



Understanding the complex interplay: Causes and treatment modalities of mental disorders

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Abstract

The human brain, a pivotal organ governing the intricate activities of the body, is susceptible to various disorders stemming from defects or abnormalities. While genetics and environmental factors stand as primary influencers, the etiology of mental disorders is multifaceted, encompassing a myriad of genetic predispositions and environmental triggers. This paper illuminates the diverse landscape of mental disorders, exceeding a hundred distinct conditions, with causes extending beyond genetic origins to encompass an array of environmental influences. Moreover, the study scrutinizes contemporary treatment modalities, which encompass pharmacotherapy, psychotherapy, and rehabilitation interventions. By examining the interplay between genetic predisposition, environmental factors, and treatment approaches, this study provides insight into the complexities of mental health care, paving the way for enhanced understanding and more effective interventions.

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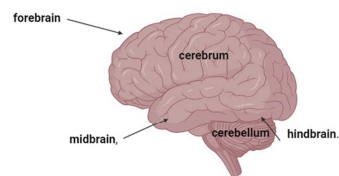
Introduction

Human Brain is the major organs of human nervous system, along with spinal cord that make human central nervous system (Paxinos and Mai, 2024). Human brain consists of cerebrum, brainstem and cerebellum. Almost all the activities of human body are controlled by brain (Nieuwenhuys *et al.*, 2007). Brain receives sensory information from sensory organs and then analyzing, processing, coordinating and integrating it. This important organ is protected by skull bones of the head region of the body (Rao *et al.*, 2024). The largest part of the human brain is cerebrum composed of two cerebral hemispheres each one is composed of inner core of white matter and outer surface the cerebral cortex is composed of gray matter (Al-Dalahmah *et al.*, 2024).

The cortex has inner layer called allocortex and outer layer called Neocortex (Licastro *et al.*, 2024). Neocortex is composed of six neuronal layers while allocortex is composed of three or four layers (Padilla-Ferrer *et al.*, 2024). The hemisphere is further divided into four lobes, frontal, temporal, parietal and occipital lobes. The function of frontal lobe is planning, reasoning, thoughts and self-control. Occipital lobe is associated with vision (Ullman *et al.*, 2024). Cortical area in each lobe is associated with specific function such as the motor, sensory and association regions. Furthermore, the both right and left hemisphere are broadly similar in function and shape. Some functions among the both lobes are same although some are associated with each side like visual spatial ability in right and language is in the left side. Hemispheres are connected with commissural nerve tract, the largest being the corpus callosum (Ullman *et al.*, 2024).

The cerebrum is connected to the spinal cord by the brainstem. The brainstem comprises the midbrain, the pons, and the medulla oblongata. The cerebellum is connected to the brainstem by three pairs of nerve tracts called cerebellar peduncles (Kameyama *et al.*, 2024; Althaus *et al.*, 2024) within the cerebrum lies the ventricular system, consisting of four interconnected ventricles in which cerebrospinal fluid

is produced and circulated. Beneath the cerebral cortex lie several important structures, including the thalamus, the epithalamus, the pineal gland, the hypothalamus, the pituitary gland, and the subthalamus (Akter *et al.*, 2024). Additionally, there are limbic structures, such as the amygdalae and the hippocampi, the claustrum, various nuclei of the basal ganglia, basal forebrain structures, and three circumventricular organs. Brain structures not on the midplane exist in pairs, such as two hippocampi and two amygdalae (Arora *et al.*, 2024). The brain comprises neurons and supportive glial cells (Ozawa, 2024). With more than 86 billion neurons and a roughly equal number of other cells, brain activity is facilitated by interconnections of neurons and their release of neurotransmitters in response to nerve impulses (Arora *et al.*, 2024). Neurons connect to form neural pathways, neural circuits, and elaborate network systems, all driven by the process of neurotransmission. The brain is shielded by the skull, suspended in cerebrospinal fluid, and isolated from the bloodstream by the blood-brain barrier (Fig. 1).



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Fig. 1. The anatomy of Human Brain, the brain can be divided into three basic units: the forebrain, the midbrain, and the hindbrain. The hindbrain includes the upper part of the spinal cord, the brain stem, and a wrinkled ball of tissue called the cerebellum. The hindbrain controls the body's vital functions such as respiration and heart rate.

