

# From Inner Balance to Visual Health: Unraveling the Therapeutic Role of Yoga in Optic Neuropathy and Ocular Manifestations – Narrative Review

## Abstract

The optic nerve comprises approximately 1.2 million axons of retinal ganglion cells and is vulnerable to degeneration due to a myriad of causes. While traditional treatments have been the cornerstone of ocular care, emerging evidence highlights the benefits of integrative approaches, which can be used as an adjunct in the management of optic neuropathy. Yoga is a mind–body energy medicine encompassing physical postures, breath control, and meditation. Currently, it has gained attention for its holistic effects on well-being, by promoting health, preventing onset of diseases, adjunct in disease management, and for its rehabilitative potential. In addition, the underlying mechanisms through which yoga exerts its therapeutic influence, evaluates clinical outcomes, and explores potential synergistic effects with conventional treatments remain largely unexplored. Neuroprotective mechanisms of yoga, such as enhancing retinal ganglion cell function, reducing oxidative stress, coupled with its ability to modulate inflammatory processes and improve circulation, contribute to its potential benefits in visual health. Analysis of clinical studies reveals promising outcomes, including improvements in visual acuity, visual fields, quality of life, and functional outcomes in individuals with optic neuropathy and ocular manifestations who undergo yoga intervention (especially dhyaan) with awareness of breath. Furthermore, the integration of yoga with conventional treatments and complementary modalities unveils the possibilities of multidisciplinary approaches in ocular care that need evaluation. By unraveling the role of yoga intervention in ocular health, this review provides valuable insights for clinicians and researchers, fostering a deeper understanding of the mind–body connection and paving the way for enhanced visual health outcomes. Embracing yoga as an adjunctive therapy may have the potential to revolutionize the management of optic neuropathy and ocular manifestations, offering individuals a holistic approach to optimize visual well-being, reduce comorbid depression and caregiver burden, and improve overall quality of life.

**Keywords:** *Integrative approaches, meditation optic neuropathy, neuroprotection, visual health, yoga*

## Introduction

Optic neuropathy, characterized by damage or dysfunction of the optic nerve, is a debilitating condition that significantly impacts visual health. It encompasses a range of disorders, including ischemic optic neuropathy, optic neuritis, and glaucomatous optic neuropathy, which can lead to various ocular manifestations such as visual field defects, decreased visual acuity, altered color perception, and changes in the optic nerve disc. The consequences of optic neuropathy and its ocular manifestations are far-reaching, affecting individuals' ability to perform daily tasks, reducing their independence, and deteriorating their overall quality of life.<sup>[1]</sup> Visual impairment and functional limitations resulting from

these conditions can have profound social, emotional, and economic implications for those affected.<sup>[2]</sup> Understanding the underlying mechanisms involved in optic neuropathy and ocular manifestations is crucial for developing effective treatment strategies. Researchers have revealed the pathophysiology of these conditions, including factors such as ischemia, inflammation, oxidative stress, and neuronal apoptosis.<sup>[3]</sup> For example, studies have shown that hypertension, diabetes, and smoking are associated with an increased risk of nonarteritic anterior ischemic optic neuropathy.<sup>[4,5]</sup> Recent studies have also shown an increased risk of optic neuropathy in Alzheimer's disease and Parkinsonism. In cases of optic neuritis, intravenous

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corticosteroid treatment has shown benefits in accelerating visual recovery.<sup>[6]</sup> In addition, identifying biomarkers such as retinal nerve fiber layer thickness has provided insights into disease progression and visual recovery in optic neuritis patients. In the case of glaucomatous optic neuropathy, reducing intraocular pressure (IOP) has been identified as a key factor in slowing disease progression.<sup>[7]</sup> A study on ocular hypertension demonstrated the efficacy of topical ocular hypotensive medication in delaying or preventing primary open-angle glaucoma.<sup>[8]</sup> This evidence contributes to the understanding, diagnosis, and management of optic neuropathy and ocular manifestations, enabling the development of diagnostic criteria, treatment guidelines, and therapeutic interventions. However, there is a pressing need to advance our knowledge in the field of optic neuropathy and ocular manifestations to optimize clinical management.

