

A Comprehensive Examination of Human Brain Disorders

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Abstract – Various factors such as illness, genetics, and trauma have been identified as potential aetiologies for a diverse array of neurological conditions. The hazards, identification, and treatments for each type differ. Dementia, brain tumours, and other neurological disorders represent a subset of the various pathological conditions that can impact the brain. They may introduce challenges in the execution of mundane activities. The prognosis of an individual is influenced by various factors, including brain pathology, spatial distribution, and the degree of severity. The prevalence of brain diseases poses a significant concern in global healthcare due to the considerable stress associated with contemporary lifestyles. Consequently, there exists a compelling necessity for continuous investigations pertaining to the anatomy and functionality of the brain within the framework of both well-being and disease. Since antiquity, scholars have engaged in the inquiry and analysis of the functional and anatomical brain aspects, resulting in the extensive acquisition of knowledge in this field globally. Scientists have made significant progress in elucidating the aetiology of brain disorders and abnormalities, bringing them closer to a comprehensive understanding of these conditions. The present synopsis encompasses a compilation of cerebral ailments and dysfunctions, delineating their respective manifestations and the therapeutic modalities employed for their management.

Keywords – Central Nervous System, Human Brain Disorders, Brain Tumours, Traumatic Brain Injury, Blood–Brain Barrier System.

I. INTRODUCTION

The nervous system is composed of the spinal cord, brain, nerves, and the muscle fibres that are innervated by these anatomical components. The human neurological system is distinguished from that of other species due to its remarkable design, rendering humans exceptional in comparison. The brain is an intricately developed and complex organ, with particular emphasis on the cortex, which refers to the grey layer covering the brain's surface. While humans may possess physical organs that are comparable or less robust than those of other animals, it is the cortex of the human brain that endows them with superior mental capacity, aptitude, and cognitive abilities, including reasoning, memory, and language proficiency. The brain is comprised of approximately 100 billion neurons. In contrast, individuals with exceptional intellectual abilities utilise approximately 15 percent of their brain's capacity, while individuals of average cognitive abilities typically employ only 5 to 10 percent [1].

Hence, it can be inferred that individuals have the potential to cultivate their intellectual abilities and attain genius status through deliberate practise and mental exertion. The typical weight of the adult human brain ranges from 1200 to 1400 grammes. Although the human brain constitutes a mere 2% of the overall body weight, it is responsible for consuming approximately 25% of the oxygen we inhale and a substantial 70% of the glucose we ingest [2]. The most basal group of chordates exhibits the absence of a brain-like organ, resulting in their physiological processes being autonomous from their surroundings. Hence, it can be argued that insects such as flies do not experience pain. The size of a skull does not necessarily correlate with an individual's level of intelligence. The significance of brain size is overshadowed by the brain's structural characteristics.

The cortex refers to the outermost layer of the brain's surface, while white matter pertains to the layer located in the interior. The brain is protected by three meninges located within the cranial cavity, serving as a safeguard against potential harm caused by physical motion. The term "meninges" refers to the designation of these membranes. The three layers consist of the outermost dura mater, the intermediate arachnoid, and the innermost pia mater. Meningitis is a medical condition characterised by the inflammation of the meninges, which are the protective membranes enveloping the spinal cord and the brain. The ventricles refer to the internal cavities within the brain. The brain consists of a total of four cavities, namely a third ventricle, a fourth ventricle and two lateral ventricles. Cerebrospinal fluid (CSF) is the term used to describe the fluid that is found within these cavities. The distribution of this phenomenon extends beyond the outer membranes of the spinal cord and the brain, encompassing the entirety of the brain's central region.

The analysis of cerebrospinal fluid (CSF) obtained through a lumbar puncture technique provides a straightforward means of identifying potential brain infections or haemorrhages. Cerebrospinal fluid (CSF) fulfils a range of functions, encompassing the facilitation of brain metabolism as well as the mitigation of friction. The cells of the brain exhibit an elevated metabolic requirement for calories and oxygen due to their extensive functional responsibilities. Consequently, there is a need to augment and accelerate the blood circulation. The cessation of blood and oxygen supply to the brain for a duration exceeding five minutes results in permanent cessation of brain function, leading to death. The initial structure to consider is the cerebrum, occupying a significant portion of the cranium and representing the most substantial constituent of the brain. The brain exhibits a bilateral organisation, with distinct left and right hemispheres, as anticipated. The corpus callosum is a neural structure that serves as the anatomical bridge connecting the hemispheres of the brain, facilitating interhemispheric communication. The cerebellum is a bilaterally symmetrical structure found in the posterior parts of the cranium. The major function of the skeletal system is to maintain the body's stability. The brain stem integrates the medulla oblongata, pons and the midbrain, which all terminate at the spinal cord and establish connections between the two hemispheres of the brain.

In the human body, the left hemisphere of the brain governs the motor and sensory functions of the right side, while the right hemisphere performs the same functions for the left side. The ability to communicate verbally is also predominantly associated with the left hemisphere of the brain. The frontal lobe is the anatomical region accountable for the origination of various cognitive functions, including the formation of personalities, regulation of behaviour, and the coordination of limb movements. The parietal lobe is associated with cognitive abilities related to analysis and the processing of emotional information. There exists a belief among certain individuals that the limbic system, encompassing the temporal lobe, serves as the anatomical foundation for extrasensory perception (ESP), telepathy, and various other manifestations of psychic capabilities. The regional hearing facility is also situated within this vicinity. The occipital lobe serves as the primary visual cortex within the brain. Individuals who exhibit right-handedness, characterised by a preference for using their right hand for activities such as writing, eating, and throwing, tend to possess a more dominant left hemisphere of the brain.

This left hemisphere is responsible for hosting crucial cognitive functions, including language processing, arithmetic computation, and logical reasoning. The right hemisphere of the brain is commonly believed to be the location where sensitivity, creativity, and imagination are predominantly housed. It is imperative to acknowledge that individuals with exceptional intelligence tend to exhibit greater utilisation of the right hemisphere of the brain.

