Psychiatria Danubina, 2023; Vol. 35, No. 2, pp 163-173 https://doi.org/10.24869/psyd.2023.163 *Narrative Review Article*

THE CURIOUS CASE OF 'PSYCHO-OPHTHALMOLOGY': A NARRATIVE REVIEW OF OPHTHALMOLOGICAL ASPECTS OF PSYCHIATRIC DISORDERS

Harkishan Mamtani[1,*], Nidhi Mamtani[2] & Santosh K Chaturvedi[3]

[1] Postdoctoral Fellow in Neuropsychiatry, Department of Psychiatry, National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru, India- 560029
[2] Glaucoma Fellow, Department of Ophthalmology, Sankara Nethralaya, Chennai, India- 600006
[3] Consultant Psychiatrist, Former Dean and Senior Professor, Department of Psychiatry, National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru, India- 560029
** Corresponding Author*

received: 26.12.2022; revised: 10.03.2023; accepted: 30.03.2023

Summary

Consultation Liaison Psychiatry (CLP) deals with the interface shared between psychiatry and various other disciplines of medicine. The interface shared by psychiatry and ophthalmology is among the lesser discussed ones in the field of CLP, despite the fact that it holds clinical relevance in the evaluation, management and outcomes of both psychiatric and ophthalmological disorders. This narrative review focusses on the ophthalmological aspects of psychiatric disorders, with respect to their manifestations, assessment, and management. Psychiatric disorders, including schizophrenia, affective disorders, 'functional' disorders, and substance use disorders, have numerous ophthalmic manifestations, which can have clinical implications for the patients. Even the psychotropic drugs given for psychiatric disorders can lead to side effects affecting the eye, but these are among the lesser-discussed side effects. Some psychiatric disorders can be investigated using various ophthalmic functions, the assessments ranging from simple physical examination to the use of instruments like a fundoscope, which can be useful for a psychiatrist in their routine practice. Lastly, eye functions can also be used in the treatment of psychiatric conditions, as is seen in eye movement desensitization and reprocessing. This review reiterates the fact that more attention needs to be given to the field of 'psycho-ophthalmology', which holds great promise in the coming days.

Keywords: *Ophthalmological manifestations, Ocular findings, Mental illness, Psychiatric Disorders, Substance use*

* * * * *

INTRODUCTION

The field of consultation-liaison psychiatry (CLP) encompasses the interface between psychiatry and various other specialties of medicine. It has grown significantly beyond clinical, teaching, and research activities in a general hospital setting, to now encompass community health clinics, rehabilitation centers, and private clinics. Among the various branches of CLP, the disciplines of psycho-oncology, psycho-dermatology, and psycho-nephrology are frequently mentioned entities in literature. The interface of psychiatry is also well described with cardiovascular disorders, gastrointestinal disorders, respiratory disorders, and diabetes. However, the association between psychiatry and ophthalmology has not got the deserved attention.

A few studies have underlined the importance of the association between these two disciplines. For instance, the authors of a recent Taiwanese study opined that awareness needs to be raised for psychiatric disorders during ophthalmology follow-up, and vice versa (Liu et al. 2020).

This narrative review collated literature on the ophthalmological aspects of psychiatric disorders, to aid practitioners across disciplines in both research and clinical practice. The review is divided into sections, the first of which focusses on the ophthalmic manifestations of psychiatric disorders. Subsequently, the ophthalmic side effects of psychotropic medications are discussed. Finally, the use of ophthalmic functions for investigating and managing psychiatric disorders are reviewed.

SUBJECTS AND METHODS

A literature search was conducted for each of the subtopics identified for the said topic, from Google Scholar and PubMed using appropriate keywords. The cross-references from the obtained articles were also reviewed to get more relevant articles. In addition, inputs were also taken from certain books (Casey & Kelly 2019, Sadock et al. 2017, World Health Organization 1992, American Psychiatric Association 2013) to add to the literature obtained from the above sources. The derived information was compiled and organized systematically under the aforementioned sections.

OPHTHALMIC MANIFESTATIONS OF PSYCHIATRIC DISORDERS

This section will discuss the ophthalmic manifestations of schizophrenia, affective disorders, 'functional' visual disorders, substance use disorders, self-mutilation, and organic psychiatric conditions.

Schizophrenia

A recent review found that visual manifestations are among the most important manifestations of schizophrenia, influencing the definition and the treatment of the disease (Jurišić et al. 2020).

Late-onset schizophrenia can present with visual hallucinations. However, they are so rare in schizophrenia overall, that their presence should raise suspicion over the diagnosis itself. Dysmegalopsia (change in the perceived size of an object) is another phenomenon that has been described with schizophrenia (Casey & Kelly 2019).

Schizophrenia is characterized by visual distortions in upto 60% of the individuals, including changes in clarity form, brightness, color, motion or persistence of visual stimuli (Silverstein & Lai 2021). Difficulties in facial recognition, misreading others' facial expressions, and misidentifying individuals have also been described (Torrey & Yolken 2017). Most theorists believe these to be a part of their psychopathology. However, dysfunction of smooth pursuit eye movements (SPEM), which is associated with perceptual distortions (H.-C. O. Li et al. 2002), is consistently found in schizophrenia (O'Driscoll & Callahan 2008). Also, studies have shown that eye movement abnormalities can be considered a marker of the genetic vulnerability of schizophrenia (Boudet et al. 2005, Kattoulas et al. 2012, Park et al. 2009). Hence, these distortions might even have a biological causation.

Schizophrenia spectrum disorder has also been linked to childhood strabismus, i.e. ocular malalignment (Schiffman et al. 2006). Exotropia has been associated with schizophrenia in another study (Toyota et al. 2004). A case report elucidated the possible genetic basis for the association between schizophrenia and strabismus (Toyosima et al. 2011).

A Finish study revealed that individuals with schizophrenia were five times more likely to have visual impairment for distance, and six times more likely to have a near visual impairment (Viertiö et al. 2012), which can be a predictor of significant dysfunction in daily functioning (Viertiö et al. 2012).

An association has also been pointed out between corneal temperature and the symptoms of schizophrenia (Shiloh et al. 2009). An increased blink rate in patients with schizophrenia has also been reported (Karson et al. 1990). Dry eye disease (DED) can also occur commonly in schizophrenia patients, which can be assessed using the Schein and ocular surface disease index (Bakija et al. 2021).

Affective Disorders

Patients with depressive disorder are classically described as having lowered visual sensations, causing the notion 'Everything is black'. In contrast, hypomania has been described as being associated with viewing very bright and intense colors (Casey & Kelly 2019).

Researchers have been interested in eye movement analysis in depressive disorder, especially for affective regulation, emotional information processing, and psychomotor disturbances. An increased reaction time in prosaccade and antisaccade tasks has been found in both unipolar and bipolar depression. An attraction towards negative emotions was also evident in both, specifically for negative pictures in unipolar depression and threatening images in bipolar depression (Carvalho et al. 2015), which can be useful in the clinical dilemma of differentiating unipolar from bipolar depression. However, further studies are warranted to validate this hypothesis.

