



An Exploratory Study On The Influence Of Neurological And Psychological Disorders

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Abstract: The paper researches the synergy between neuroscience and psychology in understanding psychological disorders. Along with understanding the above, the treatment involves both of these branches of science. Recent research is continuously evolving towards psychological treatment along with allopathic medicines to manage patients suffering from various mental and neurological disorders. Neither of these branches alone is sufficient to cure these disorders, which have increased manifold in the last couple of decades.

Research Question: An attempt will be made to understand the importance of neuroscience and psychology in understanding various disorders. How important are both of these streams in analysing diseases like autism, ADHD, dementia, and Alzheimer's? Is it the influence of both these streams that cause these ailments? Is there a cure for them? Or does the answer lie in prevention and managing these ailments? These and many more such questions will be attempted during the research.

Keywords: Neuroscience, Neurological, Operational Diagnostic Criteria, Neurons, Cerebrum, Cerebellum, Dendrites, Neurotransmitters, Neurobiology, Synapse, Cognitive Science, Neuropsychology, Disorders, Autism Spectrum Disorder, Functional Neural Imaging

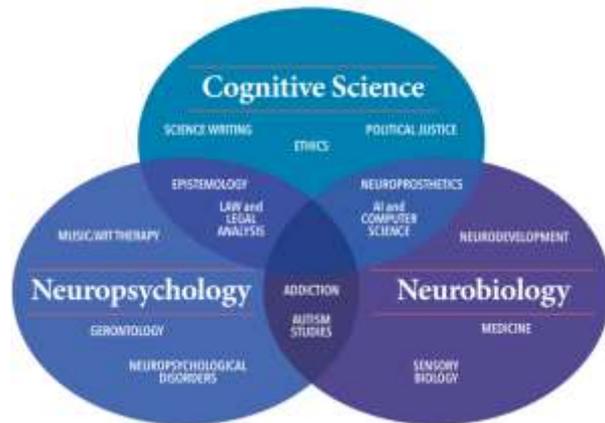
Introduction

Neuroscience is a fast-developing field that has given psychology and other disciplines many new tools and perspectives for investigating various health challenges and the well-being of a human's mental life. These innovations have led to a clearer understanding of the mechanisms of mental illness and have innovated precise new modes of treatment. The downside is that the neuroscientific information can leave practitioners in psychiatry and psychology with difficult questions not only from the complexity of these fields but also due to the rapidly evolving understanding of 'neuroscience'.

It was in the 1970s that there was a paradigm shift in the thought process regarding various illnesses, from a behavioral to a biological explanation. The brain is the biological organ composed of cells and organized

in a particular structure that enabled these ailments to be understood as biologically grounded. In the 1980s this had been reorganized based on different descriptive definitions of these ailments and the introduction of standard “operational diagnostic criteria”. This put in place a list of symptoms that could be independently and reliably identified by clinicians, resulting in an assessment of symptoms such as depressed mood, fatigue, or insomnia with a biomedical explanation.

Figure 1: Image depicting the confluence of neuroscience with psychology and biology



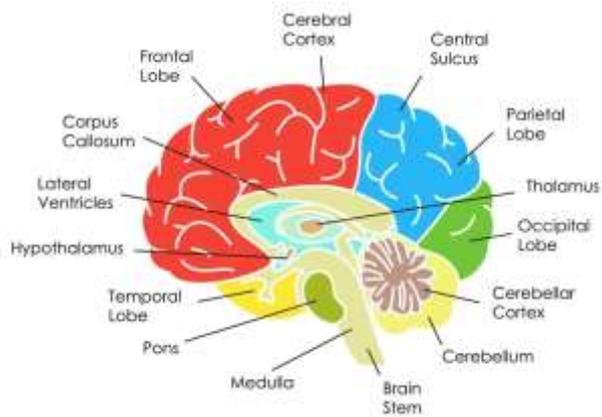
Source- www.neuroscience.saintmaryscollege.notredame

Neuroscience is the scientific study of the nervous system, the brain, the spinal cord, and the network of nerve cells (neurons) that are a part of this organ. Psychology, on the other hand, is the study of the mind and conduct that encompasses a variety of theories and approaches to figuring out human actions. Both these fields research the complicated activities of the brain and unravel the characteristics of human cognition and actions. Both these areas are firmly intertwined as neuroscience gives the biological foundation in figuring out conduct, emotions, and mental processes while psychology helps contextualise and apply this to real-world situations.