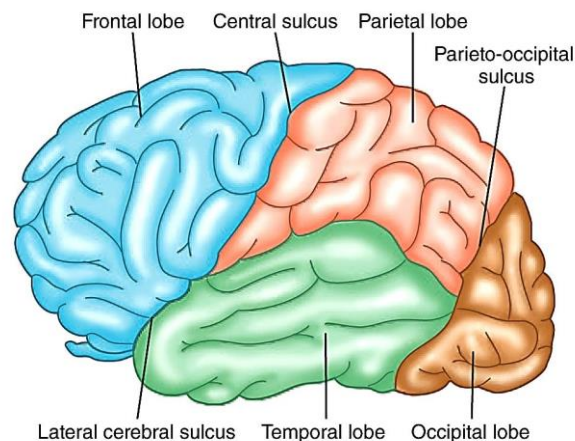


Fig 1. Image of the cerebral cortex

The cerebral cortex, illustrated in **Fig 1**, constitutes the largest portion of the human brain. The cerebral hemispheres, which collectively constitute approximately two-thirds of the brain's overall mass, are anatomically divided by a midline. In the context of language and speech, there exists functional dominance in one hemisphere. The contralateral hemisphere is accountable for visual information processing obtained from the eyes and the surrounding environment. The corpus callosum is a complex network of neural fibres that serves as the primary connection between the right and left cerebral hemispheres in the human brain. The four lobes comprising each cerebral hemisphere are the temporal lobe, frontal lobe, occipital lobe, and parietal lobe. The frontal lobe plays a crucial role in a diverse range of cognitive and physiological

functions, encompassing problem-solving, emotional expression, language utilisation, memory retention, decision-making, and engagement in sexual behaviours. The temporal lobe assumes responsibility for fundamental auditory functions such as the perception of sound, and it integrates the major auditory cortex that enhance the processing of the sensory stimuli obtained from ears and other associated areas to generate the linguistic expressions utilised for communication. The parietal lobe is accountable for the processing of sensory stimuli related to temperature, gustation, tactile perception, and kinesthetic awareness. The occipital lobe is the primary region responsible for visual processing.

This paper provides a comprehensive examination of human brain disorders in the following structural organization: Section II presents a critical survey of the brain cells. Section III focuses on the blood brain barrier (BBB), while Section IV evaluates the brain disorders. Section V reviews the causes of neuropsychiatry disorders and neurodegenerative diseases. Section VI discusses the database for neurodegenerative diseases, while Section VII focuses on the models to research brain disorders. Lastly, Section VIII draws final remarks regarding the paper.

II. BRAIN CELLS

Glial cells, also referred to as supporting cells, are a category of brain cells distinct from neurons. The brain of an adult human normally integrates about 86 billion neurons. There is a consensus among scholars that both glial cells and neurons play crucial roles in maintaining the optimal working of the brain. Neurons within the brain are obliged for the transmission and reception of metabolic and electrical signals. The brain's functional tissue comprises neural cells. The stroma, comprising blood vessels, serves as the structural or connective component of the residual brain tissue. Neurons, referred to as nerve cells, and glial cells, alternatively known as neuroglia, constitute the two principal cellular components within the brain. Neurons, which are the fundamental units of the brain, exhibit excitability and function by engaging in interactions with interneurons and other neurons within neural circuits and larger brain networks via synapses. The cerebral cortex consists primarily of two types of neurons: excitatory projection neurons and inhibitory interneurons. Neurons make up approximately 70-80% of the total cell population, while inhibitory interneurons account for 20-30% of the cells [3]. A nucleus refers to a cluster of neurons that frequently exhibit similarities in terms of their interconnections and functionalities. White matter tracts serve as conduits connecting the nuclei to each other.

The cells that provide support to neurons are referred to as glial cells. Oligodendrocytes, astrocytes, and ependymal cells that are collectively referred to as macroglia, are three different forms of glial cells. Additionally, microglia, which are smaller scavenger cells, are also considered a type of glial cell. Glial stem cells are present in all regions of the adult brain. Glial cells exhibit a significantly higher numerical prevalence compared to neurons. Moreover, aside from their role in supporting neurons, glial cells, particularly astrocytes, have demonstrated the capacity to engage in interactions with neurons via gliotransmission, a signaling mechanism that bears resemblance to neurotransmission. While lacking the ability to generate action potentials similar to neurons, these entities possess the capability to release substantial amounts of substances that demonstrate excitability and exert an influence on the circuitry of the brain. The star-shaped morphology of astrocytes facilitates their ability to interact with a significant number of synapses.

The glial cells, illustrated in **Fig 2**, which provide support to neurons, possess a range of functions that remain incompletely understood. However, one of their roles involves the maintenance and nourishment of neurons. There are two distinct categories of glial cells, namely microglia and macroglia. Microglia is relatively smaller in size, while macroglia consists of larger cells such as oligodendrocytes, astrocytes, and ependymal cells. Research has demonstrated that astrocytes possess the ability to establish communication with neurons via gliotransmission, a signaling mechanism that bears resemblance to neurotransmission. The neuron is composed of three essential components: the cell body, also known as the soma, the branching dendrites, and the axon. Neurons function as the fundamental structural units of the brain and are responsible for transmitting information to the various muscles, tissues, and neurons within the body.

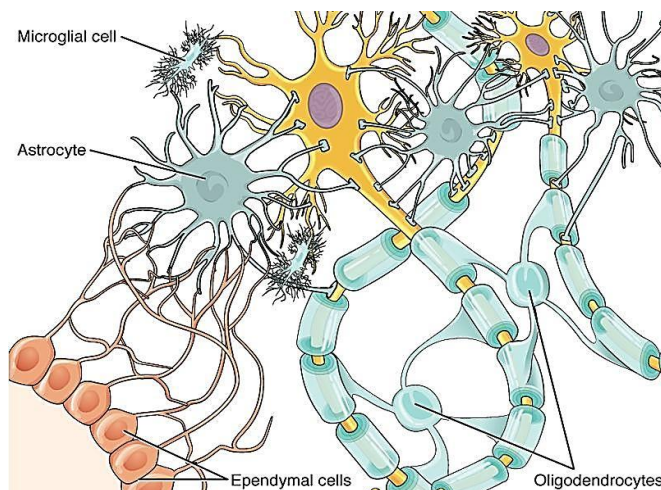


Fig 2. Types of glial cell



Fig 3. Purkinje cells within the cerebellum

The neuronal cells within the brain that have the potential to be electrically stimulated are commonly referred to as neurons. Neurons rely on the assistance of other neurons and interneurons to execute their functions within the cerebral cortex. The human brain is projected to integrate about 100 billion neurons. Neurons are a type of specialized cells that exhibit polarity and are primarily responsible for the transmission of electrical signals, referred to as action potentials or nerve impulses. According to Víggh and Maresca [4], individuals possess the capacity to generate their own membranes and proteins. Neurons utilize inhibitory, excitatory, or neuromodulatory neurotransmitters, which are released from their synapses in order to facilitate inter-neuronal communication. Excitatory dopaminergic neurons and inhibitory GABAergic neurons are among the various neuronal types that can be categorized according to the neurotransmitter they release.