Visual health encompasses the well-being of the eyes and the optimal functioning of the visual system. While various interventions exist for managing visual health, the therapeutic role of yoga remains an area that has received limited exploration. Yoga, a mind–body practice that combines asanas, pranayama, and dhyaan (meditation), has been widely recognized for its potential benefits in promoting overall well-being and improving physical and mental health. The holistic nature of yoga, which addresses physical, psychological, and spiritual activity, suggests its potential relevance in promoting visual health. By incorporating specific yoga practices, majorly dhyaan that focus on eye exercises, relaxation techniques, and stress reduction, it may be possible to enhance blood circulation to the eyes, alleviate eye strain, and reduce the impact of stress on visual function.<sup>[9]</sup> Furthermore, the mindfulness and meditative phases (dhyaan) of yoga contribute to improved focus, attention, and visual perception and induce the relaxation response. Exploring the therapeutic role of yoga in visual health has the potential to uncover new insights, develop evidence-based interventions, and provide holistic approaches to support individuals with visual impairments and ocular conditions.<sup>[10]</sup> Further research elucidated the specific effects of yoga on visual health and to develop yoga interventions for individuals with visual challenges.<sup>[11]</sup> Hence, we aimed to conduct a literature search using the keywords “optic neuropathy,” “yoga therapy,” “Trataka,” and “visual health” in databases such as PubMed and Google Scholar, focusing on articles published in the last approximately 15 years. We comprehend the role of yoga in visual health, with a specific focus on optic neuropathy and ocular manifestations. By exploring the available evidence, this review uncovers the impact of yoga on visual health outcomes, such as visual acuity, eye strain, glaucoma, and raised IOP and overall well-being. The scope of this review encompasses studies of different yoga interventions and their impact on visual health conditions.

## Yoga: Principles and Practices

Yoga, originating from ancient Indian traditions, is a holistic mind–body practice that encompasses physical postures (asanas), controlled breathing techniques (pranayama), and meditation. It promotes the integration of body, mind, and spirit to enhance overall well-being. The practice of yoga involves harmonizing physical movements with breath awareness, fostering a deep sense of connection within oneself and the surrounding environment. Through the combination of physical postures, controlled breathing, and mental focus, yoga offers a comprehensive approach to promoting physical fitness, mental clarity, emotional balance, and spiritual growth.<sup>[12]</sup> Numerous studies have demonstrated the beneficial effects of yoga on various aspects of health, including stress reduction, improved flexibility and strength, enhanced mental focus, and reduced anxiety and depression. In addition, yoga has been shown to have positive effects on cardiovascular health, immune function, and overall quality of life. Its holistic nature and emphasis on mind–body connection make yoga a promising therapeutic modality for various health conditions, including those related to visual health.<sup>[13,14]</sup> Meditation induces relaxation response and thus reduces cortisol levels and it also impacts the epigenome, which is highly beneficial as it switches on the expression of genes which reduce inflammation, decrease oxidative stress, apoptosis, aid in aqueous outflow, and promote neuronal health by upregulating expression of various genes which code for neurotrophic factors, which promote neuroplasticity and also enhance blood flow. This has been documented by enhanced expression of these genes.<sup>[15,16]</sup>

Research study has shown that regular practice of yoga postures can lead to improvements in musculoskeletal health, such as increased range of motion and reduced pain in individuals with conditions such as arthritis or back pain.<sup>[17]</sup> Breath control techniques in yoga, such as deep breathing exercises and alternate nostril breathing, have been found to have positive effects on the autonomic nervous system, promoting relaxation, reducing stress, and improving respiratory function.<sup>[18]</sup> In addition, meditation, a fundamental aspect of yoga, involves focusing the mind and achieving a state of mental clarity and mindfulness. Studies have demonstrated the benefits of meditation in reducing anxiety, improving attention and cognitive function, and enhancing overall mental well-being. The combination of these key components in yoga provides a comprehensive approach to promote physical, mental, and emotional well-being. The evidence supporting the efficacy of these components underscores their potential in enhancing various aspects of health and highlights the significance of their integration into yoga practice.<sup>[19]</sup>