Definition

At the basis of neuroscience, are neurons and their functions. Neurons are cells that transmit signals through the nervous system. These cell structures are complex networks that take into account communication and information processing.

Figure 2: The brain and its parts

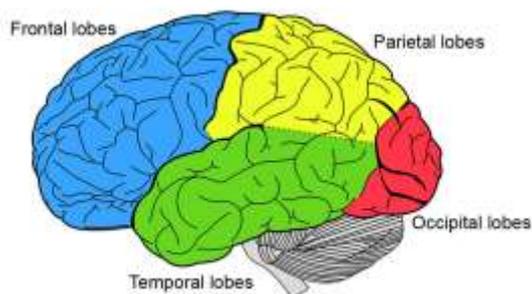


Source: www.wisruru.com

The brain has three main parts:

-Cerebrum, fills up most of the skull and is involved in remembering, problem-solving, thinking, and feeling. It also controls movement.

Figure 3: The cerebrum

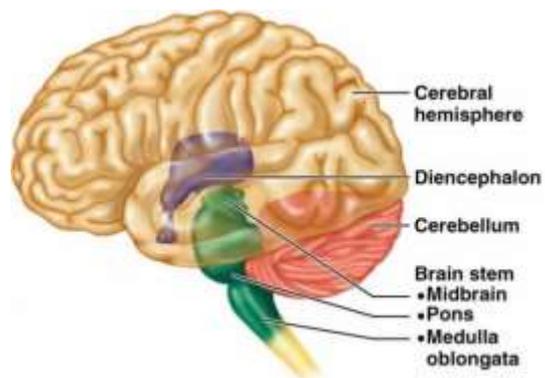


Source: www.teachmeanatomy.info.com

-The cerebellum is at the back of the head, under the cerebrum and it controls coordination and balance.

-The brain stem is beneath the cerebrum, in front of the cerebellum. It connects the brain to the spinal cord and controls automatic functions such as breathing, digestion, heart rate, and blood pressure.

Figure 4: The cerebellum and brain stem



Source: www.anatomyinfo.com

The brain is nourished by a rich network of blood vessels. At times, when one is thinking hard, the brain could use up to 50% of the fuel and oxygen. The vessel network in the brain includes veins, capillaries, and arteries.

The wrinkled surface of the cerebrum, called the cortex, is an area that is strongly linked to certain functions, these are:

- interpreting sensations from the body
- processing sights
- processing sounds
- processing smells
- thoughts, problem-solving, and planning
- forming and storing memories
- controlling voluntary movement

In most people, the language area is governed by the left half of the brain.

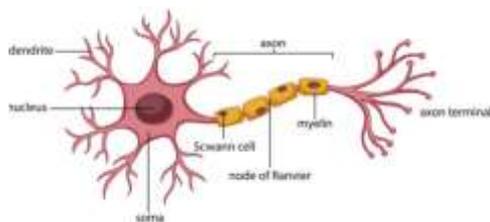
Neurons:

Definition and images of a neuron:

A neuron is a nerve cell that receives and sends messages from the body to the brain, and back to the body. These messages are sent by a weak electric current. These are the fundamental building blocks of the brain, and the nervous system. They are responsible for receiving sensory input from the external world, as well as, sending motor commands to the muscles in the body, and also at every step in between. The structure of the neuron includes the cell body called soma (tree trunk), which contains the nucleus and other cell organelles. Dendrites are branch-like structures that receive messages from other neurons and convey them to the cell body. The axon (tree root) is a long, slender projection that transmits electrical impulses away from the cell body. The myelin sheath is a fatty layer that covers the axon. There are different types of neurons in the brain and spinal cord and are divided according to:

- where they originate
- where they project to
- which neurotransmitters they use

Figure 5: Neuron and its parts

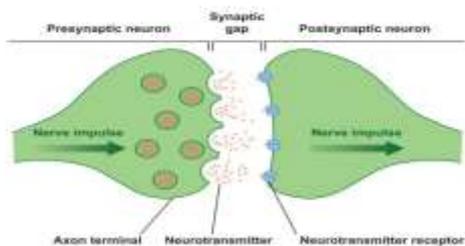


Source: www.teachingexpertise.com

Synaptic transmission:

Brief electrical events are typically generated in the axon. This indicates that the neuron is active. An action potential travels the length of the axon and causes the release of neurotransmitters into the synapse. The synapse is a small gap at the end of the neuron that allows a signal to pass from one neuron to the next.