Although interneurons in the cortex constitute a relatively small proportion, approximately 20%, of the total number of neurons, their role in modulating cortical activity is of high relevance for the processes of memory and learning. The cortex contains a diverse range of interneurons that exhibit variations in size, chemical composition, and electrical properties. Nevertheless, these interneurons collaborate harmoniously to maintain a stable balance between excitation and inhibition within the cortex. Neuropsychiatric disorders, such as schizophrenia, may occasionally involve a disturbance of this homeostatic balance. The potential impact of chemical and environmental exposure on pregnancy has been identified as a potential cause of disruption. Pyramidal neurons and rosehip neurons represent two distinct types of cortical neurons that are present across different layers of the cerebral cortex. The cerebellum is majorly composed of Purkinje cells and interneuronal Golgi cells (see **Fig. 3**).

Neurons are integral to the functioning of our mental, physical, and cognitive processes. Glia cells are integral components of the neurological system, serving a vital function. The term "glia" in Latin derives from the word "glue," thus giving rise to its nomenclature. Glial cells are integral to the facilitation of neuronal communication and are indispensable for the optimal functioning of neurons. The brain is comprised of a diverse array of subtypes of glial cells. Oligodendrocytes, a type of glial cell, play a vital role in facilitating the insulation of axons and the efficient transmission of electrical impulses over long distances. They are considered a single of the triple main forms of glial cells. Microglia referred to as central nervous system (CNS) immune cells, engage in ongoing communication with other glial cells while traversing the brain. Astrocytes, characterized by their star-shaped morphology, play a fundamental obligation in the maintainability of the BBB (Blood-Brain Barrier), provision of neurons nutrients, facilitation of neurological tissue regeneration, and facilitation of intercellular communication among nerve cells.

III. BLOOD BRAIN BARRIER

The Blood-Brain Barrier (BBB) [5] refers to physiological obstruction that exhibits selective permeability, facilitating the passage of particular small and large molecules into the neuronal cytoplasm. This process is facilitated by a multitude of cellular transport channels distributed across the membrane. The transporters responsible for facilitating the entry of crucial chemicals into the brain incorporate glucose transporter 1 (GLUT1), amino acid transporters, nucleotide and nucleoside transporters, and MCT1 and MCT2 monocarboxylate transporters, including ion transporters like as the Na⁺/K⁺-ATPase pumps. Amino acid transporters serve the dual function of facilitating amino acid uptake by the brain and potentially facilitating the transportation of toxic heavy metals into the periphery of the brain. Consequently, the presence of a significant amount of this substance can lead to neurotoxic effects. Glucose is conveyed via the GLUT1 transporter, while lactate and ketones are transported through MCT transporters.

Blood-brain barrier system

The brain possesses a complex system of venous and arterial vessels that serve the purpose of supplying oxygenated blood to, as well as removing deoxygenated blood from, the various cells within the brain. Nevertheless, it is at the capillary level where tasks are accomplished. The maintenance of cell integrity in arteries is facilitated by significant features present on both the luminal (internal) and abluminal (external) surfaces. The endothelial lining of capillaries consists of squamous epithelial cells, which directly interface with blood and its constituents on their luminal surface. The interior of the body is enveloped by a continuous foundation membrane that makes contact with the abluminal surface.

The basement membrane is a structural component that separates and supports the underlying tissues from the overlying squamous epithelium. In the provided diagram, the green coloration represents the presence of simple squamous epithelium. Zonula occludens, commonly referred to as tight junctions, and zonulae adherens serve the purpose of maintaining the cohesion of endothelial cells. Both components are essential for the proper functioning of the endothelial wall; however, the former component plays a crucial role in providing structural support, whereas the latter component facilitates the physical connection between cells. Furthermore, the close interconnections serve to envelop the cells and establish a physical boundary separating them from adjacent cells. Due to the impermeability of the endothelium, brain tissue is unable to traverse it, resulting in the complete isolation of the capillary lumen from the surrounding brain.

The objective of pericytes in the enhancement of the BBB has been demonstrated in multiple animal models. To regulate blood flow through the capillaries, these cells envelop the endothelial cells and have the ability to undergo contraction. Hence, the blood-brain barrier is fortified as contractility regulates the extent of blood circulation within the capillaries. Certain hypotheses also suggest that pericytes play a role in inhibiting the production of substances that increase vascular permeability, alongside facilitating the formation of tight junctions. Astrocytes, specialized cells, are available in both the fibrous astrocytes (white matter) and protoplasmic astrocytes (grey matter). Both fibrous and

protoplasmic astrocytes unsheath the abluminal surface of capillaries, similar to their coverage of nerve fibers and neuronal somas. At this stage, the aforementioned processes are knowledge as the perivascular endfeet.

The viability of the body's tissues and organs is contingent upon the presence of blood arteries, which serve the vital function of supplying oxygen and nutrients to sustain their survival. The BBB is a prominent component of the central nervous system's vascular system, facilitating precise regulation of ion, chemical, and cellular transportation between the circulatory system and the brain. The major function of the BBB is to safeguard the brain by selectively regulating the passage of substances, allowing vital nutrients to enter while impeding the entry of harmful agents such as toxins and pathogens. The BBB is formed by the endothelium of brain capillaries. The brain maintains a finely tuned equilibrium of hormones, nutrients, and water within its milieu, ensuring optimal levels. The administration of therapeutic remedies to the particular parts of the brain poses a notable challenge in the management of nearly all neurological disorders. The BBB hinders the brain's ability to effectively access a diverse range of pharmaceutical substances that hold potential for diagnostic or therapeutic purposes. The limited penetration of therapeutic chemicals and antibodies through the BBB restricts their therapeutic efficacy.

IV. BRAIN DISORDERS

Brain abnormalities, dysfunctions, and diseases exhibit systemic effects. Various types of infections can occur in neurons, tissues, or the brain itself. Both trauma, which refers to a mental disorder, and stroke, a condition resulting from insufficient blood flow caused by external factors, have the potential to cause harm. The occurrence of brain damage leads to the demise of brain cells. Numerous internal and external factors are implicated. Traumatic brain injury (TBI) [6] occurs as a consequence of external forces or mental instability, whereas neurotoxicity arises due to chemical exposure. Diseases impacting the human brain can be broadly categorized into two main groups: neurodegenerative and neuropsychiatric, as illustrated in **Fig. 4**. Although the etiology of these illnesses remains poorly comprehended and lacks a definitive cure, there exist therapeutic interventions that can effectively mitigate the associated symptoms.