Nevertheless, the brain remains vulnerable to damage, disease, and infection. Trauma or a loss of blood supply, known as a stroke, can cause damage. The brain is also susceptible to degenerative disorders such as Parkinson's disease, dementias like Alzheimer's disease, and multiple sclerosis. Psychiatric conditions including schizophrenia and

clinical depression are thought to be associated with brain dysfunctions. Furthermore, the brain can be the site of tumors, benign and malignant, primarily originating from other sites in the body (Ozawa, 2024; Ahirwar *et al.*, 2024; Mukadam, Patil, 2024).

Mental health

The concept of mental health, given its vague and broad meaning, can benefit from a historical perspective to be better understood. The term "mental health" can trace back its development to advances in public health, clinical psychiatry, and other branches of knowledge (Gonzales *et al.*, 2024; Hutmacher and Franz, 2024; Asker *et al.*, 2024). In 1946, the International Health Conference held in New York decided to establish the World Health Organization (WHO), and a Mental Health Association was founded in London (Gostin *et al.*, 2024). These developments paved the road to institutionalizing the mental health industry (Denis *et al.*, 2024). An integral part of general health and a basic human right, mental health is a main indicator of well-being and the ability to connect, function, cope, and thrive. Mental health is not black or white in nature but rather lies on a complex continuum, with experiences ranging from an optimal state of well-being to debilitating states of great suffering and emotional pain (Meredith and Horgan, 2024). Mental health conditions are highly prevalent in all countries. According to the latest report by the World Health Organization, about one in eight people in the world live with a mental disorder (Arafat *et al.*, 2024). The prevalence of different mental disorders varies with sex and age. In both males and females, anxiety disorders and depressive disorders are the most common (Arafat *et al.*, 2024).

The COVID-19 pandemic has had many effects on the world, creating a global crisis for mental health (Alnaji *et al.*, 2024). As stated by the WHO, there has been a rise in both anxiety and depressive disorders by more than 25% during the first year of the pandemic (Gupta *et al.*, 2024).

Mental disorders are the leading cause of years lived with disability, and suicide remains a major cause of

death globally. The main concern surrounding mental health issues is their costly treatment and the underserving of the industry (Alnaji *et al.*, 2024). Mental health systems all over the world are marked by major gaps and imbalances in information and research, governance, resources, and services (Carmine, 2024). Before the pandemic, an estimated 193 million people (2,471 cases per 100,000 populations) had major depressive disorder, and 298 million people (3,825 cases per 100,000 populations) had anxiety disorders in 2020. After adjusting for the COVID-19 pandemic, initial estimates show a jump to 246 million (3,153 cases per 100,000 population) for major depressive disorder and 374 million (4,802 per 100,000 population) for anxiety disorders (Degtiareva *et al.*, 2024). This represents an increase of 28% and 26% for major depressive disorders and anxiety disorders, respectively, in just one year (Degtiareva *et al.*, 2024).

Causes of mental illness

There is no single cause of mental illness. Instead, it is thought that they stem from a wide range of factors, sometimes in combination (Alnaji *et al.*, 2024). The following are some factors that may influence whether someone develops a mental illness:

Biology: Brain chemistry plays a major role in mental illnesses. Changes and imbalances in neurotransmitters, the chemical messengers within the brain, are often associated with mental disorders (Degtiareva *et al.*, 2024).

Environmental exposures: Children exposed to certain substances in utero may be at a higher risk of developing mental illness. For example, if your mother drank alcohol, used drugs, or was exposed to harmful chemicals or toxins when she was pregnant with you, you may be at an increased risk (Degtiareva *et al.*, 2024).

Genetics: Experts have long recognized that many mental illnesses tend to run in families, suggesting a genetic component. People who have a relative with a mental illness—such as autism, bipolar disorder,

major depression, and schizophrenia—may be at a higher risk of developing it (Gupta *et al.*, 2024).

Life experiences: The stressful life events you have experienced may contribute to the development of mental illness. For example, enduring traumatic events might cause a condition like PTSD, while repeated changes in primary caregivers in childhood may influence the development of an attachment disorder (Bourque *et al.*, 2024).

Types of mental health conditions

There are hundreds of mental illnesses listed in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), the American Psychiatric Association's diagnostic manual. The DSM-5 categorizes illnesses based on their diagnostic criteria (Table 1). The most recent version of the manual, the DSM-5-TR (text revision), features some significant changes, including the addition of prolonged grief disorder, updated language regarding

sex and gender, and changes to the diagnostic criteria for more than 75 conditions (Sung *et al.*, 2024).

