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Know the signs of autism: One of the fastest growing neurodevelopmental disorder

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Abstract

Autism is a lifetime neurodevelopmental condition. It is identified by difference in behavior, social interaction, communication, special interests and sensory processing. These differences can present people on the autism spectrum with challenges in how they interact with their surroundings. Autism is a complicated condition which affects speech, language, neurodevelopmental, sensory perception and social interaction.

Some people on the autism spectrum may behave in non-typical ways, often in response to the different ways in which they experience their surroundings. Such behaviors are generally a way to communicate their feeling or to change to a situation, or may result from their heightened sensitivity to a sound or something they have seen or felt. The researchers suggest that genes and environment play major roles in the causing of ASD. A more recent study examined the cell structure, size and shape of the brains of personals with ASD, they demonstrated that different brain regions showed these differences more profoundly than others.

Keywords: Autism spectrum disorder; Neurodevelopmental; Symptoms; Diagnosis

1. Introduction

A neurological disorder known as autism spectrum disorder (ASD) affects people of all ages. Disparities in communication, social interaction, repetitive activities, and narrow interests are its defining characteristics. People on the autism spectrum may experience difficulties interacting with their surroundings as a result of these differences.

A group of developmental disorders collectively referred to as autism spectrum disorder (ASD) are characterized by:

- Persistent difficulties with social interaction and communication in many contexts.
- Repetitive actions and a strong desire to maintain regular routines.
- Early-life symptoms that often appear in the first two years of life.

A growing number of people are being identified with autism spectrum disorder in recent years, despite its widespread impact. ASD is diagnosed in more boys than in girls. [1]

ASD, or autism spectrum disorder, is a general term used to describe a set of behaviorally characterized neurodevelopmental diseases that formerly included Asperger's syndrome, pervasive developmental disorder not otherwise specified (PDD-NOS), childhood autism, and autistic disorder. The presence of anomalies or deficits in communication and social interaction, together with constrained or repetitive behaviors, interests, or hobbies, characterizes autism spectrum disorder (ASD). The prevalence of Autism Spectrum Disorder (ASD) in the general population is estimated to be one in 100. In [2]

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This new definition is intended to be more accuracy and works toward diagnosing ASD at an earlier age. [3] Four to five years old is the average age at which an ASD diagnosis is made. [4] One of the most important ways to identify developmental abnormalities early on is by visual observation and study of children's natural behaviors, including autism spectrum disorder (ASD). Despite the availability of a gold standard observational instrument, some limitations prevent children from being screened for ASD at an early age. Manual testing, parent interviews, and interpretative coding of kid observations are time- and money-consuming processes.

Furthermore, due to variations in professional training, resources, and cultural context, the validity and dependability of the conclusions drawn from a clinician's observations may also be subjective. Moreover, behavioral assessments generally fail to collect data from kids in their natural settings. In order to shorten wait times for care, these constraints along with increasing incidence rates need the development of novel techniques for diagnosing ASD without sacrificing accuracy. This has significant importance, since early diagnosis and intervention can lead to long-term benefits for the kid and perhaps even more significant effects on outcomes. [5]

Figure 1 Autism [6]

Leo Kanner, an American psychiatrist, defined autism as a dysfunction of the brain occurring in the first 2.5 years of life. He made this diagnosis in 1943. Three areas of weakness are considered to be present in autism spectrum disorder (ASD): social cognition, communication, and imagination. The most well-known significant developmental disabilities are those that fall into the following three categories.

Even though all or most autistic persons have a number of basic characteristics, autism spectrum disorder (ASD) is a widespread developmental condition that affects people with variable degrees of impairment. These people often have poor fine or gross motor skills, for instance, and like engaging with a certain topic—such as dinosaurs, railroads, or space exploration—which is known as a special interest. [7]

Accurately predicting the diagnosis at an early stage is a critical first step toward improving treatment results for ASD. Physicians, healthcare workers, and researchers face challenges in designing medical diagnostic systems, which include illness diagnosis, human health analysis, disease risk identification, monitoring, and reporting on human health. The world over, autism spectrum disorder, or ASD, is a societal stigma unchecked. There is presently no recognized cause of ASD, and there is no known medical intervention or cure. Making an accurate early diagnostic prediction is a critical first step in improving the results of ASD therapy. It is a challenging task for doctors, healthcare workers, and researchers to build medical diagnostic systems, which include illness diagnosis, human health analysis, and disease risk identification, monitoring, and reporting. [8]

Retrospective analysis of home films has been used to identify early behavioral risk factors associated with autism spectrum disorders. Studies have shown that during the first few months of life, ASD-related behavioral traits become apparent. These traits include decreased social engagement and joint attention, abnormal visual attention, such as trouble with response-to-name protocol, longer latencies to disengage from a stimulus if multiple ones are presented, and non-smooth visual tracking. Additionally, children with ASD may display abnormal social behaviors such paying less attention to faces and expressing less emotion. Furthermore, research points to variations in motor control as an early ASD characteristic. [5]