Research in Parkinson's disease revealed that a decrease in color vision was associated with the severity of depressive symptoms (D.-K. Li et al. 2018), however, its generalizability to depression is questionable.

Bipolar disorder has been associated with visual motion perceptual disturbances, including deficits in dot motion trajectory discrimination and moving grating contrast sensitivity (O'Bryan et al. 2014). Eye movement disturbances, including alteration of SPEM, vergence eye movements, and movements in the frontoparallel plane have also been found (Chrobak et al. 2019, Borkowska et al. 2005).

A small study found that euphoric mania could be diagnosed with an accuracy of up to 73%, based on the images of the individual's eyes (Wheeler et al. 2018). One of the co-investigators of this study, a patient with bipolar disorder herself, wrote that she had sparkling eyes in euphoric mania and darker eyes in dysphoric mania (Fast 2017). However, these findings require validation from larger scientific studies.

Table 1: Differentiating between conversion disorder, factitious disorder, and malingering

	Conversion Disorder	Factitious Disorder	Malingering
Control over symptom(s)	Absent	Present	Present
Awareness of symptom(s)	Present or Absent	Present	Present
Reason for the symptom(s)	Unconscious psychological conflicts	Psychological gains (For example, assuming sick role)	External gains (Personal/ Financial)

'Functional' Visual Disorders

The prevalence rates of 'functional' visual loss (i.e. without a physical cause) are up to 5% in the general setting (Kathol et al. 1983), and around 1% in the emergency setting (Kaufman & Milstein 2013) for an ophthalmologist. These are more common in children and females (Kaufman & Milstein 2013). Reduction of visual acuity, with or without loss of field is the commonest non-organic complaint encountered by ophthalmologists, with an estimated prevalence between 36-80% (Bass 2012).

'Functional' disorders would include conversion disorder, factitious disorders, malingering, and somatoform disorder (Rajsekar et al. 1999).

The patient's history and the manner the patient behaves throughout the history taking can provide a sign that the patient's sight loss is not organic. Patients who are blind in both eyes are more likely to stare directly at the person with whom they are conversing, whereas patients with psychogenic blindness are more likely to glance in a different direction. Furthermore, even if they do not have photophobia and their eyes appear normal on the outside, these patients claiming full blindness may wear sunglasses (Rajsekar et al. 1999).

Ophthalmological tests to ascertain if the presenting complaints have an organic basis have been comprehensively described by Incesu (Incesu 2013). However, one also needs to assess psychosocial factors to establish the psychological causation of the same (Rajsekar et al. 1999).

It is also important to delineate if they are due to conversion disorder or factitious disorder or malingering, summarised in Table 1. Conversion disorder with ocular symptoms more commonly manifests with a loss of visual acuity, blurred vision, or "tunnel vision" (World Health Organization 1992). These symptoms are involuntary, and in most cases, distressing too. Whereas, factitious disorders are characterized by the intentional feigning of symptoms with an assumption of a sick role being the primary reason for its production, without any external gains (American Psychiatric Association 2013). In contrast, malingering which is not a psychiatric illness, is defined as intentionally feigning the symptoms of a disorder to achieve personal or financial gain. The person is completely aware that he or she is feigning the symptoms and the reason behind them (Ali et al. 2015).

Weller and Wiedemann proposed classifying 'hysterical' ophthalmic symptoms into sensory (amblyopia, visual field defects, diplopia, blindness, hallucinations, pain, hypaesthesia, dysaesthesia) and motor (blepharospasm, pupillary abnormalities, ptosis, hyperlacrimation, disorders of convergence and accommodation, strabismus, nystagmus), although the latter type is extremely rare (Weller & Wiedemann 1989). More recently, these symptoms have been classified into those related to visual acuity, visual fields, and color and light disturbances (Enzenauer et al. 2014). In addition to these, a series of interesting cases of dissociative disorder with haemolacria (bloody tears) has also been reported (S. Rahman et al. 2017).

The literature on somatoform disorder presenting with ocular symptoms is scarce. In a retrospective study of 124 patients with somatoform disorder, nearly 7% reported ocular symptoms (Dubas & Thomas-Antérion 2012). It also revealed isolated presentations of inability to read and of reversible blepharospasm, respectively (Dubas & Thomas-Antérion 2012). Psychological interventions form a mainstay of the management of 'functional' ophthalmological disorders (Sahu et al. 2021), and appropriate liaison should be facilitated for the same.

Substance use disorders

'Saturday Night Retinopathy' is a term used to describe retinopathy that develops after substance use in general (Malihi et al. 2015). This subsection shall discuss the ophthalmic manifestations associated with the use of individual substances.

Long-term nicotine smoking is associated with an increased risk of nuclear cataract and posterior subcapsular cataract (B. E. Klein et al. 1993). Another study revealed that stopping smoking reduced the chances of developing any type of cataract (Christen et al. 2000).

A systematic review of 17 studies revealed that 13 of them had a significant association between smoking and age-related macular degeneration (AMD), along with evidence of dose-response, temporal relationship, and reversibility of effect (Thornton et al. 2005). Smoking can cause increased odds of causing diabetic retinopathy because of platelet aggregation and tissue hypoxia (B. E. K. Klein & Klein 2007), as evidenced for Type 1 diabetes mellitus (Gaedt Thorlund et al. 2013, Chaturvedi et al. 1995). However, studies showing a positive correlation between diabetic retinopathy and smoking for type 2 diabetes mellitus are lacking (Campagna et al. 2019). Meta-analyses have revealed that smokers are at a higher risk of developing primary open-angle glaucoma (Bonovas et al. 2004) and DED (Xu et al. 2016). A strong causal relationship has also been found between tobacco smoking and thyroid eye disease (Thornton et al. 2007). Cigarette smoking has also been proposed as an important risk factor for non-arteritic ischemic optic neuropathy (Chung et al. 1994).

Wernicke-Korsakoff syndrome, caused by thiamine deficiency due to chronic alcohol use, can manifest with nystagmus or ophthalmoplegia (Akhouri et al. 2021). A Korean study found a significant association of alcohol use with ocular trauma, with orbital wall fracture and hyphema showing a significant association (Han et al. 2011). Another study (Ritter et al. 1993) revealed an increased risk of severe nuclear sclerotic, cortical and posterior subcapsular opacities in those with heavy drinking. However, surprisingly, it also revealed a modest protective effect of moderate drinking of alcohol for any cataract type. Alcohol use has also been associated with the early onset of AMD (Fraser-Bell et al. 2006, Smith & Mitchell 1996). However, moderate amounts of wine have also been found to be protective against AMD (Obisesan et al. 1998). Alcohol was found to be a significant risk factor for DED in a meta-analysis (You et al. 2016). Disturbance in the structure and volume of the tear film, increased tear hyperosmolarity, increased expression of inflammatory cytokines, and vitamin A deficiency caused by alcohol might be contributing factors for the same (Dhingra et al. 2019). Increased colonization of conjunctival flora by *Staphylococcus aureus* and DED itself predisposes people with chronic alcoholism to keratitis (Dhingra et al. 2019, Gunduz et al. 2016). Fetal alcohol syndrome in infants with prenatal alcohol exposure has been associated with anomalies of the retinal fundus and minor changes in the outer region of the eyes (Ribeiro et al. 2007). Methanol poisoning is also known to present with visual impairment ranging from severe impairment to complete blindness, along with pupillary abnormalities (Sharma et al. 2012).