Figure 6: Synapse



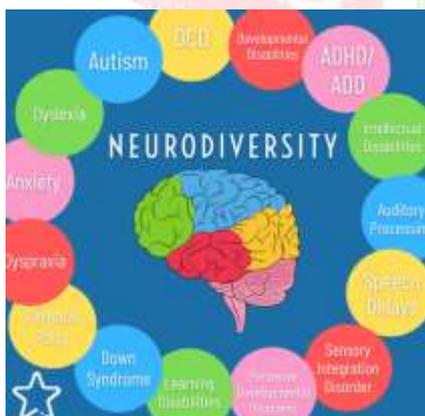
Source: www.animalia-life.club.com

2.1 Neurobiology

Neurobiology is the study of cells and tissues that make up the nervous system. It studies the physiology of each part of the nervous system and how they interact within the system. It deals with the anatomy, physiology, and pathology of the nervous system. It is a subset of neuroscience. It combines physiology, anatomy, molecular biology, developmental biology, cytology, mathematical modelling, and psychology to understand the fundamental and emergent properties of neurons and neural circuits. The theories under this category include theories of psychology that investigate the link between the brain and the mind.

The basic assumption is that all psychological processes are linked to specific patterns of brain activity and the study of neurobiological behavior enhances the understanding of human psychology.

Figure 7: Neurodiversity



Source: www.barrierfreemd.com

2.2 Neuropsychology

Figure 8- Branches of neuropsychology



Source: www.katiehamilton.co.za

Neuropsychology is a branch of science that studies the physiological processes of the nervous system and relates them to behavior and cognition. This is both concerning normal functions and the dysfunctional processes associated with brain damage. Donald Hebb is known as “the father of neuropsychology” for his seminal work in merging the worlds of psychology and neuroscience. This branch aims at understanding the relationship of the brain on the one hand and the ‘mind’ and behavioral control on the other. This science is valuable in treating disorders like dementia, epilepsy, and certain mental health conditions. This is concerned with the diagnosis and treatment of behavioral and cognitive effects of neurological disorders whereas neurology is only concerned with the pathology of the nervous system. Neuropsychology correlates the brain and the mind and is concerned with neuropsychiatry, as well as, behavioral neurology. During ancient Egyptian times, the brain was thought to be useless and it was claimed that a person was alive if his heart was beating. People like Aristotle used phrases like, “follow your heart” and “learn by heart”. But soon Hippocrates viewed the brain as ‘the seat of the soul’. It was his theory that led to more scientific discoveries of the organ responsible for human behavior. This led to the understanding that the capabilities of the mind were much more than simply reacting and tended to be rational and functioning in an organized, thoughtful, complex way.

In 1873, Carl Wernicke, a neuropsychiatrist, was interested in understanding how abnormalities could be localized to specific parts of the brain. He was the first to attribute brain functions to different regions based on sensory and motor functions.

There are different approaches in this field which can be divided into:

