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Paper-Original Article

To find out the correlation between modifiable risk factors like Body Mass Index (BMI), waist circumference and smoking with Age-related macular degeneration (AMD).

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Abstract

Aim : To find out the correlation between modifiable risk factors like Body Mass Index (BMI), waist circumference and smoking with Age-related macular degeneration (AMD).
Materials and methods: In this hospital-based, observational, case-control study, 60 patients presenting to our outpatient department over a period of two year were included. The selected participants were grouped into the AMD group which included 30 eyes with non-neovascular AMD and neovascular AMD along with 30 eyes as a control group. All participants underwent comprehensive ophthalmological examination along with measurement of weight, height and waist circumference.
Results: 30 eyes of 30 patients diagnosed to have AMD and 30 eyes of 30 age-matched controls were included in this study. The mean age was 66 years (49-85 years). The mean BMI (weight in kilograms [kg]) / (height in meters [m])^2 in patients with neovascular AMD was 27.74 kg/m^2 ± 4.93 (n=19). The mean BMI in patients with non-neovascular AMD was 25.58 kg/m^2 ± 2.90 (n=31) whereas mean BMI in the control group was 23.85 kg/m^2 ± 3.31 (n=50). There was a statistically significant difference between the two AMD groups and the control group with respect to BMI (ANOVA; F=8.605; DF=2; p<0.001). The mean waist circumference (cm) in patients with neovascular AMD was 104.63 cm ± 5.78 (n=19). The mean waist circumference in patients with non-neovascular AMD was 102.677 cm ± 6.11 (n=31) whereas mean waist circumference in the control group was 91.74 cm ± 6.70 (n=50) and the difference was statistically significant (ANOVA; F=42.70; DF=2; p<0.001). Statistically significant difference was observed between the smokers belonging to case and control groups (ANOVA; F=13.967; DF=2; p<0.001).
Conclusion: A statistically significant correlation exists between BMI, waist circumference, smoking and severity of AMD.
Key words: Body mass index; Neovascular age-related macular degeneration; non-neovascular age-related macular degeneration; smoking; waist circumference

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Introduction : Advancement in the light of pioneering and ground-breaking research work has created a scenario wherein the ophthalmologist today is capable of offering far greater precision and predictability to the patient. However, we still remain plagued with inadequacies while dealing with a number of subjects; subjects that continue to be the cause of significant morbidity. Age-Related Macular Degeneration (AMD) is one of such spheres, where lack of conclusiveness in our understanding of the pathogenesis and treatment options renders us in a spot of uneasiness.

AMD is characterized by progressive degeneration of retinal pigment epithelial (RPE) complex/ photoreceptors primarily in the macular region of the retina affecting elderly population. [1] The prevalence of AMD was 3.4% (prevalence of early and late AMD was 2.0% and 1.4%, respectively) as per the India Eye Study (INDEYE). [2] The conventional classification divides AMD into two forms: 1. Dry or Non-neovascular AMD and 2. Wet or Neovascular AMD. Dry AMD is characterized by the death of cells in the macula, geographic atrophy and wet AMD is characterized by choroidal neovascularization and/or RPE detachment. Increasing age is the most important risk factor for AMD. There are very few studies that document the association of AMD with modifiable risk factors. Our study aims to analyze the correlation between AMD and body mass index (BMI), waist circumference (WC) and smoking.

Mateials and Methods : The study was conducted after obtaining approval from the institutional ethics committee and the scientific research committee. It was a hospital-based, observational, case-control study. 60 patients presenting to our outpatient department over a period of two year were included. Inclusion criteria consisted of age more than 40 years and presence of AMD. The selected participants were grouped into the AMD group which included 30 eyes with either non-neovascular or neovascular AMD and 30 eyes in control group. Patients with co-existing retinal pathology, media opacities, any systemic inflammatory disease, known renal disease were excluded from the study.

Recruitment of patients was done after a comprehensive ophthalmologic evaluation by an experienced ophthalmologist. The diagnosis was made after slit lamp biomicroscopic examination with + 90 Diopter (D) lens, indirect ophthalmoscopy with +20 D lens, fundus fluorescein angiography (FFA) and indocyanine green angiography (ICGA).

A detailed systemic examination was done in all the cases including, a general physical examination, body weight in kilogram (kg) and height in meter (m) and waist circumference in centimeter (cm). BMI was calculated using the formula weight (kg) / height^2 (m^2).

Results : Collected data was subjected to a master tabulation in Microsoft Excel 2010 spreadsheet according to the study protocol. SAS enterprise guide 4.3 and SPSS 21.0 software was used for statistical analysis. A p-value of less than 0.05 was considered to be statistically significant. Data was analyzed using the Kruskal-Wallace test and Anderson-Darling and Kolmogorov-Smirnov (ANOVA) test.

The mean age was 66 years (49-85 years). Mean age in the AMD group was 67.26 ± 7.96 years (49-83 years) and mean age in the control group was 65.4 ± 7.86 (50-

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85 years) . There was no significant difference between the case and control group with respect to the age (p = 0.2426 and t = 1.176 at 95% CI and 98 DF). In the AMD group, non-neovascular AMD was seen in 21 eyes (62%) while neovascular AMD was observed in 19 eyes (38%).

The mean BMI in neovascular AMD cases was 27.74 ± 4.93 kg/m^2 (n=19) and the mean BMI in non-neovascular AMD cases was 25.58 ± 2.90 kg/m^2 (n=31) whereas mean BMI in control group was 23.85 ± 3.31 kg/m^2 (n=50). There was a statistically significant difference between the control group and the two AMD groups separately. (ANOVA; F=8.605; DF=2; p<0.001). Linear regression analysis showed that a unit increase in BMI leads to 4.282 times increased chance of having AMD which was statistically significant (p<0.001).