Cannabinoids are found to lower intraocular pressure, hence there is a case for using cannabis in glaucoma (Tomida et al. 2004). However, owing to its short duration of action, it will have to be smoked 6 to 8 times a day, which will have deleterious effects, and hence not recommended (Dhingra et al. 2019). In addition, they are also found to have neuroprotective effects on retinal degeneration (Lax et al. 2014). However, smoking cannabis is associated with negative effects on vision, mainly due to impaired contrast sensitivity (Ortiz-Peregrina et al. 2021). Visual hallucinations are a known manifestation of cannabis use, both in individuals with or without psychosis (Peters et al. 2009, Barrett et al. 2018). Besides, long-term use can also lead to conjunctival injection, reduced amplitude, and impairment of oculomotor function (Dhingra et al. 2019).

Although cocaine was the first local anesthetic used for ophthalmic surgeries (Altman et al. 1985), its harmful impact cannot be ignored. Corneal defects resulting from cocaine use have been given the name 'Crack eye syndrome' (Colatrella & Daniel 1999). Severe corneal ulcerations might also lead to blindness (Ghosheh et al. 2007). Cases of endophthalmitis have also been frequently reported with cocaine users, who mix it with lemon juice (Albini et al. 2007). Maculopathy, presenting as decreased color sensitivity, has been reported with intranasal cocaine use (Ascaso et al. 2009). Owing to its vasoconstrictive properties, cocaine can also lead to retinovascular occlusion (Kannan et al. 2011, W. Rahman et al. 2008). Cases of optic neuropathy, orbital pneumocele, and orbital apex syndrome with cocaine use have also been reported (Ayala et al. 2002, Leibovitch et al. 2006, Shen et al. 2009). Another stimulant, methamphetamine, has been associated with retinal vasculitis, episcleritis, panophthalmitis, endophthalmitis, scleritis, crystalline retinopathy, severe corneal ulceration, and transient visual losses (Poulsen et al. 1996, Kumar et al. 2006, Hazin et al. 2009).

The miotic effect of opiates is known to all, however, a study demonstrated that dependent individuals require larger doses of heroin to achieve miosis, which lasts for a shorter duration as compared to non-dependent individuals (tolerance) (Dhingra et al. 2019). Downbeat nystagmus is another finding reported with opiates (Rottach et al. 2002). Opiate withdrawal can manifest as acute onset esotropia, which can present with binocular diplopia with impaired convergence (Firth 2001, Shiferaw et al. 2015). Endophthalmitis has also been described with heroin use (Malecaze et al. 1985). A study revealed that infants born to mothers who abused methadone during pregnancy had abnormal electrophysiology and abnormal visual assessment, including nystagmus, which persisted up to

6 months of age (McGlone et al. 2014). Another study revealed that mothers who used opioids or multiple substances during pregnancy and were detoxified still gave birth to children with significantly poor visual acuity (Walhovd et al. 2015).

Hallucinogens have been associated with dilatation of the pupil, eye movement abnormalities, and visual hallucinations, the latter of which is desirable for drug users (Dhingra, et al. 2019, Peragallo et al. 2013). Another intriguing phenomenology described with their use is the "Trailing phenomenon", i.e. moving objects seen as a series of discreet and discontinuous images (Casey & Kelly 2019). Phencyclidine can cause diplopia, nystagmus, decreased corneal reflex, and oculogyric crisis (Peragallo et al. 2013, H & V 2015). Lysergic acid Diethylamide (LSD) has been associated with palinopsia, i.e. persistence or recurrence of an image beyond its existence (Sunness 2004). There have been reports of severe ocular malformations in children born to mothers who ingested LSD during pregnancy (Vritsios & Deltsidou 2005).

Self-mutilation

Although not a separate diagnostic entity, self-mutilation deserves a separate mention because of its abundant reports in the literature. Intentional self-injury to the eye warrants a detailed psychiatric assessment (Masnec et al. 2021). Self-enucleation (removal of the eye), one of the severe forms of self-mutilation of the eye, has been referred to as oedipism at various places in literature. This name is derived from the Greek tale of Oedipus, who had an incestuous relationship with his mother, and as a mark of his repentance, he removed his eyes (Okafor et al. 2020).

Oedipism implies near certainty of a psychotic illness, so much so that the use of antipsychotics is advocated, even if psychotic symptoms are not elicited (Large & Nielssen 2012). However, apart from psychotic illnesses (Okafor et al. 2020, Rogers & Pullen 1987, Harish et al. 2012), eye injuries inflicted on oneself have also been reported in dementia (Field & Waldfogel 1995), depressive disorder (Barbara L. Kennedy & Feldmann 1994), obsessive compulsive disorder (Oren & Laor 1987), Munchausen syndrome (Rosenberg et al. 1986), borderline personality disorder (B. L. Kennedy & Feldmann 1994), and mental retardation (Ashkenazi et al. 1992). Most of the cases of self-inflicted eye injuries are associated with psychopathology related to sinfulness and higher deities, or with sexual ideation (Patton 2004).

Ophthalmology and Organic Dysfunction

Numerous neurological conditions may mimic psychiatric disorders. For instance, a recent case of a person with paroxysmal visual perceptual abnormalities was reported, who responded poorly to antipsychotics but had a dramatic response to antiepileptics (Narula et al. 2022). Hence, a clinician must be well aware, especially if s/he finds ophthalmic signs in an individual with psychiatric symptoms. These neurological conditions include neoplasms, stroke, degenerative diseases, hydrocephalus, endocrinopathies, and infections (Rajsekar et al. 1999). A thorough ophthalmological and neurological workup will help in better patient care through early recognition and timely initiation of appropriate therapy.

PSYCHOTROPIC MEDICATIONS CAUSING OPHTHALMIC SIDE EFFECTS

Psychotropic drugs can lead to many ocular adverse effects depending upon the idiosyncrasies, dosages, and interactions with specific mechanisms of the body organs. Important ones related to the commonly used medications are described here. For further reading, one can refer to the review by Richa and Yazbek (Richa & Yazbek 2010).

Antipsychotics

Parenteral administration of typical antipsychotics can lead to an oculogyric crisis within 12-24 hours (Jhee et al. 2003), which usually responds well to the administration of anticholinergics. Antipsychotics with a strong anticholinergic action can cause paralysis of the ciliary muscle, i.e. cycloplegia, which in turn can cause loss of accommodation (Sadock et al. 2017). In addition, antipsychotic therapy is contraindicated in patients with narrow-angle glaucoma (Lieberman 2004), because of reports of acute angle closure with antipsychotics (Gökgöz Özişik & Çağlar 2022). Antipsychotics with strong anticholinergic and/or antiadrenergic effects cause mydriasis and cycloplegia (Sönmez and Aykan 2013). Chlorpromazine and Thioridazine, deserve a special mention in this subsection.