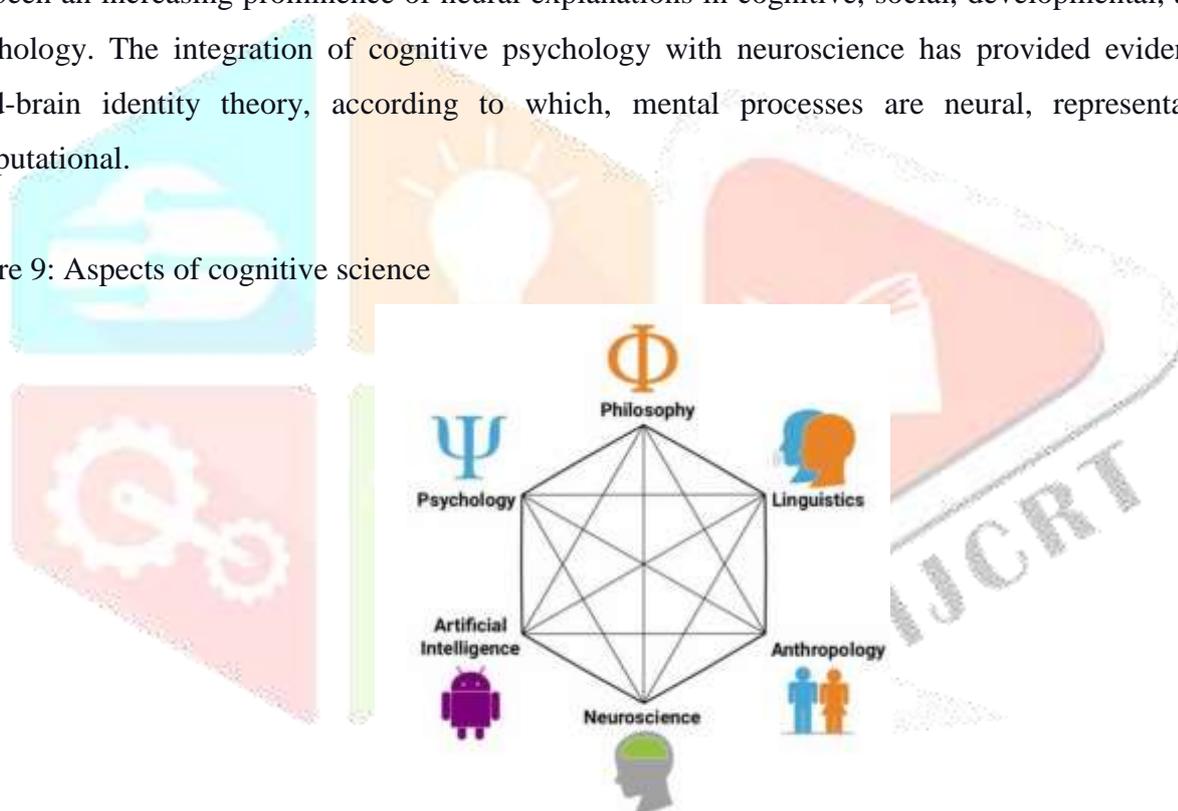
- experimental psychology (uncovering the relationship between the nervous system and cognitive function)
- clinical neuropsychology (bringing a psychological viewpoint to treatment; differentiating between brain pathology or emotional cause for an ailment)
- cognitive neuropsychology (studying the confluence of the mind and brain in people with brain injuries or neurological illnesses)
- connectionism (use of artificial neural networks in plausible models on how neurons operate)
- functional neural imaging (readings from the brain through cognitive testing with functional magnetic resonance imaging (fMRI))

2.3 Cognitive Science

This is the study of the human mind and brain, focusing on how the mind represents and manipulates knowledge and how mental representations and processes are realized in the brain. It is a study of thought, learning, and mental organization that draws on aspects of psychology, linguistics, philosophy, and computer modelling. Its intellectual origins were from mid-1950s, but its organisational origins started in the mid-70s when the Cognitive Science Society was formed. The origins of this can go back to ancient Greeks when the study of the mind was a part of philosophy. It then moved to the realm of behaviourism where the existence of the mind did not exist. It was around 1956, that the thought process and human thinking entered into analysis.

Theoretical neuroscience is an attempt to develop mathematical and computational theories, as well as, models of the structures and the processes of the brains of humans and other animals. Cognitive science has been successful in explaining many aspects of human problem-solving, learning, and language use. There has been an increasing prominence of neural explanations in cognitive, social, developmental, and clinical psychology. The integration of cognitive psychology with neuroscience has provided evidence for the mind-brain identity theory, according to which, mental processes are neural, representational and computational.

Figure 9: Aspects of cognitive science



Source: www.bb-learningsolutions.com

Disorders

Psychiatric disorders are a heterogeneous group of mental disorders manifesting as unusual mental or behavioral patterns that cause distress or disability to the individual.

Some of the main mental disorders can be classified as:

- anxiety disorders
- depression
- bipolar disorder
- post-traumatic stress disorder (PTSD)
- schizophrenia

- eating disorders
- disruptive behavior and dissocial disorders
- neurodevelopment disorders

Figure 10: Disorders



Source: www.verywellhealth.com

One in every eight people in the world lives with a mental disorder. This involves significant disturbances in thinking, emotional regulation, or behavior. Effective prevention and treatment options do exist but a large number of people do not have access to effective care. They also, at times, experience stigma, discrimination, and violation of human rights. Some disorders become apparent in childhood, while others may develop at a much later stage in life and could be associated with aging. Alzheimer's and dementia, fall into this category.