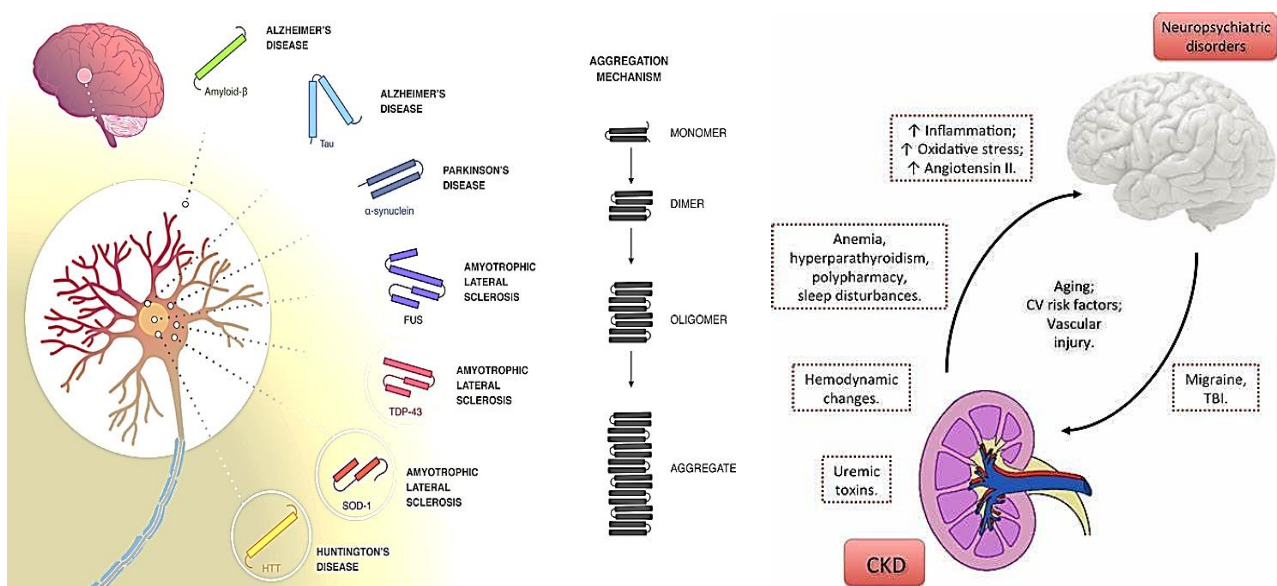


Fig 4. Main human neurodegenerative diseases and neuropsychiatry disorders

Autoimmune Diseases

Individuals diagnosed with an autoimmune disorder experience a phenomenon wherein their immune system mistakenly targets and attacks normal, healthy cells within the body. Conditions such as rheumatoid arthritis, Crohn's disease, and thyroid disorders are encompassed within this classification. An autoimmune illness refers to a condition wherein the immune system exhibits a malfunction, leading to the misidentification of healthy and functional components of the body as foreign entities. Recent scientific evidence indicates the potential existence of over one hundred distinct autoimmune disorders, thereby augmenting the estimated count of recognized autoimmune diseases to exceed eighty. Virtually every constituent of the human body has the potential to fulfill a function.

Various autoimmune diseases exhibit distinct manifestations, primarily contingent upon the specific organ or system that is affected. The symptoms vary in intensity from moderate to severe and are temporary in nature. However, they commonly include a mild increase in body temperature, feelings of exhaustion, and a general sense of discomfort. Autoimmune disorders often present with symptoms such as joint discomfort, skin rashes (such as urticaria), and neurological manifestations. Autoimmune diseases are characterized by an unclear etiology, which is considered to integrate a collection of environmental and genetic factors; however, their underlying approaches remain inadequately comprehended. It has been observed that the occurrence of disorders such as lupus tends to cluster within families, suggesting a genetic predisposition. However, certain cases have also been associated with viral triggers or exposure to

environmental factors, indicating a multifaceted interaction between environmental and genetic factors in the development of these disorders.

Dementia

Dementia is distinguished by a notable deterioration in cognitive functions, integrating but not limited to memory, learning, and reasoning, to the extent that they become debilitating. Two symptoms commonly associated with dementia are persona shifts and emotional instability. The impact of dementia can range from minimal discernibility to the extent that the afflicted individual requires continual support for basic activities such as nourishment and personal hygiene. Dementia, despite its prevalence among older individuals, is not an inherent consequence of the aging process. It impacts a substantial number of people and its incidence rises with advancing age, with approximately one-third of adults aged 85 or above potentially experiencing some form of dementia. Dementia is a relatively infrequent occurrence among the elderly population, with a significant number of individuals managing to live well into their nineties and beyond without experiencing this cognitive impairment. Alzheimer's disease (AD) is the most predominant type of dementia, although there exist other types as well. The manifestation of dementia symptoms arises from the deterioration and malfunctioning of neurons, which are the fundamental units of nerve cells in the brain. This degeneration results to the disruption of connections between neurons and, ultimately, the demise of these cells. Although the natural aging process leads to a certain degree of neuronal loss, individuals with dementia experience a considerably more pronounced decline.

Brain Infections

Various microorganisms, such as parasites, fungi, viruses, and bacteria, have the potential to induce a cerebral infection. Frequently, it exerts an impact on additional areas within the spinal cord and central nervous system. Infections that target the brain have the potential to impact various regions within the CNS. Inflammation within the cerebral region, commonly referred to as encephalitis, Meningitis refers to the inflammatory condition affecting the meninges, the protective membranes enveloping the spinal cord and the brain. The condition characterized by the inflammation of the spinal cord, commonly referred to as transverse myelitis, and the formation of a pus-filled lesion in the brain, known as a cerebral abscess. The phenomenon of brain or spinal cord enlargement resulting from inflammation, which is the body's typical response to infection, can lead to the manifestation of both somatic and neurological symptoms. The application of pressure on the parenchyma, which refers to the functional tissues of the brain, by an abscess, can have detrimental effects.

Infections affecting the brain can arise from a diverse range of microorganisms and can be transmitted through various modes of transmission. Utilizing shared utensils or engaging in intimate activities such as kissing is merely a couple of instances wherein close contact and the exchange of respiratory secretions can facilitate the transmission of viral pathogens. Furthermore, aside from transmission through oral communication or consumption of contaminated food, bacteria can also be spread through direct physical contact. The determination of the appropriate diagnostic method to confirm the presence of a brain infection is contingent upon the evaluation of your symptoms and the findings obtained from the physical examination. It is imperative for a healthcare practitioner to expeditiously evaluate individuals displaying symptoms indicative of a cerebral infection. As part of a neurological assessment, the physician will conduct an examination of the patient's motor and sensory functions in the event that a brain infection is a concern.