The practice of yoga is rooted in various theoretical foundations that contribute to its ability to promote well-being and balance. One such foundation is the

concept of mind–body connection, which emphasizes the interplay between mental and physical health. Yoga incorporates physical postures (asanas), breath control (pranayama), and meditation to facilitate this connection, enhancing self-awareness, reducing stress, and fostering a sense of inner balance. Another theoretical basis is the yogic philosophy of holistic health, which acknowledges the interconnectedness of physical, mental, and spiritual dimensions. By cultivating mindfulness, yoga helps individuals develop a deeper understanding of their thoughts, emotions, and bodily sensations, leading to improved self-regulation and overall well-being. In addition, the practice of yoga promotes the activation and dominance of the parasympathetic nervous system, facilitating relaxation and stress reduction.<sup>[20]</sup> Recent research has demonstrated the benefits of yoga in improving mental health outcomes, such as reducing symptoms of anxiety and depression, enhancing emotional resilience, and improving quality of life. Moreover, studies have shown the positive effects of yoga on physiological markers of well-being, including reduced inflammation, improved immune function, and better cardiovascular health.<sup>[21]</sup> The details of the different types of yoga, the impact of yoga types and asanas, which may associate and modulate to patients of ocular neuropathy, along with their advantages

and limitations, are listed in Table 1. The theoretical foundation lifestyle modifications provide a framework for understanding how yoga can promote holistic well-being and balance in individuals, offering a valuable approach to enhance overall health and quality of life.

### Pathophysiology of Optic Neuropathy and Ocular Manifestations

The pathophysiology of optic neuropathy and ocular manifestations involves complex mechanisms that impact visual health. Optic neuropathy refers to damage or dysfunction of the optic nerve, which can result from various factors such as ischemia, inflammation, or compression. This can lead to impaired transmission of visual signals from the eye to the brain, resulting in visual deficits. On the other hand, ocular manifestations encompass a wide range of conditions affecting different structures of the eye, including the cornea, lens, retina, and optic nerve. These manifestations can include abnormalities in visual acuity, color vision, visual field, and IOP regulation.<sup>[31]</sup> The underlying pathophysiological processes involve various key modulators, including disruptions in blood flow, oxidative stress, neuroinflammation, and neurodegenerative changes.<sup>[32]</sup> Understanding the intricate mechanisms involved in optic neuropathy and ocular manifestations is

**Table 1: The impact of different yoga types and asanas on ocular neuropathy: Advantages and limitations**

Yoga types	Asanas (Yoga poses)	Ocular neuropathy disease type	Clinical implication	Advantages	Limitations	References
Hatha yoga	Shavasana, Shalabhasana, Trataka	Optic neuropathy	May improve blood circulation to the optic nerve, potentially aiding in recovery	Promotes relaxation, stress reduction, and overall well-being	Requires proper guidance for beginners	[22-24]
Iyengar yoga	Tadasana, Viparita Karani, Setu Bandhasana	Ischemic optic neuropathy	A y enhances body awareness and alignment, which may help reduce strain on the eyes	Focuses on precision and correct alignment	Requires the use of props and may be less accessible for some individuals	[25,26]
Kundalini yoga	Anulom Vilom, Kapalabhati, Sirsasana	Leber hereditary optic neuropathy	May improve energy flow and oxygenation, potentially benefiting the optic nerve	Emphasizes breath control and meditation	Involves dynamic movements that may be challenging for beginners	[26,27]
Ashtanga yoga	Surya Namaskar, Padmasana, Bhujangasana	Toxic optic neuropathy	May promotes strength, flexibility, and mindfulness, potentially aiding in overall eye health	Follows a specific sequence of poses for rigorous practice	Requires physical fitness and may not be suitable for individuals with certain health conditions	[28]
Yin yoga	Balasana, Anahatasana, Supta Matsyendrasana	Glaucoma	May help reduce intraocular pressure and promote relaxation	Gentle and slow-paced practice	Requires modifications for individuals with limited flexibility	[26]
Restorative yoga	Viparita Karani, Supta Baddha Konasana, Savasana	Optic neuritis	May facilitates relaxation, stress reduction, and healing of the optic nerve	Promotes deep rest and rejuvenation	Requires the use of props and guidance for proper alignment	[29]
Pranayama	Nadi Shodhana, Bhramari, Kapalabhati	Neurooptic diseases (various)	May enhance oxygenation and circulation to the eyes and optic nerve	Focuses on breath control and relaxation	Requires proper guidance and caution for individuals with respiratory conditions	[18,29,30]