Autism

Autism Spectrum Disorder (ASD) is a neurological and developmental disorder that affects how people interact with others, communicate, learn, and behave. It is also described as a developmental disorder because its symptoms appear in the first two years of life. These children have difficulty with communication and interaction with other people, restricted interests, and repetitive behavior. Its symptoms affect their ability to function in school, work, and other areas of life. It constitutes a diverse group of conditions related to the development of the brain.

It is known as a spectrum as there is wide variation in the type and severity of symptoms people experience. People of all genders, races, ethnicities, and economic backgrounds can be diagnosed with ASD. The symptoms of this disorder may include:

- making little or inconsistent eye contact
- appearing not to look at or listen to people who are talking
- infrequently sharing interest, emotion, or enjoyment of objects or activities
- not responding or being slow to respond to one's name or other verbal instructions
- having difficulties with the back and forth of conversation
- talking at length about a favourite subject without noticing that others are not interested
- displaying facial expressions, movements, and gestures that do not match what is said
- having an unusual tone of voice, that may sound sing-song, flat, or robot-like

- difficulties adjusting behaviors to social situations
- difficulty sharing in imaginative play or in making friends

Figure 11- Early signs of autism



Source: www.cannondisability.com

People with autism often have co-occurring conditions including epilepsy, depression, anxiety, and attention deficit hyperactivity disorder, as well as, challenging behavior such as difficulty in sleeping and self-injury.

Adult Attention Deficit

This is a mental health condition that can lead to unstable relationships, poor work performance, and low self-esteem. It includes a combination of problems such as difficulty in paying attention, hyperactivity, and impulsive behavior. Even though it is called Adult ADHD, symptoms start in early childhood and continue until adulthood, and at times, it is not recognized or diagnosed until the person is an adult. It is likely that hyperactivity in adults decreases, but struggles with impulsiveness, recklessness, and difficulty paying attention, may continue.

The other symptoms may include:

- impulsiveness
- disorganization and problems of prioritization
- poor time management skills
- problems focusing on a task
- trouble in multitasking
- excessive activity or recklessness
- poor planning
- low frustration tolerance
- frequent mood swings
- problems following through and completing tasks
- hot temper
- trouble coping with stress

Some of these above-mentioned difficulties occur in almost everyone, but only when the symptoms are severe to the extent that they cause problems in more than one area in one's life, they are diagnosed as ADHD.

Figure 12: ADHD



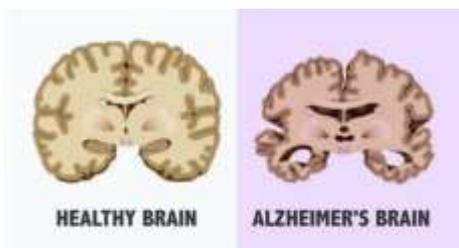
Source: www.woodsholepubliclibrary.com

Alzheimer's

This is a progressive disease that destroys memory and other important mental functions. It is a brain disorder that worsens over time. This is because of changes in the brain, which are due to deposits of certain proteins. It causes the brain to shrink and eventually die. Alzheimer's is the most common cause of dementia, which is a gradual decline in memory, thinking, behavior, and social skills. A larger percentage of this disease impacts the age group 75 years and older. As the disease progresses it leads to serious memory problems and the loss of the ability to perform everyday tasks. People with this ailment may:

- repeat statements and questions over and over
- forget conversations, appointments
- misplace items
- forget the names of family members and everyday objects
- experience trouble finding the right words to express thoughts or taking part in conversation

Figure 13: Image of an Alzheimer's Brain



Source: www.mycirclecare.com

This impacts moods and behavior and is likely to include:

- depression
- social with-drawl
- mood swings
- distrust
- anger
- wandering
- loss of inhibition
- delusions

Figure 14: Symptoms of Alzheimer's



Source: www.betteraging.com

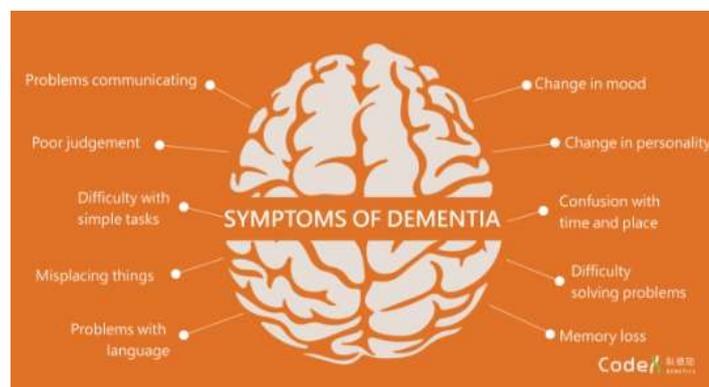
Dementia

Dementia is a group of conditions that is characterized by impairment of at least two brain functions:

- memory loss
- judgment

Symptoms include forgetfulness, limited social skills, and thinking abilities that are so impaired that it interferes with daily function.