Treatment of mental illness

Many people diagnosed with mental illness achieve strength and recovery through participating in individual or group treatment (Benzon and Jørgensen, 2024). There are numerous different treatment options available, and there is no treatment that works for everyone. Physician can choose treatment or combination of treatments that work best for patients individually. Psychotherapy, provided by a trained mental health professional, is a therapeutic treatment for mental illness. It explores thoughts, feelings, and behaviors and seeks to improve an individual's well-being. Psychotherapy paired with medication is often the most effective way to promote recovery. Examples of psychotherapy include Cognitive Behavioral Therapy, Exposure Therapy, and Dialectical Behavior Therapy, among others (Davies *et al.*, 2024).

Table 1. Details of major mental disorders and their classifications

| SL | Disorders | Classes of disorders |
|----|--|---|
| 1 | Anxiety disorders | Generalized anxiety disorder (GAD) Panic disorder Social anxiety disorder (SAD) |
| 2 | Bipolar and related disorders | Bipolar I Bipolar II Cyclothymia |
| 3 | Depressive disorders | Depressive disorder Premenstrual dysphoric disorder (PMDD) Intermittent explosive disorder |
| 4 | Disruptive, Impulse-control, and Conduct disorders | Kleptomania Oppositional defiant disorder (ODD) Pyromania |
| 5 | Dissociative disorders | Consciousness, memories, emotions, perceptions, and behaviors |
| 6 | Elimination disorders | Elimination disorders Encopresis and Enuresis |
| 7 | Feeding and Eating disorders | Anorexia nervosa Binge-eating disorder Bulimia nervosa |
| 8 | Gender dysphoria | Body dysphoria Social dysphoria Mind dysphoria |
| 9 | Neurocognitive disorders | Huntington's disease Neurocognitive issues due to HIV infection Traumatic brain injury (TBI) |
| 10 | Neurodevelopmental disorders | Attention-deficit/hyperactivity disorder (ADHD) Autism Learning and intellectual disabilities |
| 11 | Obsessive-compulsive and related disorders | Body dysmorphic disorder Hoarding disorder Obsessive-compulsive disorder (OCD) |
| 12 | Paraphilic disorders | Pedophilia, Exhibitionism, Voyeurism, Sexual sadism, Sexual |

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|----|--|--|
| | | masochism, Frotteurism, Fetishism, and Transvestic fetishism |
| 13 | Schizophrenia spectrum and other psychotic disorders | Delusions Disorganized thinking Disorganized or abnormal motor behavior Hallucinations Negative symptoms |
| 14 | Sexual dysfunctions | Delayed ejaculation Erectile disorder Female orgasmic disorder Female sexual interest/Arousal disorder |
| 15 | Sleep-wake disorders | Insomnia Narcolepsy |
| 16 | Somatic symptom and related disorders | Somatisation disorder Hypochondriasis Conversion disorder Body dysmorphic disorder Pain Disorder |
| 17 | Substance-Related and Addictive Disorders | Opioid use disorder Marijuana use disorder Nicotine use disorder Stimulant use disorder Sedative use disorder Hallucinogen use disorder Alcohol use disorder |
| 18 | Trauma and Stressor-Related Disorders | Child physical Abuse Child sexual Abuse Child emotional Abuse Emotional neglect Physical neglect Mentally ill, depressed, or suicidal person in the home Drug addicted or alcoholic family member Witnessing domestic violence against the mother |

Medication does not outright cure mental illness; however, it may help manage symptoms. Medication paired with psychotherapy is often the most effective way to promote recovery (Davies *et al.*, 2024). Case management coordinates services for an individual with the help of a case manager, who can assess, plan, and implement strategies to facilitate recovery. In a minority of cases, hospitalization may be necessary so that an individual can be closely monitored, accurately diagnosed, or have medications adjusted when their mental illness temporarily worsens (Laurent, 2024). A support group is a meeting where members guide each other toward the shared goal of recovery. Support groups are often comprised of non-professionals but rather peers who have suffered from similar experiences (Laurent, 2024). Complementary & Alternative Medicine, or CAM, refers to treatments and practices that are not typically associated with standard care. CAM may be used in place of or in addition to standard health practices (Mortada, 2024). A self-help plan is a unique health plan where an individual address his or her condition by implementing strategies that promote wellness

(Mortada, 2024). Self-help plans may involve addressing wellness, recovery, triggers, or warning signs. Peer Support refers to receiving help from individuals who have suffered from similar experiences (Mortada, 2024).