crucial for developing effective therapeutic interventions. By targeting these specific mechanisms, it may be possible to prevent or mitigate visual impairments and promote ocular health. However, further research is needed to elucidate the underlying pathophysiology and identify novel therapeutic targets for the management of optic neuropathy and ocular manifestations. The current research has provided insights into various factors contributing to these conditions. Vascular factors, such as impaired blood flow and ischemia, have been implicated in optic neuropathy, particularly in glaucoma and ischemic optic neuropathy.<sup>[33]</sup> Inflammation, including autoimmune disorders such as optic neuritis, plays a significant role in optic nerve damage. Oxidative stress, neuroinflammation, and mitochondrial dysfunction are also identified mechanisms in the pathogenesis of optic neuropathy.<sup>[34]</sup> In addition, genetic factors and systemic diseases such as diabetes and multiple sclerosis increase the risk of optic nerve damage and ocular manifestations.<sup>[35]</sup> Animal models, clinical observations, and molecular investigations have contributed to our understanding of these underlying mechanisms and causes. Unraveling these complex pathways will aid in identifying potential therapeutic targets and developing interventions to prevent or slow the progression of optic neuropathy and ocular manifestations.<sup>[36]</sup> The impact of optic neuropathy and ocular manifestations on visual function and overall ocular health is a significant concern. It has been shown that the detrimental effects of these conditions can have on visual acuity, contrast sensitivity, color vision, visual field, and other aspects of visual function. It results in permanent visual impairment and even blindness, affecting the individual's quality of life. Ocular manifestations, such as corneal abnormalities, cataracts, and retinal degeneration and further contribute to visual deficits and compromised ocular health.<sup>[37]</sup> Several studies have investigated the impact of optic neuropathy and ocular manifestations on visual function using various assessment tools and techniques, including visual field testing, optical coherence tomography, electroretinography, and visual acuity measurements.<sup>[2,38,39]</sup> These studies have provided valuable insights into the extent of visual impairment and ocular pathology associated with these conditions.

### **Yoga and Optic Neuropathy: Evidence from Preclinical to Clinical Studies**

Yoga shows promise as a therapeutic intervention for optic neuropathy based on preclinical studies. Animal and *in vitro* research studies indicate that yoga can improve optic nerve function and health by reducing retinal ganglion cell death, preserving retinal thickness, enhancing retinal blood flow, and improving mitochondrial function. These effects may be attributed to the reduction of oxidative stress, modulation of inflammation, and improvement in blood flow.<sup>[40]</sup> Yoga not only reduces cortisol levels but also reduces inflammation, oxidative stress, hypoxia, and apoptosis and promotes the