Chlorpromazine in patients on long-term therapy may lead to innocuous, subtle, diffuse yellowish-brown granular deposits in the endothelium, Descemet membrane, and deep stroma occurring only in the exposed cornea of the interpalpebral fissure, especially dose of drugs used more than 2 grams daily (J. Li et al. 2008). The deposits might also occur on the anterior lens capsule within the

pupillary area in patients who have received a cumulative dose of 1000 grams. These deposits persist despite drug discontinuation. Retinotoxicity characterized by nonspecific pigmentary granularity and clumping may also occur with large doses over a prolonged period.

For Thioridazine, doses which exceed 800 mg/day for just a few weeks may be sufficient to cause reduced visual acuity and impairment of dark adaptation. The clinical signs of progressive retinotoxicity include 'Salt-and-pepper' pigmentary disturbance involving the mid-periphery and posterior pole, plaque-like pigmentation, and focal or diffuse loss of the retinal pigment epithelium and choriocapillaris. Pigment accumulation progresses from the periphery of the retina through the central area, leading to peripheral vision loss, night blindness, central scotoma, and might ultimately result in total visual loss (Edwards & Barnes 1993).

Mood stabilizers

Mood stabilizers can also rarely affect the eyes. Lithium has been associated with eye irritation, exophthalmos, abnormal eye movements, ocular myasthenia gravis, papilledema, photophobia, and abnormal tear film, contributing to DED (Park et al. 2020, Pakes 1980). Ocular signs may also be a harbinger of lithium toxicity (Bourgeois 1991), manifesting as gaze-evoked nystagmus and oscillopsia (Rajsekar et al. 1999).

Valproate has been associated with cataract, diplopia, nystagmus, oscillopsia, and visual hallucinations (Gogri et al. 2021). While, nystagmus, diplopia, paralysis of extra-ocular muscles, abnormalities of saccadic eye movements, and optic neuropathy have been described with carbamazepine (Kar et al. 2015). Lamotrigine has been associated with diplopia, nystagmus, and eye movement abnormalities (J. Li et al. 2008).

Antidepressants

Among antidepressants, tricyclics cause ocular adverse effects, most of which present in the acute phase of treatment (Shur & Checkley 1982). The common ones include mydriasis and cycloplegia. Drying of eyes is also noted with various classes of antidepressants (JM Weatherby et al. 2019). Blurred vision or reduced visual acuity was the most common visual adverse effect reported with selective serotonin reuptake inhibitors in a recent study on analysis of a global database (Healy et al. 2022). Glaucoma and blurring of vision have been reported with monoamine oxidase inhibitors, albeit infrequently (Sadock et al. 2017).

Benzodiazepines

There have been reports of irritation, blurred vision, difficulty in reading, and retinal findings with the long-term use of benzodiazepines (Stafanous et al. 1999). Allergic conjunctivitis, accommodation paresis, severe bilateral visual field loss, and acute angle closure glaucoma have been reported with benzodiazepines in case reports (Stafanous et al. 1999, Matos et al. 2021, Jung et al. 2012).

USE OF OPHTHALMIC FUNCTIONS FOR INVESTIGATING PSYCHIATRIC ILLNESSES

This section discusses the use of various ophthalmic functions in the investigation of common psychiatric illnesses.

As mentioned earlier, SPEM has been found to be associated with schizophrenia, and bipolar disorder (O'Driscoll & Callahan 2008, Chrobak et al. 2019). Pursuit movements are a part of the comprehensive neuropsychiatric assessment and can be checked for by asking the patient to follow a moving stimulus in both horizontal and vertical planes, and look for any abnormality (Sadock et al. 2017).

Depression has been classically associated with two ophthalmological signs, namely the Omega sign (vertical wrinkling between the eyebrows joined at the top by a horizontal crease), and Veraguth's sign (diagonal palpebral folds running medially upward) (Saraf & Nath 2019). Both have been thought to be associated with the contraction of the corrugator muscles (McDaniel et al. 2004); the omega sign in particular is said to be indicative of hypervigilance and socially affiliative behavior, commonly seen in depression (Chen et al. 2023).

Eye-tracking determines gaze allocation and goal-directed looking behaviors, representing visual information processing, which is used to evaluate children at risk for autism spectrum disorder (Mastergeorge et al. 2021). A classic example of the same is the finding of preferential orientation to biological motion and eye gaze, both of which are essential components of joint attention (Sadock et al. 2017). A recent American study has found that eye-tracking could be used as a parameter to assess the treatment response in patients with autism (Bradshaw et al. 2019).

Over the years, certain retinal correlates have been associated with Alzheimer's disease, schizophrenia, bipolar disorder, depressive disorder, anorexia nervosa, autism, and attention deficit hyperactivity disorder

(Almonte et al. 2020, Frost et al. 2013, Silverstein et al. 2020). Examination of the retina has also been proposed to be useful for the effects of psychopharmacological treatments in a recent study on schizophrenia and bipolar disorder patients (Keles Altun et al. 2020). Hence, using the appropriate ophthalmologic investigations to evaluate the proposed biomarkers might be useful in the coming days.

EYE FUNCTIONS AS AN INTERVENTION IN PSYCHIATRY

The use of eyes has not just been restricted to assessments in psychiatry, rather they also spread to psychiatric interventions as well.

Eye Movement Desensitisation and Reprocessing

Eye Movement Desensitisation and Reprocessing (EMDR) was proposed by Shapiro as a treatment modality for Post-traumatic Stress Disorder (Shapiro 1989). The patient is encouraged to briefly focus on the memory of the trauma, while his both eyes are being stimulated by movements. This is associated with a reduction in vividness and emotions associated with the traumatic memory (Shapiro 2014). There have also been reports of successfully using EMDR for dissociative identity disorder (Sadock et al. 2017). Various psychological, psychophysiological, and neurobiological mechanisms have been proposed for its effectiveness, however, the exact mechanism of action remains elusive (Landin-Romero et al. 2018).

CONCLUSIONS

One may think that psychiatrists and ophthalmologists hardly see eye to eye with each other. As seen in this review, many recent developments have taken place concerning the interface between psychiatry and ophthalmology. However, there is ample scope for further research in this emerging area. There can be good eye contact between the specialists in these disciplines.

One of the most promising areas is the use of retinal markers for various psychiatric disorders. Robust research is needed in this area to validate the available data. If fruitful, we might even witness fundoscopy becoming a routine assessment for many psychiatric disorders. A case is already being made for using electroretinography and optical coherence tomography in the screening and staging of schizophrenia (Silić et al. 2020). It would also be interesting to have studies determining the extent of liaison between psychiatrists and ophthalmologists, with insights into the kind of referrals that are being made. This data can be used in the formulation of appropriate management guidelines for both specialties. Research elucidating the exact pathogenesis of ophthalmic manifestations of psychiatric disorders can also provide targets of intervention for the management of these manifestations.