In the last ten years, there has been a sharp rise in the prevalence of ASD. Even after numerous in-depth investigations, the causes and genesis of ASD remain unclear; however, a number of environmental factors, including diet, exposure to toxins, metabolic imbalances, viral infection, postnatal and genetic factors, and microbiome, have been linked to the disorder's genesis. As with ASD, there are no recognized and effective therapy. [9]

2. Type of ASD

Table 1 Types of Autism [7]

Sr. No.	Type	Characteristic
1.	Autistic Disorder	Markedly uncommon or impaired development in social interaction and a markedly restricted repertoire of activity and interests, usually noted within the first year of life.
2.	Asperger's syndrome	Critical and sustained impairment in social interaction and the development of restricted, repetitive patterns of behavior, interests and activities. No clinically significant delays in language accession.
3.	Rett's disorder	A specific and highly distinctive pattern of no development following a period of normal functioning through the first five months after birth. Has been diagnosed only in females.
4.	Childhood disintegrative disorder	Marked regression in multiple areas of functioning following a period of at minimum two years of apparently normal development.
5.	Pervasive developmental disorder not otherwise	Critical and pervasive impairment in the development of reciprocal social interaction, but the criteria is not met for a specific pervasive developmental disorder.

3. Risk factors

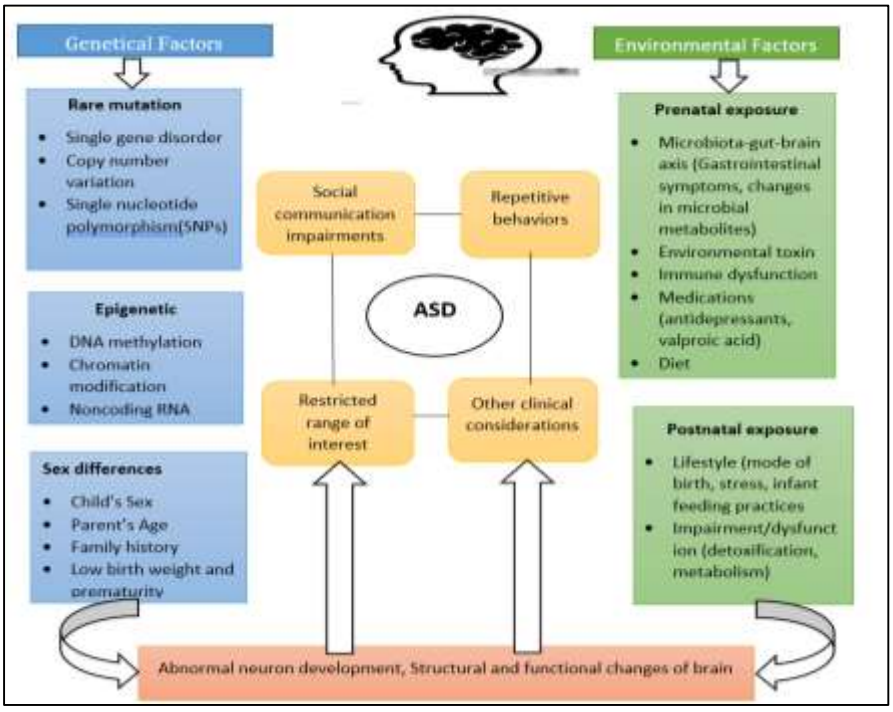

Figure 2 Risk factors ASD [10]

4. Signs and symptoms

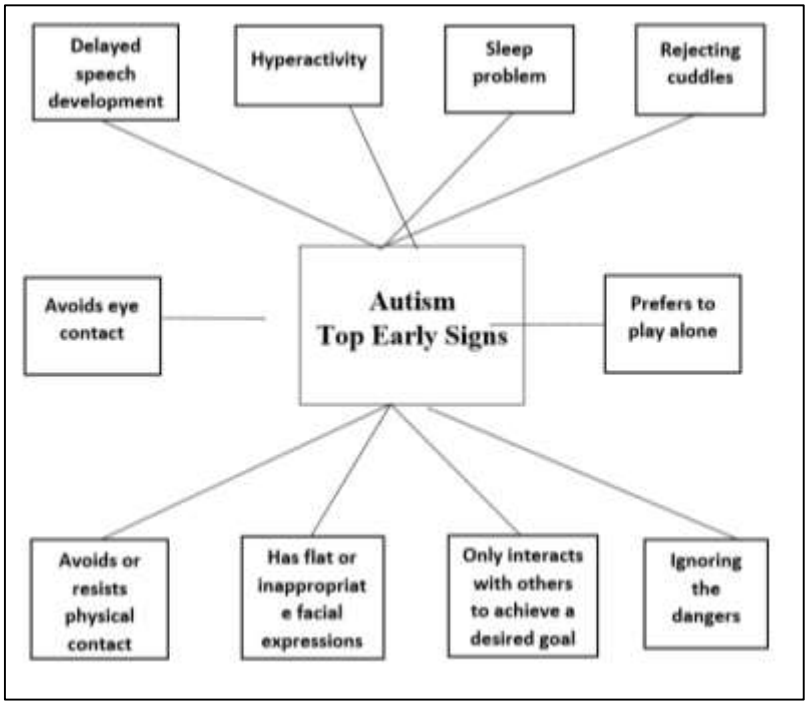

Figure 3 Signs and Symptoms of ASD [11, 12]