health of retinal ganglion cells by secretion of various neurotrophic factors and by improving mitochondrial integrity as these cells are high energy-demanding cells.<sup>[41]</sup> It has been shown that using animal models, including mice in glaucoma research, allowing the investigation of molecular and pathological aspects through various models and genetic manipulation, greatly advancing our understanding of the disease.<sup>[42]</sup> In a randomized controlled trial (RCT), it has been reported that improved retinal blood flow was observed in patients with acute normal tension glaucoma following yoga practice. *In vitro* studies have provided further insights into the cellular mechanisms underlying yoga's effects.<sup>[43]</sup> It has been demonstrated that yoga practice reduced oxidative stress markers, improved mitochondrial function, and enhanced cellular viability in retinal cells. These findings collectively suggest that yoga interventions have the potential to improve optic nerve function and health through various mechanisms, including reducing cell death, enhancing blood flow, and mitigating oxidative stress.<sup>[44]</sup> However, further research is required to fully validate these findings and establish the therapeutic efficacy of yoga in the management of optic neuropathy. The neuroprotective mechanisms and potential therapeutic pathways underlying the effects of yoga on optic nerve function and health have been explored in various research studies. In a study, it has been indicated that yoga practice can reduce oxidative stress, which is a key contributor to optic nerve damage.<sup>[45]</sup> In addition, yoga has been associated with the modulation of inflammation, as evidenced by decreased pro-inflammatory cytokine levels and increased levels of anti-inflammatory cytokines.<sup>[22]</sup> Improved blood flow is another therapeutic pathway attributed to yoga, as it enhances the delivery of oxygen and nutrients to the optic nerve, promoting its function and health.<sup>[26]</sup> Furthermore, yoga's impact on stress reduction in inducing relaxation response and the regulation of the autonomic nervous system may also reduce the diurnal variations in IOP.<sup>[46]</sup> These findings suggest that the modulatory effects of yoga on optic neuropathy may be mediated through a combination of antioxidant, anti-inflammatory, vasodilatory, and stress-regulating mechanisms.

Clinical studies investigating the effects of yoga on ocular manifestations have provided valuable insights into its potential therapeutic benefits. In a RCT demonstrated that yoga interventions improved visual acuity and contrast sensitivity in patients with age-related macular degeneration.<sup>[47]</sup> Similarly, a study reported that significant improvements in IOP and visual field parameters in individuals with the primary open-angle glaucoma following a yoga-based intervention.<sup>[48,49]</sup> A case study, it has been highlighted that a patient with congenital glaucoma who experienced progressive optic neuropathy after regularly practicing the Sirsasana yoga posture. IOP significantly increased during this posture, raising concerns about potential glaucomatous optic nerve damage in

susceptible individuals.<sup>[50]</sup> In a randomized trial study involving 164 normal individuals, specific nasal breathing techniques (pranayama), such as right and left nostril breathing, were found to be safe and demonstrated a beneficial effect by lowering IOP in both eyes, providing insights into potential IOP management through yogic breathing exercises.<sup>[51]</sup> In a randomized control trial study, the effects of Tratak (Yogic Ocular Exercises) on IOP in glaucoma were observed. In this study, yogic ocular exercise, including extraocular muscles exercise and modified Tratak Kriya were given for 4 weeks glaucoma. Within the intervention group, a reduction in IOP was observed on day 14–day 28, suggesting larger studies to assess the potential benefits of yoga-based interventions in glaucoma management.<sup>[47]</sup> In a RCT conducted in Egypt with 62 type 2 diabetes mellitus patients having high tension primary open-angle glaucoma, practicing Jyoti-trataka for 55 min per day over 1 month led to significant reductions in IOP, systolic and diastolic blood pressure, pulse rate, respiratory rate, and fasting blood glucose compared to the control group receiving glaucoma medication alone.<sup>[49]</sup> A study involving 41 healthy participants found that Trataka (yogic visual concentration) sessions, including eye exercises, significantly improved working memory, spatial memory, and spatial attention compared to eye exercise sessions and baseline assessments, highlighting the cognitive benefits of Trataka.<sup>[52]</sup> A 6-week RCT in India involved 60 moderate and severe primary open-angle glaucoma patients, with 30 in a yoga group receiving standard medical treatment and 30 in a control group with only standard medical treatment. The yoga group practiced 45 min of daily meditation focused on breathing, resulting in a significant reduction in IOP, serum cortisol, interleukin (IL)-6 levels, and reactive oxygen species. Functional near-infrared spectroscopy indicated increased prefrontal cortex oxygenation in the yoga group, and they also showed improved quality of life, higher serum beta-endorphin, brain-derived neurotrophic factor (BDNF), and total antioxidant capacity compared to the control group.<sup>[23]</sup> In a prospective observational study conducted in the USA, ten primary open-angle glaucoma patients and ten normal individuals practiced specific yoga poses, including Adhomukha Svanasana, Uttanasana, Halasana, and Viparita Karani. These poses caused a significant and rapid increase in IOP within 1 min, with Adhomukha Svanasana inducing the highest increase, returning to baseline levels within 2 min after assuming a sitting position.<sup>[53]</sup> In a case report from the USA, a juvenile open-angle glaucoma patient practicing the headstand pose (Sirsasna) experienced a significant increase in IOP during the pose, which returned to a normal range but remained higher than baseline afterward.<sup>[54]</sup> Another case report from Switzerland noted a two-fold increase in IOP during the headstand position, which later showed visual field improvement after discontinuing the pose.<sup>[55]</sup> These findings highlight the potential benefits of yoga interventions in enhancing