Movement Disorders

The clinical conditions referred to as movement disorders are characterized by both an excess and a deficiency of voluntary and involuntary movement, regardless of the presence or absence of weakness or spasticity. The terms "basal ganglia" and "extrapyramidal illnesses" are often used interchangeably in the context of movement disorders. Hyperkinetic and hypokinetic are the two predominant classifications of movement disorders. Dyskinesia refers to the medical condition characterized by the presence of hyperkinetic movement disorders, which manifest as excessive and frequently repeated involuntary movements that disrupt the typical motor activity. The terms akinesia, hypokinesia, bradykinesia, and stiffness are all associated with hypokinetic movement disorders, which involve involuntary inactivity, reduced amplitude of movements, slow movement, and rigidity. The salient manifestation in primary movement disorders is the presence of involuntary movements. Within the domain of secondary movement disorders, the manifestation of erratic behaviour acts as an indication of a more profound and consequential medical condition.

Neuromuscular Disease

Neuromuscular diseases encompass a range of conditions that impact the motor unit and its constituents, namely the neuromuscular junction, the skeletal muscle, and the peripheral nervous system (PNS). Muscle atrophy and weakening can occur as a consequence of damage to any of the aforementioned structures. Sensory impairments may also be a potential factor. Muscle and nerve disorders can arise due to a multitude of factors. More than 500 genes have been associated with genetic mutations that lead to neuromuscular disorders. Other factors, which could contribute to the degeneration of nerves or muscles include autoimmune disorders, exposure to toxins, the use of certain medications, malnutrition, metabolic disturbances, hormone imbalances, infections, nerve compression or entrapment, compromised blood supply, and traumatic events. The potential impact of exposure to environmental toxins, such as heavy metal poisoning, on the development of neuromuscular disease has been documented. Additional factors contributing to the occurrence of the

condition encompass autoimmune disorders, genetic or hereditary disorders, and specific variants of the collagen condition.

Ehlers-Danlos syndrome is a medical condition that has been documented in the literature. Deficiency disorders, such as the one resulting from inadequate absorption of vitamin B-12, present themselves through the deterioration of the myelin sheath responsible for providing electrical insulation to the nerves within the human body. Both myasthenia gravis and Lambert-Eaton myasthenic syndrome (LEMS) are disorders affecting the motor end plate, leading to muscle weakness due to the presence of antibodies targeting the acetylcholine receptor. Both tetanus and botulism are bacterial diseases that lead to changes in muscle tone as a consequence of the toxin generated by the infecting bacteria. The muscular dystrophies encompass a diverse range of conditions, such as Duchenne's and Becker's that are characterized by progressive muscle weakness and reduced life expectancy resulting from the impairment of muscle integrity.

Seizure Disorders

A seizure refers to a transient disturbance in typical cerebral functioning resulting from an unregulated and deviant electrical discharge within the brain. Despite originating in the gray cortical matter of the brain, seizures have the potential to propagate to various regions within the brain. According to Orlandi et al. [7], approximately 10% of individuals will experience a seizure at some juncture, although a significant proportion of these individuals will not encounter subsequent episodes. The identification of multiple seizures or the presence of a medical condition that is known to cause recurrent seizures can potentially result in the diagnosis of a seizure disorder. The diagnosis of epilepsy is established when an individual experiences two or more seizures that are not provoked by any identifiable external factors. Focal seizures, characterized by their initiation on one hemisphere of the brain, can manifest as either localized or diffuse in nature. Focal seizures, similar to generalized-onset seizures, have the potential to impair motor skills and muscular tone, primarily affecting one side of the body. A tonic-clonic seizure is characterized by the propagation of a focal seizure to encompass bilateral cerebral hemispheres. Medical professionals have identified two distinct subtypes of focal seizures, which can be differentiated based on their impact on the patient's level of consciousness. There are two categories of seizures: focal impaired awareness seizures earlier identified as complicated partial seizures; and focal aware seizures, earlier identified as the simple partial seizures.

Stroke Disease

A stroke happens whenever there is disruption in the supply of blood in the brain, either as a result of the occlusions of blood vessels or cerebral artery rupture resulting in bleeding. When a blood vessel within the cerebral region ruptures or experiences occlusion, the supply of oxygen and blood to the brain's tissues is impeded. According to the Centers for Disease Control and Prevention (CDC) [8], stroke is a significant cause of mortality in the United States. Annually, a significant number of 795,000 individuals in the United States experience a stroke. Brain cells and tissue commence undergoing cellular death within a matter of minutes subsequent to oxygen deprivation. The three predominant manifestations of stroke include: (i) In instances of transient ischemic attack (TIA), the thrombus spontaneously resolves within a span of several days. In the context of ischemic stroke, the presence of a clot or plaque within the artery is responsible for the occurrence of the obstruction. The potential consequences and symptoms of an ischemic stroke are typically more enduring, and in some cases, may even be permanent, in comparison to those of a transient ischemic attack (TIA).

A hemorrhagic stroke, specifically an intracerebral hemorrhage, is characterized by the extravasation of blood from a ruptured or otherwise impaired blood vessel, leading to the accumulation of blood within the brain. The cerebral tissues experience damage when there is a cessation of blood supply. The symptoms of stroke become evident in the anatomical regions of the body that are governed by the specific cerebral areas that have been impacted. There exists a wide range of pharmaceutical interventions available for the treatment of stroke. The doctor's recommendation will be significantly influenced by the specific characteristics of the stroke experienced by the patient. Certain treatments have been found to reduce the probability of a subsequent stroke, whereas others are aimed at primary stroke prevention. The prescription of one or multiple medications for the treatment or prevention of a stroke may be contingent upon various factors, such as an individual's health background and associated risks, as determined by a medical professional.

Mental Disorders

A mental disorder is characterized by clinically significant cognitive impairment, emotional dysregulation, or behavioral abnormalities. Common manifestations encompass psychological distress or a decline in essential faculties. Mental illness manifests in a diverse range of presentations. The term "mental diseases" can be used to describe various conditions that impact an individual's mental health. The term "latter" is a comprehensive designation encompassing various forms of mental health conditions that result in significant distress, impairment in functioning, or the potential for self-harm. This includes mental illnesses, psychosocial impairments, and other altered mental states. The main focus of this information page is on the criteria outlined in the ICD-11 for the diagnosis of mental disorders.

In [9], it was observed by Sankar et al. that anxiety and depressive disorders were prevalent psychiatric conditions, impacting approximately one out of every eight individuals globally (1). The prevalence of anxiety and depression significantly escalated as a result of the COVID-19 pandemic in 2020. The prevalence of anxiety and severe depressive

disorders has exhibited an upward trend, experiencing a notable surge of approximately 26% and 28% respectively within a single year (2). Despite the existence of effective strategies for the prevention and treatment of mental disorders, a significant proportion of individuals who could potentially derive advantages from these interventions do not avail themselves of such opportunities. A significant portion of the population also encounters instances of stigma, discrimination, and various other manifestations of human rights violations.