Figure 15: Symptoms of Dementia



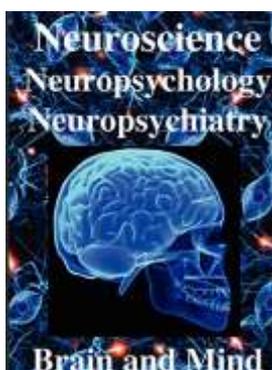
Source: www.codexgenetics.com

Role of These Sciences on the Above Disorders

There needs to be an interdisciplinary role for psychology and neuroscience where both of them complement each other. Psychology has frequently been relegated to a stream that was primarily considered either a social science or a natural science. The social science perspective meant that questions about motivation, underlying decisions and behavior, correlation and causation of personality and intelligence, and experiences of racial, ethnic, and cultural groups were considered. The biological side of neuropsychology has recently acquired dominance. This has happened in the last two decades. The changes reflect a shift in scientific priorities and interests as psychology is increasingly embracing the brain as the most important level in understanding psychological phenomena like anxiety disorders, addiction, and social problems. The introduction of the MRI has accelerated the progress of synergy between the two. There are clearer insights into the damage that drugs and alcohol cause to the brain. There are brain circuits that are linked to psychobiological systems (negative emotion system, attention systems) that need to be addressed in diagnosing mental disorders. It has now been researched that addiction is a disease of the brain and that treating it would require the help of both neuroscience and neuropsychology. All levels are needed for a complete understanding of human psychological phenomena, for example, in the case of Alzheimer's both these fields will be addressed but greater emphasis will be on neuroscience. In the case of marital conflict, neuropsychology will be given greater importance.

Neuroscientific methods will contribute to the understanding of the diseases mentioned, but an integrative use with psychology will lead to expertise and attention to emergent properties as well as neural processes. Different types of expertise in both fields will be needed to understand and find solutions to these disorders. Mental disorders are necessarily brain diseases at some level as psychological phenomena, normal and abnormal, necessarily originating from the brain and the central nervous system. These disorders can also be regarded as a part of the malfunctioning of the body at the psychological level.

Figure 16: Confluence of the Brain and Mind



Source: www.abebooks.com

Care should be taken that as neuropsychology converges with natural science, it must still retain its connection with social science so that the wider integrative scientific perspective is formulated to include both social and biological components. Similarly, neuroscience needs to collaborate with domains of psychology such that meaningful linkages are achieved.

Managing the Above Ailments

The percentage of global mental disorders is increasing rapidly. 38% of the European Union population in 2010 is estimated to suffer from mental disorders each year. The cost of treating such ailments is on the higher side of 3,500 euros per affected individual. It is with the discovery of MRI that these disorders provide insights into psychopathology, cognition, and behavior. The neuropathology underlying psychiatric conditions include schizophrenia, social anxiety disorders, ADHD, and others.

Diagnosis of mental disorders is based on observation and/or self-reported symptoms. In ailments like cancer, there has been the use of biomarkers (biological indicators of a condition, using blood, urine, or tissue samples) by clinicians who can realistically assess the spread of the disease. But to date, there has been no such biomarker that can indicate the assessment of mental disorders.

The moment a mental disorder is observed the clinician would request an MRI to understand whether the brain has been affected. If it is discovered that there are changes in the brain, then neuroscience, through various medicines, can try and control or even cure the disorder. Neuropsychology works with the mind to improve the patient's well-being and it is possible, that the two together, may be in a position to reduce the impact if not cure it completely. It is also possible that by working on neuropsychology or neuropsychiatry, the damage in the brain can be stemmed.

