=1.37, Soft drusens=1.07 and RPE abnormalities=1.14
Kawasaki *et al*.[16]	2008	Prevalence and risk factors for age-related macular degeneration in an adult Japanese population: The Funagata study	Population based, cross sectional	1625, Japan	No	No significant association between stages of AMD and BMI category
Adams *et al*.[3]	2011	Abdominal obesity and age-related macular degeneration	Population based, cross sectional	21,287, Melbourne, Australia	Yes	Significant association. In men: Early AMD-WHR; OR=1.13, Late AMD-WHR; OR=1.75, WC-1.39. In women: Early AMD-BMI; OR=0.93, WC; OR=0.92, WHR; OR=0.89. No significant association with late AMD
Howard *et al*.[17]	2014	Measures of Body Shape and Adiposity as Related to Incidence of Age-Related Eye Diseases: Observations From the Beaver Dam Eye Study	Population based, prospective, longitudinal	2641, Wisconsin, US	Yes	In females, the HR of BMI=1.31, WC=1.21, WHR=1.95, waist-height ratio=1.74. In males, there was no significant association
Jaisankar *et al*. (present study)	2016	Obesity and AMD in Indian population	Population based, cross sectional	4791, Tamil Nadu, India	No	No significant direct association between the presence and severity of AMD and BMI

BMI: Body mass index, WHR: Waist-to-hip ratio, OR: Odds ratio, WC: Waist circumference, AMD: Age-related macular degeneration, RR: Relative risk, AREDS: Age-Related Eye Disease Study as monocyte chemoattractant protein-1 and tumor necrosis factor-α, was significantly elevated in obese individuals. The migration and infiltration of monocyte could be regulated by these pro-inflammatory factors, causing a disturbance in the function of the RPE which might contribute to retinal changes encountered in AMD.[19,20] They had also described that increased adiposity on the distribution of macular carotenoids may partly be related to increased risk of AMD in obese individuals.[21]

We did not find any association with risk factors such as smoking and alcohol consumption. Previous studies[22-26] had shown smoking to be a well-known risk factor for AMD progression. Smoking is known to affect the circulation of antioxidants. This leads to decrease in the levels of compounds with antioxidant capabilities in the body, thereby the protection of retina against oxidative damage is perturbed.[14] Severity of AMD was significantly associated with consumption of tobacco in the population with combined obesity. This infers that combined obesity is indirectly associated with AMD in addition to tobacco consumption. However, this study being a cross-sectional study, we could not find the relative risk of smoking and alcohol, which could be established well with a longitudinal study by assessing the progression of AMD in groups with and without risk factors.

We did not find any significant association of AMD with systemic diseases such as diabetes mellitus and hypertension. Increase in the risk of AMD progression with the presence of diabetes mellitus and hypertension in obesity category was reported in previous studies.[5,19,27]

The novelty of the study is its design being population based which included both urban and rural populations of India over 60 years of age with large sample size. However, there are few limitations: (1) This being a cross-sectional study, the relative risk of AMD progression with the presence of obesity and other risk factors could not be assessed. This study restricted to measuring the occurrence rather than incidence of AMD. (2) Patients in early stage are usually asymptomatic and it is not easy to distinguish them only by routine ophthalmic examination. Thus, the true association of early AMD is more likely to be underestimated; however, to overcome this, we have highlighted both early and late AMD. (3) A higher level of BMI tends to be associated with other unhealthy behaviors, such as lower levels of physical activity, lower vegetable consumption, and higher alcohol consumption. Hence, it could be a confounding factor. However, these confounders could not be tested due to nonavailability of the data.

Conclusion

In the Indian population, presence or severity of AMD did not seem to directly relate to any of the obesity indices. However, there is an association between severity of AMD and consumption of tobacco in population with combined obesity. AMD, being a multifactorial etiology, should be more carefully studied with a longitudinal study with a similar design for prevention of its progression by altering the lifestyle-related risk factors.

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Conflicts of interest

There are no conflicts of interest.

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