Neurodegenerative Diseases

Neurodegenerative diseases encompass a collection of pathological conditions featured by the slow neurons loss, resulting in the impairment of both central and peripheral nervous system functionality. These conditions have an impact on various physical and cognitive functions, including locomotion, communication, memory, and motor coordination. Due to the presence of symptom overlap, the etiology of these disorders is challenging to ascertain precisely. Several neurodegenerative disorders can be identified, including Parkinson's disease (PD), Alzheimer's disease (AD), Huntington's disease (HD), Prion disease, Spinal Muscular Atrophy (SMA), and Spino-Cerebellar Ataxia (SCA). The occurrence of neuronal death has been demonstrated in the amygdala, cortex, and hippocampus among individuals diagnosed with Alzheimer's disease. Conversely, individuals with Parkinson's disease exhibit a deficiency of dopamine within the substantia nigra pars compacta. AD is the prevailing type of dementia, primarily impacting individuals aged 60 and above. The condition was initially documented by German doctor Alois Alzheimer in 1906, following his observation of signs of psychological disturbances and memory loss in a patient named Auguste D. The observed symptoms encompassed fluctuations in mood and a lack of responsiveness. The disease was named after Emil Kraepelin, a German colleague of Dr. Alzheimer.

The author of the medical treatise "Psychiatrie" introduced the term "Alzheimer's disease" to designate the condition in the year 1910. The characteristic features of this condition include progressive forgetfulness and cognitive decline. The accumulation of tau protein and beta-amyloid in the brain is widely recognized as the principal mechanism underlying the pathogenesis of AD [10]. There is a suggestion in the literature that both proteins may play a role in the process of neuronal cell death. The establishment of the intracellular neurofibrillary tangle and availability of extracellular amyloid plaques are recognized as two significant pathological characteristics of Alzheimer's disease. Collectively, these two characteristics contribute to neuronal demise, cerebral atrophy, and synaptic dysfunction. Parkinson's Disease (PD) is positioned second in terms of prevalence among neurodegenerative disorders, surpassed only by Alzheimer's Disease (AD).

The aforementioned is a pathological state affecting the central nervous system, majorly featured by a decline in motor function. The effects of this phenomenon are observed to be equally influential on both motor and non-motor skills. The precise etiology of Parkinson's disease (PD) remains uncertain; however, it is widely postulated that an amalgamation of environmental and genetic influences contributes to the pathogenesis of this disorder. The initial characterization of the condition was conducted by Dr. James Parkinson in a paper titled "An Essay on the Shaking Palsy" published in 1817. The initial manifestation of the disease occurs in the substantia nigra pars compacta, a midbrain part, featured by dopaminergic neurons demise and the succeeding accretion of Lewy bodies. The most frequently observed clinical symptoms include akinesia, rigidity, postural instability, non-motor symptoms, and tremors.

In the year 1920, the phenomenon of prion disease in humans was initially documented by neurologists Alfons Maria Jakob, and Hans Gerhard Creutzfeldt [11]. Transmissible spongiform encephalopathies (TSEs), also identified as prion illnesses, are infrequent progressive neurodegenerative disorders that have the potential to impact both humans and animals. This condition involves the production of an aberrant variant of the cell surface glycoprotein PrPC, known as PrP^{Sc}. This neurological disease is attributed to the abnormal PrP^{Sc} protein. Creutzfeldt-Jakob disease (CJD) is the predominant prion disease in humans, whereas bovine spongiform encephalopathy (BSE), frequently denoted to as "mad cow disease," is the prevailing prion disease in animals. Prions are protein molecules that have undergone misfolding, resulting in their ability to self-replicate and propagate throughout biological systems. Huntington's disease, also identified as Huntington's chorea, is an alternative nomenclature for the aforementioned condition. It is attributed to the progressive neurons degeneration within the brain. The genetic neurodegenerative disorder was initially recognized by George Huntington in 1872. The etiology of this neurodegenerative disorder can be attributed to the presence of an unstable trinucleotide repeat sequence consisting of cytosine, adenine, and guanine (CAG). Furthermore, it follows a pattern of dominant inheritance. Involuntary movements, amnesia, and aberrant conduct are characteristic features of the aforementioned disorder.

Neuropsychiatry Disorders/Conditions

Neuropsychiatry is a medical discipline that focuses on the study and treatment of mental disorders that arise from abnormalities or dysfunctions in the brain. The term "mental illness" is commonly used to refer to a neurological condition. Bechter [12] discuss how neuropsychiatry posits that mental disorders can be attributed to structural abnormalities in the brain. Neuropsychiatric disorders have extensive implications for an individual's overall well-being and health-related outcomes. Experiencing difficulties in maintaining focus or adhering to tasks as an adult bears resemblance to the challenges encountered in maintaining focus during childhood. The complexity and limited comprehension of these symptoms contribute to their overlapping nature. Seizures, attention or cognitive impairments, unregulated aggression,

migraine headaches, substance dependencies, eating disorders, depressive symptoms, and anxiety disorders are all illustrative instances of commonly occurring neuropsychiatric conditions. Criminal behavior, aggression, violence, psychopathy, antisocial personality disorder and difficulties with episodic dyscontrol and impulse control are all indicative of neuropsychiatric disorders. The etiology of brain disorders remains uncertain, even though it is accredited that environmental and genetic factors contribute to their development. Both autism and schizophrenia are characterized by early onset, occurring in infancy for autism and in adulthood for schizophrenia. Additionally, both conditions exhibit a high prevalence.

V. CAUSES OF NEUROPSYCHIATRY DISORDERS AND NEURODEGENERATIVE DISEASES

The disentangling of the influences of heredity and environment on the progression of neurological disorders is an insurmountable task. Cell death and subsequent functional impairment occur as a consequence of any form of injury to the CNS. The aforementioned brain illnesses directly lead to the impairment or loss of normal brain function, including sensory, motor, and cognitive abilities. The accumulation of tau protein, beta-amyloid in the type of misfolded Huntingtin protein, neurofibrillary tangles, ubiquitinated protein aggregation, alpha-synuclein accumulation, and cell surface glycoprotein accumulation have been observed in Huntington disease, Alzheimer's disease, amyotrophic lateral sclerosis (ALS), prion disease, and Parkinson's disease. According to Desai, Rao, Jegga, Dhandapani, and Sadayappan [13], there is a correlation between genetic mutations and the accumulation of misfolded proteins. Brain injuries have the potential to result in synaptic insufficiency, extensive cellular demise, and inflammation, thereby compromising or potentially obliterating cognitive and motor functions such as memory, learning, decision-making, language, and even consciousness (manifesting as dementia). At present, neurodegenerative diseases remain devoid of effective treatment options. Deep brain stimulation (DBS) and cell transplantation therapy have been employed as treatment modalities to manage and mitigate physiological and cognitive impairments in individuals afflicted with severe illness.