ECT treatment is generally administered in the morning, before breakfast. Prior to the actual treatment, the patient is given general anesthesia and a muscle relaxant (Lazaro *et al.*, 2024). Electrodes are then attached to the patient's scalp, and an electric current is applied, which causes a brief convulsion. Minutes later, the patient awakens without memory of events surrounding the treatment (Table 2). This treatment is usually repeated two to three times a week for approximately one month, with the number of treatments varying from six to 12. It is often recommended that the patient maintain a regimen of medication after the ECT treatments to reduce the chance of relapse (Lazaro *et al.*, 2024). To maximize the benefits of ECT, it is crucial that the patient's illness be accurately diagnosed, and that the risks and adverse side effects are weighed against those of

alternative treatments. The risks and side effects involved with ECT are related to the misuse of equipment, ill-trained staff, incorrect methods of administration, persistent memory loss, and transient post-treatment confusion (Lazaro *et al.*, 2024).

Genetics of mental health

There are hundreds of different types of mental (or psychiatric) disorders as characterized and defined by the DSM and ICD. No single psychiatric or mental disorder has a full 100% genetic basis or heritability, and many environmental factors may strongly influence the likelihood of developing a particular disorder, despite the presence or absence of genetic elements. Therefore, many of these disorders have multifactorial causes, some genetic and some environmental (Nienaber-Rousseau, 2024). In this article, only those disorders with a strong genetic basis were highlighted. A large

proportion of mental disorders do indeed have a high degree of heritability meaning that the risk of having a disorder significantly increases if another family member has it. Independent of that, specific genetic mutations or polymorphisms may predispose individuals to a higher risk of mental disorder without a family history (Bourque *et al.*, 2024). Genetic mutations, polymorphisms, or epigenetic changes (which will be discussed below) can alter the development of the brain in a way that changes the typical wiring of the brain. Consequently, mental disorders can arise at any point in life, such as from birth (e.g., ASD), or later in life in combination with environmental triggers (e.g., bipolar disorder) (Bourque *et al.*, 2024). These predispositions may lower the threshold required for mental disorders to begin in adults compared to "neurotypical" individuals (Li *et al.*, 2024).

Table 2. Detail of medicines currently used for the treatment of mental illness and their mechanisms

| SL | Medicine | Mechanisms |
|----|---------------|--|
| 1 | Sertraline | Sertraline works by increasing the levels of a mood-enhancing chemical called serotonin in your brain. It helps many people recover from depression and has fewer unwanted side effects than older antidepressants. Sertraline comes in tablets, which are available only with a prescription. |
| 2 | Beta blockers | Beta blockers work mainly by slowing down the heart. They do this by blocking the action of hormones like adrenaline. Beta blockers usually come in tablet form. They are prescription-only medicines, which mean they can only be prescribed by a GP or another suitably qualified healthcare professional. |
| 3 | Dosulepin | Dosulepin is an antidepressant medicine used to treat depression. Occasionally, dosulepin is also used for some types of nerve pain, such as fibromyalgia, and to prevent migraines. Dosulepin is available on prescription but usually only if you are already taking it and have not experienced any serious side effects. |
| 4 | Duloxetine | Duloxetine is a type of antidepressant medicine known as a serotonin-noradrenaline reuptake inhibitor (SNRI). SNRIs are thought to work by increasing the amount of mood-enhancing chemicals, serotonin, and noradrenaline, in your brain. It is used to treat depression and anxiety. Additionally, it is used to treat nerve pain, such as fibromyalgia, and can be used to treat stress urinary incontinence in women. Duloxetine comes in capsules and is only available with a prescription. |
| 5 | Escitalopram | Escitalopram is a type of antidepressant known as a selective serotonin reuptake inhibitor (SSRI). It is often used to treat depression and is sometimes prescribed for anxiety, obsessive-compulsive disorder (OCD), or panic attacks. Escitalopram helps many people recover from depression and has fewer side effects than older antidepressants. It is available by prescription, coming in tablets and liquid drops that can be added to a drink. |
| 6 | Lamotrigine | Lamotrigine is a medicine used to treat epilepsy. It can also help prevent low mood (depression) in adults with bipolar disorder. Seizures are bursts of electrical activity in the brain that temporarily affect how it works. Lamotrigine slows down these electrical signals to stop seizures. Lamotrigine is available by prescription and comes either as tablets you swallow or |