visual acuity, expanding visual fields, and improving other clinical outcomes related to ocular health. However, further research is needed to validate these findings and establish the long-term effects of yoga on visual function.

### Mechanisms of Yoga in Promoting Visual Health

The therapeutic influence of yoga on optic neuropathy and ocular manifestations is believed to involve a range of underlying mechanisms. Research studies have shed light on these mechanisms, providing valuable insights into how yoga promotes visual health. One mechanism is the modulation of the autonomic nervous system, with yoga practices such as deep breathing and meditation promoting a shift toward parasympathetic dominance, thereby reducing sympathetic activity and stress-related responses. This has been associated with improvements in ocular blood flow, oxygenation, increase in various neurotrophic factors, and nutrient delivery to the optic nerve.<sup>[22,43,53]</sup> Yoga is also known to have anti-inflammatory effects, as evidenced by reductions in pro-inflammatory cytokines and markers of inflammation in various conditions.<sup>[22,56]</sup> Inflammation plays a crucial role in optic neuropathy; yoga causes a decrease in inflammatory cytokines such as IL6, tumor necrosis factor- $\alpha$ , and NF- $\kappa\beta$  and thus may help mitigate its detrimental effects.<sup>[41]</sup> Furthermore, yoga has been shown to enhance antioxidant defense mechanisms, reducing oxidative stress, and cellular damage; oxidative stress is reduced due to reduced free radical levels and optimal adenosine triphosphate (ATP) production which is required for optimal neuronal function and this due to improvement in mitochondrial integrity due to upregulation in levels of various factors which enhance mitochondrial biogenesis and integrity and also due to increase in levels of NAD, other proposed mechanisms include improved mitochondrial function and energy metabolism, neuroplasticity, and neuroprotection and enhanced mind–body connection and self-regulation.<sup>[57]</sup> These mechanisms collectively contribute to the therapeutic effects of yoga on visual health. However, further research is needed to fully elucidate the specific pathways and interactions involved in yoga's beneficial effects on optic neuropathy and ocular manifestations.

The therapeutic effects of yoga on optic neuropathy and ocular manifestations can be attributed to various factors, including neuroplasticity, inflammation modulation, stress reduction, and other relevant mechanisms. Neuroplasticity refers to the brain's ability to reorganize and adapt in response to new experiences, and yoga has been shown to promote neuroplastic changes in the brain.<sup>[58]</sup> Thus, yoga causes not only increase in the levels of various factors which promote neuroplasticity such as dehydroepiandrosterone (DHEA), BDNF, serotonin, and melatonin; it also reduces stress and anxiety and builds emotional resilience.<sup>[53]</sup> These changes can potentially enhance neural pathways related to visual processing

improve visual function in individuals with optic neuropathy, enhance their coping mechanism, and thus also reduce caregiver burden.

Inflammation modulation is another key mechanism through which yoga may exert its beneficial effects on ocular health. Chronic inflammation is known to contribute to the progression of optic neuropathy and ocular manifestations. Several studies have demonstrated that yoga interventions can reduce inflammatory markers, such as C-reactive protein and IL-6, thereby mitigating inflammation.<sup>[41,59]</sup> By reducing inflammation, yoga may help protect the optic nerve and preserve visual function.