The accumulation of amyloid-beta protein in the sub-cortical regions, cerebral cortex, parietal lobes, cingulate gyrus, and temporal lobes leads to synaptopathy in patients with Alzheimer's disease. This synaptopathy is featured by glial inflammation and neuronal cell death. The buildup of intracellular protein-synuclein in conjunction with the ubiquitin complex hastens the demise of dopaminergic neurons founded within the substantia nigra, a feature element of Parkinson's disease. Lewy bodies, which result from the accumulation of protein aggregates within the cytoplasm, play a significant role in both inherited and sporadic cases of Parkinson's disease. The Huntington's disease (HD) is additionally precipitated by the accumulation of Huntingtin protein within cellular structures. The presence of the huntingtin gene mutation leads to the degeneration of cells in the striatum part of the brain. The underlying cause of multiple sclerosis (MS) can be attributed to dysfunction in glial cells.

The occurrence of extensive axonal injury and subsequent impairment of neuronal transmission is attributed to an immunological reaction, predominantly affecting basal ganglia, the brain stem, and white matter tracts. The etiology of Alzheimer's disease (AD) has been postulated to be influenced by genetic factors in approximately 49% to 79% of cases, as suggested by Farlow [14]. Likewise, the percentage for PD ranges from 5% to 10%. However, Huntington's disease (HD) is a hereditary condition that is solely triggered by expansions of the CAG nucleotide repeat. The utilization of whole genome sequencing may facilitate the comprehension of genetic factors that impact health, illness, and the effectiveness of treatments. Understanding the complex interaction between hereditary and environmental factors in relation to brain function impairment is a challenging endeavor. Numerous studies have showed that genetic elements play a fundamental obligation in the etiology of schizophrenia and bipolar disorder. According to a study conducted on twins, the range of prevalence falls between 70 and 80 percent.

Moreover, it has been shown that hereditary elements play a fundamental obligation in the development of depression, with a notable increase observed from 38% to 75%. According to Zhou et al. [15], a significant proportion of individuals aged 55 and older who suffer from dementia have either a personal or familial background of the condition. Dementia is a comprehensive term encompassing a range of symptoms that arise as a result of neurodegenerative disorders. During the advanced phases of neurodegenerative disorders, individuals experience significant cognitive impairments that can significantly interfere with their ability to carry out daily activities. Dementia is characterized by various manifestations, including memory and learning impairments, visual deficits, diminished attentional capacity, and behavioral abnormalities. The impact of epigenetic factors on the exacerbation or deterioration of disease-like symptoms is also noteworthy. Several studies have established a correlation between the presence of mercury (Hg), lead (Pb), cadmium (Cd), arsenic (As) and aluminum (Al) and the accelerated progression of disease in Parkinson's disease (PD) and Alzheimer's disease (AD). Certain pesticides, such as 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP) and paraquat (PQ) have been associated with the development of neurological disorders. Rotenone, akin to Trichloroethylene (TCE) and hazardous nanoparticles, has been observed to induce detrimental effects on neurons and interfere with the typical operation of CNS.

VI. NEURODEGENERATIVE DISEASES DATABASE

Given the shared biology and symptomatology among numerous illnesses within this category, it is imperative to establish a comprehensive database dedicated to neurodegenerative disorders. The Database of Neurodegenerative Disorders (DND) is an online repository that has amassed a substantial collection of over one hundred disease concepts pertaining to the nervous system. This comprehensive database encompasses a wide range of genetic information, gene

products, pathophysiological pathways, and treatment modalities. The resource offers comprehensive information pertaining to various facets of neurodegenerative diseases, thereby facilitating researchers in gaining enhanced insights into the biochemical and genetic approaches underlying the progression and management of these conditions. The Integrated Neurodegenerative Disease Database (INDD), a collaborative effort between researchers at the University of Pennsylvania and other specialists, encompasses a comprehensive representation of neurodegenerative disorders such as Parkinson's disease, Alzheimer's disease, frontotemporal lobar degeneration, and amyotrophic lateral sclerosis [16]. The Penn INDD platform offers a consolidated interface that enables accurate and reliable queries across multiple database tables. Additionally, it can be utilized to examine the comparative progression of different neurodegenerative diseases.

In their study, Li, He, Li, and Guo [17] have identified a total of 18 diseases that have been documented in the Integrated Database of Neurodegenerative Diseases (IDND). The Integrated Database of Nucleotide Variants (IDND) was constructed by utilizing data obtained from reputable sources such as UniProt kB, which provides comprehensive protein data, KEGG, which offers pathway data, and PubMed, which contains articles related to diseases. PD Gene is a comprehensive online database that conducts meta-analyses on all published literature related to the disease. The acquisition of this knowledge has facilitated researchers in elucidating the genetic factors that contribute to the susceptibility of Parkinson's disease (PD). The identification of a novel locus for Parkinson's disease (PD) risk, ITGA8, was achieved through the utilization of the provided data set. Alz Data prioritizes the study of Alzheimer's disease due to its high prevalence and significant rate of growth as a neurological disorder.

The database encompasses a inclusive collection of reliable functional data derived from different sources, including neuroimaging screening, population-based longitudinal investigations, and transgenic mice phenotyping. Additionally, it incorporates genomic information from genome-wide association studies (GWAS) and whole exome sequencing, as well as transcriptomic, proteomic, and functional genomic data. Schizophrenia, a prevalent mental disorder, is believed to have a heritability rate of approximately 80%. The SZDB database encompasses the findings derived from genetic and molecular investigations pertaining to schizophrenia. SZDB 2.0, accessible at [18], represents the most recent version of an extensive database designed for the purpose of investigating schizophrenia. Young and Scott [19] incorporate novel additions such as data derived from genome-wide association studies (GWAS), genetic and gene expression investigations, polygenic risk score calculators, copy number variants, transcript quantitative trait loci (QTL), gene eQTL (expression quantitative trait loci), protein-protein communication researches, and methylation quantitative trait loci (MQTL).

Utilizing this resource as an initial reference for further exploration of schizophrenia is an obvious choice. The BD gene database is a supplementary resource that seeks to elucidate the intricate genetic aspects of bipolar disorder (BD), including the association between BD, and major depressive disorder (MDD), including and schizophrenia. Lussier et al. [20] offer a comprehensive examination of existing literature, along with empirical evidence pertaining to potential genes and pathways that could potentially contribute to the pathophysiology of the disease.