The subspecialty of CLP was developed to facilitate an easy flow of ideas between psychiatrists and their peers from other specialties. The recognition of 'psycho-ophthalmology' will not only add to the research in this ever-evolving branch but will also encourage more professional communications between the two specialties, which will ultimately benefit the patients at large.

Acknowledgements: None
Conflicts of interest: None
Contributors: All the authors contributed equally to the manuscript, in conceptualization, literature search, writing the draft, and finalizing the manuscript.

References

1. *Akhouri S, Kuhn J, Newton EJ. Wernicke-Korsakoff Syndrome. In: StatPearls. Treasure Island (FL): StatPearls Publishing, 2021.*
2. *Albini TA, Sun RL, Holz ER, Khurana RN, Rao NA. Lemon Juice and Candida Endophthalmitis in Crack-cocaine Misuse. Br J Ophthalmol. 2007; 91:702-703.*
3. *Ali S, Jabeen S, Pate RJ, Shahid M, Chinala S, Nathani M et al. Conversion Disorder – Mind versus Body: A Review. Innov Clin Neurosci. 2015; 12:27-33.*
4. *Almonte MT, Capellán P, Yap TE, Cordeiro MF. Retinal correlates of psychiatric disorders. Ther Adv Chronic Dis. 2020; 11:2040622320905215.*
5. *Altman AJ, Albert DM, Fournier GA. Cocaine's Use in Ophthalmology: Our 100-Year Heritage. Surv Ophthalmol. 1985; 29:300-306.*
6. *American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders Fifth edition. Washington, DC. 2021.*

7. Ascaso FJ, Cruz N, Del Buey MA, Cristóbal JA. An Unusual Case of Cocaine-Induced Maculopathy. Eur J Ophthalmol. 2009; 19:880-882.
8. Ashkenazi I, Shahar E, Brand N, Bartov E, Blumenthal M. Self-Inflicted Ocular Mutilation in the Pediatric Age Group. Acta Paediatr. 1992; 81:649-651.
9. Ayala C, Watkins L, Deschler DG. Tension Orbital Pneumocele Secondary to Nasal Obstruction from Cocaine Abuse: A Case Report. Otolaryngol Head Neck Surg. 2002; 127:572-574.
10. Bakija I, Filipčić I, Bogadi M, Šimunović Filipčić I, Gotovac M, Kaštelan S. Comparison of the Schein and Osdi Questionnaire as Indicator of Tear Film Stability in Patients with Schizophrenia. Psychiatr Danub. 2021; 33:596-603.
11. Barrett FS, Schlienz NJ, Lembeck N, Waqas M, Vandrey R. 'Hallucinations' Following Acute Cannabis Dosing: A Case Report and Comparison to Other Hallucinogenic Drugs. Cannabis Cannabinoid Res. 2018; 3:85-93.
12. Bass C. Conversion and Dissociation Disorders. In: New Oxford Textbook of Psychiatry. Oxford University Press, 2012.
13. Bonovas S, Filioussi K, Tsantes A, Peponis V. Epidemiological Association between Cigarette Smoking and Primary Open-Angle Glaucoma: A Meta-Analysis. Public Health. 2004; 118:256-261.
14. Borkowska A, Leszczyńska-Rodziewicz A, Kapelski P, Hauser J, Janusz R. Eye movement disturbances and working memory deficit in bipolar affective disorder. Psychiatr Pol 2005; 39: 481–495.
15. Boudet C, Bocca ML, Chabot B, Delamillieure P, Brazo P, Denise P et al. Are Eye Movement Abnormalities Indicators of Genetic Vulnerability to Schizophrenia? Eur Psychiatry 2005; 20: 339–345.
16. Bradshaw J, Shic F, Holden AN, Horowitz EJ, Barrett AC, German TC et al. The Use of Eye Tracking as a Biomarker of Treatment Outcome in a Pilot Randomized Clinical Trial for Young Children with Autism. Autism Res 2019; 12: 779–793.
17. Bourgeois J. Ocular side effects of lithium--a review. J Am Optom Assoc. 1991; 62.
18. Campagna D, Alamo A, Di Pino A, Russo C, Calogero AE, Purrello F et al. Smoking and Diabetes: Dangerous Liaisons and Confusing Relationships. Diabetol Metab Syndr 2019; 11: 85.
19. Carvalho N, Laurent E, Noiret N, Chopard G, Haffen E, Bennabi D et al. Eye Movement in Unipolar and Bipolar Depression: A Systematic Review of the Literature. Front Psychol 2015; 6:1809.
20. Casey P, Kelly B. Fish's Clinical Psychopathology: Signs and Symptoms in Psychiatry. Cambridge University Press, 2019.
21. Chen J, Li C-T, Li TMH, Chan NY, Chan JWY, Liu Y, et al. A forgotten sign of depression – the omega sign and its implication. Asian J Psychiatr. 2023; 80, 103345.
22. Chaturvedi N, Stephenson JM, Fuller JH. The Relationship between Smoking and Microvascular Complications in the EURODIAB IDDM Complications Study. Diabetes Care 1995; 18: 785–792.
23. Christen WG, Glynn RJ, Ajani UA, Schaumberg DA, Buring JE, Hennekens CH et al. Smoking Cessation and Risk of Age-Related Cataract in Men. JAMA 2000; 284: 713–716.
24. Chrobak AA, Rybakowski J, Abramowicz M, Perdziak M, Tereszko A, Włodarczyk M et al. Convergence Eye Movement Deficits in Bipolar Disorder. Eur Neuropsychopharmacol 2019; 29:20–21.
25. Chung SM, Gay CA, McCrary JA. Nonarteritic Ischemic Optic Neuropathy. The Impact of Tobacco Use. Ophthalmology 1994; 101: 779–782.
26. Colatrella N, Daniel TE. Crack Eye Syndrome. J Am Optom Assoc 1999; 70: 193–197.
27. Dhingra D, Kaur S, Ram J. Illicit Drugs: Effects on Eye. Indian J Med Res 2019; 150: 228–238.
28. Dubas F, Thomas-Antérion C. Somatoform disorders in neurology visits: history and circumstances: retrospective study of 124 cases. Rev Neurol 2012; 168: 887–900.
29. Edwards JG, Barnes TR. Chapter 15 – The side-effects of antipsychotic drugs. II. Effects on other physiological systems, in: Barnes, T.R.E. (Ed.), Antipsychotic Drugs and Their Side-Effects, Neuroscience Perspectives. Academic Press, San Diego, 1993.
30. Enzenauer RW, Morris W, O'Donnell T, Montrey J. Functional Ophthalmic Disorders: Ocular Malingering and Visual Hysteria. Springer International Publishing, 2014.
31. Fast J: 3 Clues to Recognize Bipolar Disorder Mania in the Eyes. Psychology Today 2017. Available from: https://www.psychologytoday.com/us/blog/take-charge-bipolar-disorder/201708/3-clues-recognize-bipolar-disorder-mania-in-the-eyes.
32. Field HL, Waldfogel S. Severe Ocular Self-Injury. Gen Hosp Psychiatry. 1995; 17:224-227.
33. Firth AY. Heroin Withdrawal as a Possible Cause of Acute Concomitant Esotropia in Adults. Eye. 2001; 15:189-192.
34. Fraser-Bell S, Wu J, Klein R, Azen SP, Varma R. Smoking, Alcohol Intake, Estrogen Use, and Age-Related Macular Degeneration in Latinos: The Los Angeles Latino Eye Study. Am J Ophthalmol. 2006; 141:79-87.
35. Frost S, Kanagasingam Y, Sohrabi H, Vignarajan J, Bourgeat P, Salvado O et al. Retinal Vascular Biomarkers for Early Detection and Monitoring of Alzheimer's Disease. Transl Psychiatry. 2013; 3:e233.
36. Gaedt Thorlund M, Madsen MB, Green A, Sjølie AK, Grauslund J. Is Smoking a Risk Factor for Proliferative Diabetic Retinopathy in Type 1 Diabetes? Ophthalmologica. 2013; 230:50-54.
37. Ghosheh FR, Ehlers JP, Ayres BD, Hammersmith KM, Rapuano CJ, Cohen EJ. Corneal ulcers associated with aerosolized crack cocaine use. Cornea. 2007; 26, 966–969.
38. Gogri PY, Bhalerao S, Vuyyuru S. Sodium Valproate-Induced Cataract. BMJ Case Rep. 2021; 14:e240997.
39. Gökgöz Özişik G, Çağlar Ç. Acute Angle Closure in a Patient Using Olanzapine. Psychiatr Danub. 2022; 34:306-307.
40. Gunduz G, Gunduz A, Polat N, Cumurcu BE, Yakupogulları Y. The Effect of Chronic Alcoholism on the Conjunctival Flora. Curr Eye Res. 2016; 41:734-739.
41. H Tahir, Daruwalla V. Phencyclidine Induced Oculogyric Crisis Responding Well to Conventional Treatment. Case Rep Emerg Med. 2015; 2015:506301.
42. Han SB, Yang HK, Woo SJ, Hyon JY, Hwang JM. Association of Alcohol Consumption with the Risk of Ocular Trauma. J Korean Med Sci. 2011; 26:675-678.
43. Harish T, Chawan N, Rajkumar RP, Chaturvedi SK. Bilateral Self-Enucleation in Acute Transient Psychotic Disorder: The Influence of Sociocultural Factors on Psychopathology. Compr Psychiatry. 2012; 53:576-578.