Stress reduction is a well-known benefit of yoga, and it plays a crucial role in promoting visual health. Chronic stress has been associated with increased risk and severity of optic neuropathy. Yoga practices, including deep breathing, relaxation techniques, and mindfulness meditation, have been shown to reduce stress hormones, such as cortisol, and improve stress resilience. By reducing stress, yoga may help alleviate the burden on the visual system and support optimal visual health.<sup>[47,60]</sup> Other relevant factors that contribute to the therapeutic effects of yoga on optic neuropathy and ocular manifestations include improved sleep quality, enhanced antioxidant defense mechanisms, and enhanced mind–body connection. These factors collectively may contribute to the overall well-being and balance of the visual system, potentially leading to improved visual function and better ocular health outcomes.<sup>[61]</sup>

### **Integrative Approaches: Yoga in Combination with Conventional Treatments**

Currently, integrative approaches that may combine yoga with conventional treatments have gained attention as a potential strategy for optimizing the management of optic neuropathy and ocular manifestations. Current studies that explore the effects of combining yoga with conventional therapies may have shown promising results. For example, an RCT investigated the impact of yoga in combination with standard medical treatment on visual function in glaucoma patients. The study demonstrated that the addition of yoga interventions, including asanas (physical postures), pranayama (breath control), and meditation, led to significant improvements in visual acuity, visual field parameters, and IOP compared to the conventional treatment alone.<sup>[61]</sup> It has been shown that a combined intervention consisting of yoga, meditation, and standard medical treatment in patients with optic neuritis showed that the combined approach led to significant improvements in visual function, quality of life, and reduction in inflammatory markers compared to standard treatment alone.<sup>[22,61-63]</sup>

In another study, the outcomes of combining yoga therapy with pharmacological interventions in individuals with

diabetic retinopathy demonstrated that the combination approach resulted in improved visual acuity, reduced macular thickness, and better glycemic control compared to pharmacological treatment alone.<sup>[43]</sup> Furthermore, it has been examined that the efficacy of integrating yoga with conventional treatments for various ocular disorders. Furthermore, it has been shown that as age-related macular degeneration, glaucoma, and dry eye syndrome.<sup>[64]</sup> Other findings indicated that the combination of yoga and/or meditation and conventional therapies showed potential benefits, including improved visual function, reduced IOP, and enhanced overall ocular health.<sup>[22,47,62,63]</sup>

These studies highlight the potential synergistic effects of combining yoga with conventional treatments in the management of optic neuropathy and ocular manifestations. The integration of yoga practices, such as physical postures, breathing exercises, meditation, and relaxation techniques, may complement the effects of conventional therapies by addressing multiple aspects of the condition, including inflammation, stress, visual function, and overall well-being. While these findings are promising, it is important to note that more well-designed RCTs and long-term studies are needed to establish the optimal protocols, effectiveness, and safety of combined treatment approaches. Nonetheless, the existing evidence suggests that integrating yoga with conventional therapies holds potential for improving outcomes and enhancing the overall management of optic neuropathy and ocular manifestations.

### **Safety Considerations and Adverse Events**

Ensuring the safety of yoga interventions is paramount when considering their use in individuals with optic neuropathy and ocular manifestations. A comprehensive assessment of the safety profile of yoga in this population is essential to make informed decisions regarding its incorporation into their treatment plans. The safety aspects of yoga interventions in individuals with ocular conditions were observed. It has been shown that yoga is safe for individuals with glaucoma, as no major adverse events were reported in patients.<sup>[22,47,62,63]</sup> Individuals with specific medical conditions, such as severe eye injuries or advanced stages of optic neuropathy, may require modified or specialized yoga practices tailored to their needs. In addition, it is crucial to ensure that yoga sessions are led by qualified instructors who have knowledge and expertise in working with individuals with ocular conditions and other medical ailments.<sup>[65]</sup> Regular monitoring of participants, adherence to proper alignment and technique, and appropriate modifications to accommodate individual limitations are important safety measures to implement during yoga sessions. In summary, the available evidence suggests that yoga especially meditation is safe for individuals with optic neuropathy and ocular manifestations, but it should be done under guidance from a yoga therapist. Ensuring the safety of individuals

with optic neuropathy and ocular manifestations during yoga interventions is crucial. Reporting any adverse events that may occur and considering necessary precautions are essential aspects of promoting safe and effective practices. While yoga is generally regarded as safe, specific considerations should be taken into account to minimize risks. In addition, a study reported that appropriate precautions and modifications during yoga practice can significantly reduce the risk of adverse events.<sup>[65-67]</sup> Regular communication between participants and instructors, as well as prompt reporting of any adverse events or discomfort, is important for monitoring and addressing safety concerns. By implementing these safety measures and reporting practices, the potential benefits of yoga in improving visual health can be maximized while minimizing any associated risks.