The mean waist circumference in the neovascular AMD cases was 104.63 ± 5.78 cm (n=19), non-neovascular AMD cases was 102.677 ± 6.11 cm (n=31) and in the control group was 91.74 ± 6.70 cm (n=50). There was a statistically significant difference between the control group and the two AMD groups separately (ANOVA; F=42.70; DF=2; p<0.001). Linear regression analysis showed that a unit increase in waist circumference leads to 7.942 times increased chance of having AMD which was statistically significant (p<0.001). Linear regression analysis showed that smokers had a 1.78 times increased risk of having AMD which was statistically significant (p<0.001).

Discussion : Due to increase in life expectancy of population along with a reduction in avoidable blindness due to the anterior segment abnormalities the global burden of AMD is likely to double by 2020 to 6 million. [3] Hence, it has occupied an important place in World Health Organization action plan to reduce the global burden of avoidable blindness by 2020. [3] This study aims to establish an association between modifiable risk factors and AMD.

The mean age of patients in AMD and control group in the present study was 67.26 ± 7.96 years and 65.6 ± 7.86 years respectively. Subramani et al reported similar findings in their study, that is, the mean age in the AMD and control group was 68.75 ± 9.23 years and 64.61 ± 9.24 years respectively. [4] In a study by Moeini *et al*, the mean age of the participants was 69.9 years. [5] In a study by Schaumberg *et al*, patients with AMD were within the age group of 40-84 years. [6]

In the present study, it was found that the mean BMI in patients with AMD was 26.40 kg/m^2 and in the control group was 23.85 kg/m^2. After statistical analysis, it was observed that BMI in patients with AMD was significantly higher (p<0.001) than the control group.

Linear regression analysis of BMI amongst the 3 groups showed that a unit increase in BMI increases the risk of AMD by 4.28 times. In a study by Seddon *et al*, based on a multivariate model in relation to obesity measures and other variables on the risk of progression of AMD, they observed that higher levels of BMI were associated with increased risk of AMD progression which was statistically significant (p=0.07). [7] It was observed that in patients having BMI in range of 25-29 the relative risk of AMD was 2.32 and for patients with BMI ≥ 30 the relative risk of AMD was 2.35. In Age-Related Eye Disease Study (AREDS), it was found that higher BMI was associated with the development of neovascular AMD. [8] In a study by Hirvela *et al,* the investigators proposed that excessive caloric intake increases the risk of oxidative damage which leads to the development of AMD. [9]

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In the present study, it was observed that the waist circumference varied significantly in AMD and control groups (p<0.001). On linear regression analysis of waist circumference as a risk factor for developing AMD, it was demonstrated that patients with larger waist circumference had a 7.94 times higher likelihood of having AMD as compared to control group. In a study by Seddon *et al*, it was found that higher waist circumference leads to 2-fold increase the risk of progression of AMD (p=0.02). [7] A study by Adams *et al*, showed that the odds of developing early AMD was 0.9 (p=0.7) and late AMD was 1.83 (p=0.02). [10]

Similar to BMI, waist circumference has been also considered as an informative measure of obesity. Waist circumference describes various patterns of abdominal adiposity which has a different metabolic consideration as compared to patterns of overall fat distribution. Waist circumference is a significant factor in predicting the occurrence of metabolic syndrome which in turn predisposes to vascular stress and AMD. As an indicator of overall mortality and coronary heart disease, waist circumference has gained importance in the current scenario. [11] However, no study in the literature so far has demonstrated a correlation between the waist circumference and AMD.

In the present study, we observed that there was a significant association between smoking and the occurrence of AMD (p<0.001). On linear regression analysis, we observed that smokers had 1.17 times increased the risk of developing AMD as compared to the non-smokers. The AREDS study demonstrated that the risk of developing geographic atrophy was 1.61 times and that of neovascular AMD was 1.91 times higher amongst the smokers. [8] In a study by Chakravarthy *et al* for comparing the risk of developing AMD amongst smokers and non-smokers, they found that the smokers had a 5 times higher risk of developing geographic and a 2.5 times higher risk of developing neovascular AMD as compared to non-smokers. Smoking leads to a decrease in the level of circulating antioxidants and thereby increasing the free radical-mediated cytotoxicity. This hypothesis is consistent with findings of the study by Stryker *et al*, who reported that, after adjustment of the dietary differences, the smokers had only 72% of plasma β– carotene levels as compared to the non-smokers. Smoking could also cause hypoxic changes by reducing the circulating oxygen levels and increasing the levels of carbon monoxide thus promoting atherosclerosis which in turn damages the choroidal vessels. [13]

There are a few limitations of this study. Since the present study does not categorize the patients according to the stage of AMD (early and late), the effects of the risk factors on the progression of the disease could not be established clearly. As the patients were not followed the change in the progression of the disease as a result of alteration in the modifiable risk factors could not be ascertained. A prospective cohort study design would have given a more conclusive result in regards to the above associations.

Conclusion : A statistically significant correlation exists between BMI, waist circumference, smoking and severity of AMD. As is evident from the findings of this study, patients presenting with a higher BMI and waist circumference will benefit from regular screening to detect early changes associated with AMD thereby helping to prevent severe vision loss associated with the pathology. Community-based awareness should be generated regarding the modifiable risk factors for prevention of AMD.

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