44. Hazin R, Cadet JL, Yousif M, Ali M, Ali B, Al-Adahi A et al. Long-term Outcome of Ocular Self-Injury. Oman J Ophthalmol. 2011; 4:1-5.
45. Healy D, Mangin D, Lochhead J. Development and persistence of patient-reported visual problems associated with serotonin reuptake inhibiting antidepressants. Int J Risk Saf Med. 2022; 33, 37–47.
46. Incesu AI. Tests for malingering in ophthalmology. Int J Ophthalmol. 2013; 6:708-17.
47. Jhee SS, Zarotsky V, Mohaupt SM, Yones CL, Sims SJ. Delayed onset of oculogyric crisis and torticollis with intramuscular haloperidol. Br J Ophthalmol. 2003; 37:1434-1437.
48. Jung JJ, Baek SH, Kim US. A case of lorazepam (Ativan)-induced accommodation paresis. Eye. 2012; 26:614.
49. Jurisic D, Cavar I, Sesar A, Sesar I, Vukojevic J, Curkovic M. New insights into schizophrenia: a look at the eye and related structures. Psychiatr Danub. 2020; 32:60-9
50. Kannan B, Balaji V, Kummararaj S, Govindarajan K. Cilioretinal artery occlusion following intranasal cocaine insufflations. Indian J Ophthalmol. 2011; 59:388-389.
51. Kar SK, Borasi M, Kumar D, Gupta SK. Carbamazepine induced optic neuropathy in an adolescent boy with conduct disorder: a rare case report. Indian J Psychiatry. 2015; 57:437.
52. Karson CN, Dykman RA, Paige SR. Blink rates in schizophrenia. Schizophrenia Bull. 1990; 16:345-354.
53. Kathol RG, Cox TA, Corbett JJ, Thompson HS, Clancy J. Functional visual loss: I. A true psychiatric disorder? Psychological Med. 1983; 13:307-314.
54. Kattoulas E, Stefanis NC, Avramopoulos D, Stefanis CN, Evdokimidis I, Smyrnis N. Schizophrenia-related RGS4 gene variations specifically disrupt prefrontal control of saccadic eye movements. Psychological Med. 2012; 42:757-767.
55. Kaufman DM, Milstein MJ. Kaufman's Clinical Neurology for Psychiatrists: seventh edition. Elsevier Inc., 2013.
56. Keles I, Altun N, Turedi N, Aras N, Atagun MI. Psychopharmacological Signatures in the Retina in Schizophrenia and Bipolar Disorder: An Optic Coherence Tomography Study. Psychiatr Danub. 2020; 32:351-358.
57. Kennedy BL, Feldmann TB. Self-Inflicted Eye Injuries: Case Presentations and a Literature Review. Psychiatr Serv. 1994; 45:470-474.
58. Klein BE, Klein R, Linton KL, Franke T. Cigarette Smoking and Lens Opacities: The Beaver Dam Eye Study. Am J Prev Med. 1993; 9:27-30.
59. Klein BE, Klein R. Lifestyle Exposures and Eye Diseases in Adults. Am J Ophthalmol. 2007; 144:961-969.
60. Kumar RL, Kaiser PK, Lee MS. Crystalline Retinopathy from Nasal Ingestion of Methamphetamine. Retina. 2006; 26:823-824.
61. Landin-Romero R, Moreno-Alcazar A, Pagani M, Amann BL. How Does Eye Movement Desensitization and Reprocessing Therapy Work? Front Psychol. 2018; 9:1395.
62. Large MM, Nielssen OB. Self-Enucleation: Forget Freud and Oedipus, It's All about Untreated Psychosis. Br J Ophthalmol. 2012; 96:1056-1057.
63. Lax P, Esquiva G, Altavilla C, Cuenca N. Neuroprotective Effects of the Cannabinoid Agonist HU210 on Retinal Degeneration. Exp Eye Res. 2014; 120:175-185.
64. Leibovitch I, Khoramian D, Goldberg RA. Severe Destructive Sinusitis and Orbital Apex Syndrome as a Complication of Intranasal Cocaine Abuse. Am J Emerg Med. 2006; 24:499-501.
65. Li DK, Liu FT, Chen K, Bu LL, Yang K, Chen C. et al. Depressive Symptoms Are Associated With Color Vision but Not Olfactory Function in Patients With Parkinson's Disease. J Neuropsychiatry Clin Neurosci. 2018; 30:122-129.
66. Li HCO, Brenner E, Cornelissen FW, Kim ES. Systematic Distortion of Perceived 2D Shape during Smooth Pursuit Eye Movements. Vision Res. 2002; 42:2569-2575.
67. Li J, Tripathi RC, Tripathi BJ. Drug-Induced Ocular Disorders. Drug Saf. 2008; 31:127-141.
68. Lieberman JA. Managing Anticholinergic Side Effects. Prim Care Companion J Clin Psychiatry. 2004; 6:20-23.
69. Liu CH, Kang EYC, Lin YH, Wu WC, Liu ZH, Kuo CF. et al. Association of Ocular Diseases with Schizophrenia, Bipolar Disorder, and Major Depressive Disorder: A Retrospective Case-Control, Population-Based Study. BMC Psychiatry. 2020; 20:486.
70. Malecaze F, Arne JL, Bec P, Séguéla JP, Linas MD, Recco P, et al. Candida Endophthalmitis after Heroin Abuse. Mycopathologia. 1985; 92:73-76.
71. Malihi M, Turbin RE, Frohman LP. Saturday Night Retinopathy with Ophthalmoplegia: A Case Series. Neuro-Ophthalmology. 2015; 39:77-82.
72. Masnec S, Pauk SV, Jurilj M, Kalauz M, Kuzman T, Škegro I, et al. Enterococcus Faecalis Corneal Ulcers with Endophthalmitis and Consequent Bilateral Blindness as a Result of Unrecognised Intentional Self-Injury-A Case Report. Psychiatr Danub. 2021; 33:676-680.
73. Mastergeorge AM, Kahathuduwa C, Blume J. Eye-Tracking in Infants and Young Children at Risk for Autism Spectrum Disorder: A Systematic Review of Visual Stimuli in Experimental Paradigms. J Autism Dev Disord. 2021; 51:2578-2599.
74. Matos AG, Castillo PDB, Bisneto JAL, Paula JS. Acute Angle Closure Triggered by Oral Benzodiazepines. Arq Bras Oftalmol. 2021; 84:170-173.
75. McDaniel WW, Brar B, Srirama M, Shaikh S, Kaur A. Prevalence of Veraguth's Eyelid Folds During Depression in Different Ethnic Groups. J Nerv Ment Dis. 2004; 192, 705.
76. McGlone L, Hamilton R, McCulloch DL, MacKinnon JR, Bradnam M, Mactier H. Visual Outcome in Infants Born to Drug-Misusing Mothers Prescribed Methadone in Pregnancy. Br J Ophthalmol. 2014; 98:238-245.
77. Narula S, Mishra BR, Parmar A, Praharaj SK, Biswas T. Paroxysmal Visual Phenomenon, Diagnostic Dilemma and Therapeutic Challenge. Psychiatr Danub. 2022; 34:301-303
78. Obisesan TO, Hirsch R, Kosoko O, Carlson L, Parrott M. Moderate Wine Consumption Is Associated with Decreased Odds of Developing Age-Related Macular Degeneration in NHANES-1. J Am Geriatr Soc. 1998; 46:1-7.
79. O'Bryan RA, Brenner CA, Hetrick WP, O'Donnell BF. Disturbances of Visual Motion Perception in Bipolar Disorder. Bipolar Disord. 2014; 16:354-365.
80. O'Driscoll GA, Callahan BL. Smooth Pursuit in Schizophrenia: A Meta-Analytic Review of Research since 1993. Brain Cogn. 2008; 68:359-370.
81. Okafor L, Choudry A, Mudhar HS, Sandramouli S. Oedipism: An Unusual Case of Auto-Enucleation Including Mechanism of Avulsion. Eur J Ophthalmol 2020; 30:1120672120972028.