VII. MODELS TO RESEARCH BRAIN DISORDERS

Caenorhabditis elegans, Fruit fly (*Drosophila melanogaster*), *Musca domestica* (also known as the house fly), *Danio rerio* (commonly referred to as the zebra fish), pigs, and monkeys are among the animal models that have been employed in [21] to evaluate the molecular route implicated in various brain illnesses and disorders. Cell lines are utilized in the examination of prospective molecular route concerned in the development of neurological disorders and illnesses. Falcone, Brunamonti, Ferraina, and Genovesio [22] have discovered notable parallels in the structural and organizational characteristics of primate and human cerebral cortices. The utilization of this technology will significantly contribute to the advancement of research on human brain disorders and diseases. The selection of a suitable model should be guided by the specific biological questions being posed. Due to its conserved characteristics, *Caenorhabditis elegans* has been utilized as a perfect organism in the investigation of different neurodegenerative disorders, such as Alzheimer's disease (AD), Huntington's disease (HD), and Parkinson's disease (PD). The utilization of transgenic technology has facilitated the utilization of the fruit fly, *Drosophila*, as an effective model organism for researching different neurodegenerative illnesses. The aforementioned conditions encompass tauopathy, Alzheimer's disease, Parkinson's disease, hereditary spastic paraplegia, polyglutamine disorders, and amyotrophic lateral sclerosis.

The origins of neurodegenerative illnesses such as Huntington's disease (HD), Parkinson's disease (PD), and Alzheimer's disease (AD) can be attributed to genes that possess homologues in zebrafish. Zebrafish larvae demonstrate observable neuro-pathological and behavioral abnormalities that bear resemblance to those found in humans. Genetic modification techniques have been employed to generate transgenic mice and rats in order to gain further insights into the etiology of Fragile X syndrome (FXS), autism, as well as other neuropsychiatric illnesses. In contrast to the cerebral cortex of mice or rats, the pig's cerebral convolution (gyri and sulci) exhibits a greater resemblance to the human neo-cortex, implying a potentially significant translational relevance. The investigation of pigs as a viable model for studying human brain disorders has been extensively examined by Lind, Moustgaard, Jelsing, Vajta, Cumming, and Hansen [23] within the realm of neuroscience. Genetically engineered pigs are currently being employed in the investigation of various neurological disorders due to their heightened genetic, physiological, and anatomical resemblances to humans. Transgenic primates have also been employed as experimental models to explore neurological disorders. The investigation of the etiology of Alzheimer's disease, Parkinson's disease, sleep disturbances, and microcephaly is most effectively conducted in

primates, particularly monkeys, owing to their significant resemblance to humans. The inevitability of brain dysfunctions and other significant effects of aging can be attributed to the limited regenerative capacity of neurons in the brain.

During the initial phases, neurodegenerative diseases and disorders exhibit a comparatively gradual progression. In industrialized nations characterized by high life expectancy, the older demographic is notably susceptible to these illnesses. Several conditions that fall under the category of neurodegenerative illnesses include Progressive supranuclear palsy (PSP), Parkinson's disease (PD), multiple system atrophy (MSA), frontotemporal dementia (FTD), dementia with Lewy bodies (DLB), and Alzheimer's disease (AD). Symptoms of Parkinson's disease (PD), a deteriorating neurological illness, encompass movement impairment and muscular rigidity. The hallmark of this disorder is the deterioration of neurons within the substantia nigra and other brain regions. Lewy bodies (LBs) represent intracellular protein aggregates found within neurons that have been associated with the disease. Nanotechnology has enabled the potential permeation of medications through the blood-brain barrier (BBB). Greenwood, Wateridge, and Turowski [24] are currently engaged in the endeavor of developing liposomes that are loaded with nanoparticles with the aim of traversing the blood-brain barrier. Further research is warranted to ascertain efficacious approaches for assisting individuals afflicted with neurological disorders. In the field of clinical neuroscience, the application of nanotechnology in medication delivery across the blood-brain barrier (BBB) emerges as a highly promising avenue. The controlled sequential performance of multiple activities by nanoparticles is potentially critical for facilitating the transportation of medications across the blood-brain barrier (BBB).

VIII. CONCLUSION

Various factors contribute to the development of diverse brain disorders, encompassing diseases, hereditary factors, and traumatic incidents. Each category possesses a distinct array of hazards, circumstances, and treatments. Brain damage frequently occurs as a consequence of blunt trauma. Trauma has the potential to cause damage to various components of the brain, including neurons, nerves, and tissue. This injury impedes the communications between the brain and the remainder of the body. The occurrence of brain tumors can occasionally arise, presenting a significant peril. Primary brain tumors are defined as tumors that originate in the brain, without spreading from other parts of the body. In specific circumstances, metastasis of cancer originating from a different anatomical site may occur, leading to the infiltration of malignant cells into the brain. These neoplasms are commonly known as metastatic or secondary brain tumors. Both malignant (cancerous) and benign (non-cancerous) brain tumors are potential occurrences. Medical professionals classify brain tumors into different grades, namely grades 1, 2, 3, or 4. Tumors with higher values are indicative of increased activity. Neurodegenerative diseases lead to the progressive degeneration of the brain and nerves over time. These individuals possess the ability to induce confusion and modify one's personality.

Additionally, there is potential for detrimental effects on the nerves and tissue within the brain. Certain neurological disorders, such as Alzheimer's disease, may exhibit a progressive deterioration in individuals as they advance in age. There is a potential for a gradual decline in memory and cognitive abilities. The terminology "mental health disorders" or "mental health conditions" encompasses a wide range of issues that exert influence on an individual's behavior. Non-genetic factors exert an influence on the progression of human brain disorders, thus prompting a surge of interest in the investigation of epigenetic factors within the realm of scientific research. The utilization of databases developed for neurodegenerative disorders and the availability of data facilitated by Genome-Wide Association Studies (GWAS) have demonstrated significant utility in this particular context. Despite the existence of multiple models for investigating neurodegenerative disorders, further specialized methodologies are necessary, particularly for neuropsychiatric states as a result of the presence of overlapping signs and symptoms. The BD genes have undertaken an endeavor to elucidate the intricate genetic condition of bipolar disorders, as well as the shared symptoms with Major Depressive Disorder (MDD) and schizophrenia.

Data Availability

No data was used to support this study.

Conflicts of Interests

The author(s) declare(s) that they have no conflicts of interest.

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Ethics Approval and Consent to Participate

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Competing Interests

There are no competing interests.

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