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| | | tablets you chew or dissolve in water to make a drink. |
| 7 | Mirtazapine | Mirtazapine is an antidepressant medicine used to treat depression and, in some cases, obsessive-compulsive disorder (OCD) and anxiety. It works by increasing the amount of mood-enhancing chemicals called noradrenaline and serotonin in your brain. Mirtazapine is only available by prescription. It comes in tablet form, tablets that dissolve in your mouth, or as a liquid that you swallow. |
| 8 | Paroxetine | Paroxetine is a type of antidepressant known as a selective serotonin reuptake inhibitor (SSRI). It is often used to treat depression and, sometimes, obsessive-compulsive disorder (OCD), panic attacks, anxiety, or post-traumatic stress disorder (PTSD). Paroxetine helps many people recover from depression, and it has fewer unwanted effects than older antidepressants. Paroxetine is available by prescription and comes in tablet form and as a liquid that you swallow. |
| 9 | Sodium valproate | Sodium valproate is used to treat epilepsy and bipolar disorder. It is occasionally used to prevent migraine headaches. This medicine is only available by prescription. It comes in capsules, tablets, and a liquid that you swallow. It also comes in granules that you mix with food or drink. Sodium valproate can also be administered by injection, but this is usually only done in the hospital. If taken during pregnancy, sodium valproate can cause problems for a baby's development, including birth defects and long-term learning difficulties. For this reason, sodium valproate is not recommended if there's a chance that you could become pregnant. For women and girls of childbearing age, if you do need to take sodium valproate, then your doctor will put you on Prevent, the valproate pregnancy prevention program. |
| 10 | Trazodone | Trazodone is an antidepressant medicine used to treat depression, anxiety, or a combination of depression and anxiety. Trazodone works by increasing your levels of serotonin and noradrenaline so you feel better. It can help if you're experiencing problems such as low mood, insomnia, and poor concentration. Trazodone comes in tablet, capsule, and liquid forms that you swallow. It is only available by prescription. |
| 11 | Temazepam | Temazepam belongs to a group of medicines called benzodiazepines. It is used to treat sleeping problems (insomnia) and can also be taken to help you relax before an operation or other medical or dental treatments, known as a pre-med. It works by increasing the levels of a calming chemical in your brain called gamma-aminobutyric acid (GABA). Temazepam comes in tablet form or as a liquid that you swallow. It is available by prescription only. |
| 12 | Lithium | Lithium is a type of medicine known as a mood stabilizer. It is used to treat mood disorders such as mania (feeling highly excited, overactive, or distracted), hypo-mania (similar to mania but less severe), regular periods of depression where treatment with other medicines has not worked, and bipolar disorder where your mood changes between feeling very high (mania) and very low (depression). Lithium can also help reduce aggressive or self-harming behavior. It is available by prescription and comes in regular tablets or slow-release tablets (lithium carbonate). Brand names for the tablets include Priadel, Camcolit, and Liskonum. It also comes as a liquid that you swallow (lithium citrate). Common brands of lithium liquid are Priadel and Li-liquid. |
| 13 | Fluoxetine | Fluoxetine is a type of antidepressant known as a selective serotonin reuptake inhibitor (SSRI). It's often used to treat depression and sometimes obsessive-compulsive disorder and bulimia. It works by increasing the levels of serotonin in the brain, which is thought to have a positive influence on mood, emotion, and sleep. Fluoxetine helps many people recover from depression, and it has fewer side effects than some other antidepressants. Fluoxetine is available only by prescription, and it comes in tablets, capsules, or a liquid that you swallow. |

Bipolar disorder

One of the most highly genetically inherited psychiatric disorders is bipolar disorder, which may affect as much as 1-4% of the population. Bipolar disorder is characterized by periods of depression

followed by periods of abnormally elevated mood (mania/hypomania) (Kong *et al.*, 2024). While environmental factors are known to be important causes of bipolar disorder, it is estimated that around 70-90% of all cases are attributed to genetic factors.

Specific genetic mutations or polymorphisms (SNPs) within CACNA1C, ODZ4, TRANK1, GNG2, ANK3, TPH2, ITPR2, SHANK2, & NCAN have been identified in genetic studies as candidates for increasing the likelihood of developing bipolar disorder (Kong *et al.*, 2024). These may either be directly inherited from parents or form de novo during development.