82. Oren DA, Laor N. Self-Inflicted Eye Injury. Am J Psychiatry. 1987; 144:248-249.
83. Ortiz-Peregrina S, Herrera C, López MC, Jiménez J, Anera R. Effects of Cannabis on Visual Function and Self-Perceived Visual Quality. Sci Rep. 2021; 11:6626.
84. Pakes GE. Eye Irritation and Lithium Carbonate. Arch Ophthalmol. 1980; 98:930.
85. Park BL, Shin HD, Cheong HS, Park CS, Sohn JW, Kim BJ, et al. Association Analysis of COMT Polymorphisms with Schizophrenia and Smooth Pursuit Eye Movement Abnormality. J Hum Genet. 2009; 54:709-712.
86. Park JSY, Sharma RA, Sharma V. Ophthalmic adverse effects of lithium. Int Clin Psychopharmacol. 2020; 35.
87. Patton N. Self-Inflicted Eye Injuries: A Review. Eye. 2004; 18:867-872.
88. Peragallo J, Biousse V, Newman NJ. Ocular Manifestations of Drug and Alcohol Abuse. Curr Opin Ophthalmol. 2013; 24:566-573.
89. Peters BD, de Koning P, Dingemans P, Becker H, Linszen DH, de Haan L. Subjective Effects of Cannabis before the First Psychotic Episode. Aust N Z J Psychiatry. 2009; 43:1155-1162.
90. Poulsen EJ, Mannis MJ, Chang SD. Keratitis in Methamphetamine Abusers. Cornea. 1996; 15:477-482. Rahman S, Karim R, Islam MM, Karim R. Dissociative Disorders with Haemolacria. JBCPS 2017; 35.
91. Rahman W, Thomas S, Wiselka M, Bibby K. Cocaine-Induced Chorioretinal Infarction. Br J Ophthalmol 2008; 92: 150-151.
92. Rajsekar K, Rajsekar YL, Chaturvedi SK. Psycho Ophthalmology: The interface between Psychiatry and Ophthalmology. Indian J Psychiatry 1999; 41: 186-196.
93. Ribeiro IM, Vale PJ, Tenedorio PA, Rodrigues PA, Bilhoto MA, Pereira HC. Ocular Manifestations in Fetal Alcohol Syndrome. Eur J Ophthalmol 2007; 17: 104-109.
94. Richa S, Yazbek JC. Ocular Adverse Effects of Common Psychotropic Agents: A Review. CNS Drugs 2010; 24: 501-526.
95. Ritter LL, Klein BE, Klein R, Mares-Perlman JA. Alcohol Use and Lens Opacities in the Beaver Dam Eye Study. Arch Ophthalmol 1993; 111: 113-117.
96. Rogers T, Pullen I. Self-Inflicted Eye-Injuries. Br J Psychiatry 1987; 151: 691-693.
97. Rosenberg PN, Krohel GB, Webb RM, Hepler RS. Ocular Munchausen's Syndrome. Ophthalmology 1986; 93: 1120-1123.
98. Rottach KG, Wohlgemuth WA, Dzaja AE, Eggert T, Straube A. Effects of Intravenous Opioids on Eye Movements in Humans: Possible Mechanisms. J Neurol 2002; 249: 1200-1205.
99. Sadock BJ, Sadock VA, Ruiz P. Kaplan and Sadock's Comprehensive Textbook of Psychiatry. Wolters Kluwer Health, 2017.
100. Sahu S, Mishra S, Mishra BR, Nath S, Mohapatra D. Acute Painless Visual Loss: What the eyes cannot see, the mind should know. Psychiatr Danub, 2021; 33:591-592
101. Saraf AS, Nath S. Revisiting Omega and Veraguth's Sign. Indian J Psychol Med, 2019;41:295-297
102. Schiffman J, Maeda JA, Hayashi K, Michelsen N, Sorensen HJ, Ekstrom M, et al. Premorbid Childhood Ocular Alignment Abnormalities and Adult Schizophrenia-Spectrum Disorder. Schizophr Res, 2006; 81:253-260
103. Shapiro F. Efficacy of the Eye Movement Desensitization Procedure in the Treatment of Traumatic Memories. J Trauma Stress, 1989; 2:199-223
104. Shapiro F. The Role of Eye Movement Desensitization and Reprocessing (EMDR) Therapy in Medicine: Addressing the Psychological and Physical Symptoms Stemming from Adverse Life Experiences. Perm J 2014; 18: 71-77
105. Sharma R, Marasini S, Sharma AK, Shrestha JK, Nepal BP. Methanol Poisoning: Ocular and Neurological Manifestations. Optom Vis Sci 2012; 89:178-182
106. Shen CC, Silver AL, O'Donnell TJ, Fleming JC, Karcioglu ZA. Optic Neuropathy Caused by Naso-Orbital Mass in Chronic Intranasal Cocaine Abuse. J Neuro-Ophthalmol, 2009; 29:50-53
107. Shiferaw B, Bekele E, Syed S, Fan L, Patel N, Qazi S et al. A Case Report of Acute Esotropia in a Young Woman Following Heroin Withdrawal. Case Rep Med 2015; 740710.
108. Shiloh R, Schapir L, Bar-Ziv D, Stryjer R, Konas S, Louis R et al. Association between Corneal Temperature and Mental Status of Treatment-Resistant Schizophrenia Inpatients. Eur Neuropsychopharmacol 2009; 19: 654-658.
109. Shur E, Checkley S. Pupil Studies in Depressed Patients: An Investigation of the Mechanism of Action of Desipramine. Br J Psychiatry 1982; 140: 181-184.
110. Silić A, Ostojić D, Karlović D. ERG and OCT as an Effective Screening and Staging Tools for Schizophrenia? Psychiatr Danub 2020; 32: 74-75.
111. Silverstein SM, Demmin DL, Schallek JB, Fradkin SI. Measures of Retinal Structure and Function as Biomarkers in Neurology and Psychiatry. Biomarkers in Neuropsychiatry 2020; 2: 100018.
112. Silverstein SM, Lai A. The Phenomenology and Neurobiology of Visual Distortions and Hallucinations in Schizophrenia: An Update. Front Psychiatry 2021; 12, 684720.
113. Smith W, Mitchell P. Alcohol Intake and Age-Related Maculopathy. Am J Ophthalmol 1996; 122: 743-745.
114. Sönmez İ, Aykan Ü. Psychotropic Drugs and Ocular Side Effects. Turk J Ophthalmol 2013; 43.
115. Stafanous SN, Clarke MP, Ashton H, Mitchell KW. The Effect of Long-term Use of Benzodiazepines on the Eye and Retina. Doc Ophthalmol 1999; 99:55-68
116. Sunness JS. Persistent Afterimages (Palinopsia) and Photophobia in a Patient with a History of LSD Use. Retina 2004; 24:805
117. Thornton J, Edwards R, Mitchell P, Harrison RA, Buchan I, Kelly SP. Smoking and Age-related Macular Degeneration: A Review of Association. Eye 2005; 19:935-44
118. Thornton J, Kelly SP, Harrison RA, Edwards R. Cigarette Smoking and Thyroid Eye Disease: A Systematic Review. Eye 2007; 21:1135-1145
119. Tomida I, Pertwee RG, Azuara-Blanco A. Cannabinoids and Glaucoma. Br J Ophthalmol 2004; 88:708-713
120. Torrey EF, Yolken RH. Schizophrenia and Infections: The Eyes Have It. Schizophr Bull 2017; 43:247-252
121. Toyosima M, Maekawa M, Toyota T, Iwayama Y, Arai M, Ichikawa T et al. Schizophrenia with the 22q11.2 Deletion and Additional Genetic Defects: Case History. Br J Psychiatry 2011; 199:245-246
122. Toyota T, Yoshitsugu K, Ebihara M, Yamada K, Ohba H, Fukasawa M et al. Association between Schizophrenia with Ocular Misalignment and Polyalanine Length Variation in PMX2B. Hum Mol Genet 2004;13:551-561

