



The Role of Diet, Micronutrients and the Gut Microbiota in Age-Related Macular Degeneration: New Perspectives from the Gut–Retina Axis

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Age-related macular degeneration (AMD) is a complex multifactorial disease and the primary cause of legal and irreversible blindness among individuals aged ≥ 65 years in developed countries. Globally, it affects 30–50 million individuals, with an estimated increase of approximately 200 million by 2020 and approximately 300 million by 2040. Currently, the neovascular form may be able to be treated with the use of anti-VEGF drugs, while no effective treatments are available for the dry form. Many studies, such as the randomized controlled trials (RCTs) Age-Related Eye Disease Study (AREDS) and AREDS 2, have shown a potential role of micronutrient supplementation in lowering the risk of progression of the early stages of AMD. Recently, low-grade inflammation, sustained by dysbiosis and a leaky gut, has been shown to contribute to the development of AMD. Given the ascertained influence of the gut microbiota in systemic low-grade inflammation and its potential modulation by macro- and micro-nutrients, a potential role of diet in AMD has been proposed. This review discusses the role of the gut microbiota in the development of AMD. Using PubMed, Web of Science and Scopus, we searched for recent scientific evidence discussing the impact of dietary habits (high-fat and high-glucose or -fructose diets), micronutrients (vitamins C, E,

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[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6267253/#:~:text=Altered%20dietary%20habits%2C%20dysbiosis%20and,related%20macular%20degeneration%20\(AMD\).](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6267253/#:~:text=Altered%20dietary%20habits%2C%20dysbiosis%20and,related%20macular%20degeneration%20(AMD).)

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Gut Microbiome in Retina Health: The Crucial Role of the Gut-Retina Axis

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The term microbiome means not only a complex ecosystem of microbial species that colonize our body but also their genome and the surrounding environment in which they live. Recent studies support the existence of a gut-retina axis involved in the pathogenesis of several chronic progressive ocular diseases, including age-related macular disorders. This review aims to underline the importance of the gut microbiome in relation to ocular health. After briefly introducing the characteristics of the gut microbiome in terms of composition and functions, the role of gut microbiome dysbiosis, in the development or progression of retinal diseases, is highlighted, focusing on the relationship between gut microbiome composition and retinal health based on the recently investigated gut-retina axis.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8795667/>

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Association between Age-Related Macular Degeneration and the Risk of Diabetes Mellitus: A Nationwide Cohort Study

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[Associated Data](#)

> [Diabetes Metab.](#) 2023 May;49(3):101442. doi: 10.1016/j.diabet.2023.101442. Epub 2023 Mar 16.

Association between glycemic status and age-related macular degeneration: A nationwide population-based cohort study

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<https://pubmed.ncbi.nlm.nih.gov/36931431/>

[Sci Rep.](#) 2015; 5: 10585.

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Homocysteine and the risk of age-related macular degeneration: a systematic review and meta-analysis

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Contrasting results have been reported regarding the associations between plasma total

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C-Reactive Protein as a Therapeutic Target in Age-Related Macular Degeneration

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<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5916960/>

[Front Med \(Lausanne\)](#). 2022; 9: 923282.

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Reduced serum magnesium is associated with the occurrence of diabetic macular edema in patients with diabetic retinopathy: A retrospective study

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Vitamin D and Age-Related Macular Degeneration

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In recent years, the relationship between vitamin D and health has received growing attention from the scientific and medical communities. Vitamin D deficiencies have been repeatedly associated with various acute and chronic diseases, including age-related macular degeneration (AMD). Its active metabolite, 1 α ,25-dihydroxy vitamin D, acts as a modulator of cell proliferation, differentiation and apoptosis, and cumulative data from experimental and observational studies suggest that relatively a lower vitamin D status could be a potential risk factor for the development of early and/or late AMD. Herein, we made a narrative review of the mechanisms linking a potential role of vitamin D with the current concepts of AMD pathophysiology.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5691736/>