Schizophrenia

Schizophrenia is thought to have up to 70-80% genetic heritability. Like bipolar disorder, having a first-degree relative with the disorder drastically increases the risk of developing schizophrenia later in life, though environmental factors are also incredibly important (Kendler *et al.*, 2023). However, separating whether this is due to genetic causes or shared environmental conditions is difficult. The cumulative effect of multiple inherited or de novo mutations/polymorphisms in combination with environmental triggers can increase the risk of developing schizophrenia (Sindelar, 2024). For example, copy number variants (CNVs) involved in DiGeorge syndrome (22q11.2), which includes deletions of around 50 genes including COMT, and 17q12 microdeletion syndrome are highly associated with an increased risk of developing schizophrenia, but are also prevalently associated co-morbidly with ASD and other intellectual disabilities. Other specific genetic mutations implicated in schizophrenia include genetic disruptions to LAMA2, SETD1A, DPYD, TRRAP, TAF13, ARC & VPS39 (Kendler *et al.*, 2023).

Perhaps the most widely known genetic cause of schizophrenia is DISC1 (disrupted in schizophrenia 1), identified in a Scottish family who had schizophrenia and subsequently other families including in America. However, subsequent GWAS studies have not shown any strong associations between DISC1 and schizophrenia, often with mixed results. While DISC1 may not be a commonly implicated gene in GWAS studies, it does still show specific mutation-level effects in

specific families with schizophrenia, e.g., 1q43:11q14 translocation (Lv *et al.*, 2024).

Autistic spectrum disorder

Autistic spectrum disorder (ASD) is a neurodevelopmental disorder usually present from birth. Specific genes have been implicated in ASD, including MECP2, SHANK1-3, CACNA1E/B2, NRXN, SYNGAP1, UBE3A, KCNQ2/3/5, SCNA2, and SYN1/3, to name a few common examples. Many of these genes are related to specific ion channels and synapses, thus suggesting abnormal synaptic and neural network development. Therefore, it is unsurprising that depending on which genes are implicated (and what mutations occur), there is a large degree of clinical and genetic heterogeneity in ASD owing to such a diverse plethora of genetic mutations (Genovese and Butler, 2024).

Common mutations

Many mutations, polymorphisms, and epigenetic changes that occur in ASD also occur in bipolar disorder and schizophrenia, as well as other mental disorders (cross-disorder association) (Mallard *et al.*, 2024). These genes that can have a broad impact and multiple effects from a single gene are called pleiotropic genes. Some of these genes seem to be highly implicated in all of these disorders, including CACNA1C (or related calcium channel genes such as CACNB2), reflecting the common pathogenesis of abnormal synaptic development (Mallard *et al.*, 2024).

There are numerous candidates that have been identified in genetic screening studies; however, a notable example includes DCC (SNP rs8084351) (Mallard *et al.*, 2024). The protein product of DCC has a role in axonal growth during neurodevelopment, which serves as a key regulator of white matter projections in the developing brain. Loss-of-function mutations in DCC lead to severe neurodevelopmental complications that involve the loss of midline commissural tracts and abnormal disorganization of white matter tracts. Another key pleiotropic gene is RBFOX1 (SNP rs7193263) (Mallard *et al.*, 2024). RBFOX1 is a regulator

gene involved in the development of neuronal NMDA receptors and voltage-gated calcium channels. Genetic knockout models of RBFOX1 in mice lead to impaired neuronal migration and synapse formation in the developing brain, and this SNP also impairs these functions. Another highly pleiotropic gene involved in ASD, schizophrenia, and bipolar disorder is NOX4 (SNP rs117956829). NOX4 is a major source of superoxide production in the developing and adult brain, as well as promoting neural stem cell growth (Mallard *et al.*, 2024).

Conclusion

In Conclusion, mental (psychiatric) disorders such as bipolar disorder, schizophrenia, and ASD have strong genetic bases (mutations, polymorphisms, and epigenetic changes) that can be directly inherited from an affected parent or occur *de novo* during development. While there are several key genes implicated in specific disorders, numerous pleiotropic genes are implicated in all of these disorders, rooted in deficits in single genes (e.g., DCC), and calcium channel genes (e.g., CACNA1C). Thus, many of these disorders arise due to abnormal neurodevelopment, which can either cause a disorder from birth (ASD) or strongly predispose individuals to developing psychiatric conditions later in life, especially in combination with additional environmental factors such as stress. Although doctors and researchers continue to learn new things about the brain, many of its functions are still not completely understood. The underlying causes of mental illnesses are biopsychosocial – that is, partly biological (pertaining to your physical body), partly psychological (related to your emotions and experiences), and partly social (influenced by your environment).

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