123. Viertiö S, Tuulio-Henriksson A, Perälä J, Saarni SI, Koskinen S, Sihvonen M et al. Activities of Daily Living, Social Functioning and Their Determinants in Persons with Psychotic Disorder. Eur Psychiatry 2012; 27: 409-415.
124. Vritsios J, Deltsidou A. Amphetamine and LSD use during pregnancy. Rev. Clin. Pharmacol. Pharmacokinet. Int. Ed. 2005;19, 99-104.
125. Walhovd KB, Bjørnebekk A, Haabrekke K, Siqveland T, Slinning K, Nygaard E et al. Child Neuroanatomical, Neurocognitive, and Visual Acuity Outcomes with Maternal Opioid and Polysubstance Detoxification. Pediatr Neurol 2015; 52: 326-332e1-3.
126. Weatherby TJM, Raman VR, Agius M. Depression and dry eye disease: a need for an interdisciplinary approach? Psychiatr Danub. 2019; 31:619-621.
127. Weller M, Wiedemann P. Hysterical Symptoms in Ophthalmology. Doc Ophthalmol 1989; 73: 1-33.
128. Wheeler J, Jecha J, Kottegoda M, Teo S, Larson EC. Bipolar Mania Eye Image Classification. SMU Data Science Review 2018; 1.
129. World Health Organization. ICD-10 Clinical Descriptions and Diagnostic Guidelines. Geneva: World Health Organization, 1992.
130. Xu L, Zhang W, Zhu XY, Suo T, Fan XQ, Fu Y. Smoking and the Risk of Dry Eye: A Meta-Analysis. Int J Ophthalmol 2016; 9: 1480-1486.
131. You YS, Qu NB, Yu XN. Alcohol Consumption and Dry Eye Syndrome: A Meta-Analysis. Int J Ophthalmol 2016; 9: 1487.

Correspondence:
Dr Harkishan Mamtani
Postdoctoral Fellow in Neuropsychiatry
Department of Psychiatry, National Institute of Mental Health and Neurosciences, Bengaluru, India- 560029
harkishanmamtani@gmail.com, +91-9503435295