### Future Prospective

Despite the growing evidence supporting the therapeutic role of yoga in promoting visual health and managing optic neuropathy and ocular manifestations, there are still several knowledge gaps and unexplored areas that may warrant further investigation. Identifying these gaps and addressing them in future research can provide valuable insights and contribute to the development of more effective interventions.

One important direction for future research is the need for well-designed RCTs specifically focusing on the effects of yoga interventions on visual health outcomes. RCTs with larger sample sizes, longer durations, and standardized assessment protocols can provide more robust evidence on the efficacy and safety of yoga for individuals with optic neuropathy and ocular manifestations. In addition, exploring the optimal timing, frequency, and duration of yoga practice, as well as the most effective yoga asanas or sequences, can further enhance our understanding of how to maximize the benefits for visual health.

Another area that requires attention is the exploration of specific mechanisms underlying the therapeutic effects of yoga on visual health. Investigating the neurobiological, physiological, and psychological mechanisms by which yoga influences optic nerve function, retinal health, and visual processing can provide valuable insights into the therapeutic pathways involved. This can involve studies examining changes in neural connectivity, neuroplasticity, inflammation levels, stress response, and other relevant factors in response to yoga practice.

Furthermore, it is important to consider the potential implications of integrating yoga interventions into standard care for individuals with optic neuropathy and ocular manifestations. This includes exploring the feasibility, acceptability, and cost-effectiveness of incorporating yoga into treatment protocols, as well as its potential to complement conventional therapies and improve patient

outcomes. By addressing these future directions and unexplored areas, we can further advance our understanding of the therapeutic role of yoga in visual health. This knowledge can have significant implications for the development of evidence-based guidelines, personalized treatment plans, and integrative approaches in managing optic neuropathy and ocular manifestations, ultimately improving the overall well-being and quality of life for individuals affected by these conditions. Recommendations for future research in the field of yoga and visual health or other medical conditions include the conduct of well-designed clinical trials to further investigate the efficacy and safety of yoga interventions in individuals with optic neuropathy and ocular manifestations. These trials should have larger sample sizes, longer durations, and standardized outcome measures to provide robust evidence on the therapeutic effects of yoga. In addition, there is a need for mechanistic studies to unravel the underlying physiological, neurobiological, and psychological mechanisms through which yoga influences visual health. These studies can explore changes in neural connectivity, neuroplasticity, inflammation levels, stress response, and other relevant factors. Furthermore, research should focus on identifying optimal yoga styles, sequences, and dosage to maximize the benefits for visual health. By addressing these recommendations, we can enhance our understanding of the therapeutic potential of yoga and provide evidence-based guidelines for its integration into clinical practice.

### Conclusion

This review suggests that yoga interventions, incorporating physical postures, breath control, and meditation may have promising effects on visual function, overall ocular health, and quality of life in individuals with these conditions. The review identified several possible mechanisms through which yoga exerts its beneficial effects, including neuroplasticity, inflammation modulation, stress reduction, and improved autonomic balance. These findings may show an important implications for clinical practice, as yoga can be considered an adjunctive therapy in the management of optic neuropathy and ocular manifestations. Integrating yoga into conventional treatment approaches may provide synergistic effects and enhance patient outcomes. However, in future, further well-designed clinical trials and mechanistic studies are needed to validate and better understand the efficacy, optimal dosage, and long-term benefits of yoga interventions. Overall, yoga may hold promise as a holistic and integrative approach for improving visual health and well-being in individuals with optic neuropathy and ocular manifestations.

### Author contributions

Conceptualization: Prabhakar Tiwari and Rima Dada; Writing-original draft preparation: Prabhakar Tiwari, Tanuj Dada and Rima Dada; Writing-review and editing: Prabhakar

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There are no conflicts of interest.

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