Treating the symptoms of Alzheimer's can provide patients with comfort, dignity, and independence for a longer period, as well as, assisting their caregivers. There are various allopathic medicines prescribed to calm and address the issues of the patient. Cognitive rehabilitation helps in using that part of the brain that is working, and in the process helps those parts of the brain that are not. Talking about the past and using props like photographs, etc. can be combined with the above to improve the mood and well-being of the patient. Medicines are used to treat both Alzheimer's and dementia, besides this, the patient can also suffer from conditions like stroke, heart problems, diabetes, kidney disease, depression, etc. These are addressed through the normal course of medicines. Medicines for Alzheimer's and dementia have to be prescribed by a consultant psychiatrist. Along with this, *cognitive stimulation therapy* and *cognitive rehabilitation* are also adopted. The psychiatric aspects of dementia and Alzheimer's are being increasingly recognized as major contributors to distress and disability. Management of the above thus requires:

- multi disciplinary team
- problem solving stance
- programs of care
- pharmacologic management

Knowledge and awareness of autism disorder has grown exponentially at all levels amongst the general public, parents, health professionals, and the research community. There are different types of autism disorders, which display the intensity of the disease. *Asperger Syndrome* is a milder form of autistic disorder. The rare disorders are *Rett Syndrome* and *Childhood Disintegrative Disorder (CDD)*. This disease typically appears during the first 3 years of life and is a result of a neurological disorder that affects the normal functioning of the brain and impacts development in areas of social interaction and communication skills.

The reasons for this are:

- genetic
- biology of the brain
- prenatal factors
- coexisting medical conditions

Besides medicines to cure this ailment, *Applied Behavioural Analysis*, a branch of psychology, has focused on the analysis and modification of human behavior.

In the prevention of ADHD, the use of probiotics is effective. Antibiotics minimize the disease. Besides this, the use of alternative therapy like yoga, to calm the mind, does go a long way in helping the drugs to be effective.

Conclusion

Increasing awareness of the above diseases has led to cures and prevention in both neuroscience and neuropsychology. Research has indicated that in the above disorders, the brain is affected which requires allopathic medicines. But along with this treatment, psychological analysis has proved to be beneficial for the patients. This indicates the synergy between both these branches of science. Continuous studies on the neuropsychological side would immensely help the patients, as they progressively reduce the impact of allopathic drugs, which more often than not, may have side effects. Additionally, emphasis on yoga, homeopath, Ayurveda, and Chinese localised medicines, may also be considered along with the other drugs in managing the above ailments.

Bibliography

1. Edmonds, Future Mark W. Bondi, and David P. Salmon. (2017). Alzheimer's Disease: Past, Present, and Future *PMC*.
2. Fumagalli, Giorgio Giulio Fumagalli, Alessandro Crippa. (2022). Search for a link between autism spectrum disorder and neurodegenerative dementia *Research Gate*.
3. Murtaza, Muhammad Shahid Nadeem,1 Salman Hosawi,1 Sultan Alshehri,2 Mohammed M. Ghoneim,3 Syed Sarim Imam,2 Bibi Nazia Murtaza,4 and Imran Kazmi1,* (2021). Symptomatic, genetic, and mechanistic overlaps between autism and Alzheimer's disease *PMC*.
4. Rogers, Debomoy K. Lahiri, Bryan Maloney, Ruizhi Wang, Deborah K. Sokol, Jack T. Rogers & Cara J. Westmark (2020). How autism and Alzheimer's disease are trAPPed *Nature*.
5. Shah, Zoe Arvanitakis, MD, MS,1,2 Raj C. Shah, MD,1,3 and David A. Bennett, MD1,2.. (2019). Diagnosis and Management of Dementia: A review *PMC*.
6. Sharma, Ishfaq Ahmad Ahanger, Anurag Sharma & Asimul Islam. (2022). The pathogenesis and complications associated with Autism Spectrum Disorder and Alzheimer's Disease: A Comparative Study, *Springer*.

7. Shea, Giacomo Vivanti, PhD,¹ Sha Tao, MPH,¹ Kristen Lyall, SCD,¹ Diana L. Robins, PhD,¹ and Lindsay L. Shea, DrPH¹. (2021). The prevalence and incidence of early-onset dementia among adults with autism Spectrum disorder *PMC*.

8. Srivastava, Jyoti Prakash, K. Chatterjee, S. Guha, K. Srivastava, and V. S. Chauhan. (2021). Adult Attention-deficit Hyperactivity Disorder: From Clinical Reality Toward Conceptual Clarity *PMC*.