5. CAUSE OF ASD

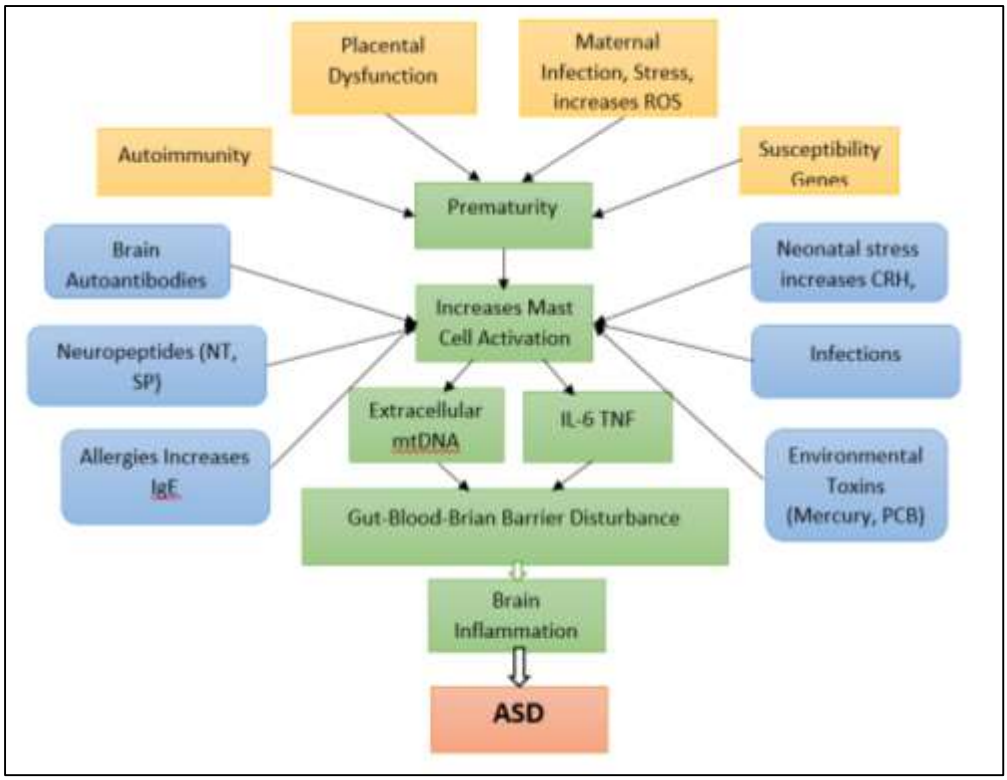

Figure 4 Cause of ASD

Prematurity is caused by placental malfunction, autoimmunity, maternal infection, and prenatal stress. The newborn is susceptible to environmental stimuli that activate mast cells and produce mediators that disrupt the gut-blood-brain barriers, producing brain inflammation, due to defective neuronal development and susceptibility genes. Corticotropin-releasing hormone (CRH); immunoglobulin E (IgE); interleukin (IL); lipopolysaccharide (LPS); Mitochondrial DNA (mtDNA); Neurotensin (NT); polychlorinated biphenyl (PCB); reactive oxygen species (ROS); substance P (SP); and tumor necrosis factor (TNF).[13]

5.1. Difficulties in social interaction and communication.

- If a child is nine months old, not reacting to his or her name.
- Avoids making or keeping eye contact.
- At nine months of age, does not exhibit a range of facial expressions, such as happiness, sadness, or anger.
- By the age of twelve months, shows little interest in interactive games like peek-a-boo.
- Absence of farewell gestures like waving.
- A delayed onset of speaking.

5.2. Restricted and/or recurring behavioral patterns.

- Plays with the same toys and/or in the same manner every time.
- Arranges toys in a row and becomes upset if they are moved out of order.
- Reiterates words or phrases they come across.
- Instead of using a toy in its whole, a child plays with its pieces, such as spinning wheels.
- Repetitive bodily movement (e.g. hand flapping or spinning). [14]

6. Diagnosis of ASD

While ASD can be identified as early as 15 to 18 months of age, the typical age of diagnosis is about 4.5 years, and some individuals do not receive a diagnosis until they are adults. That's regrettable because early intervention depends on a timely diagnosis. Extensive early intervention can significantly impact the outcomes for individuals with ASD, according to research. Don't wait to get your child tested if you think they may have the condition.

As a neurodevelopmental condition, ASD is believed to have a significant hereditary component. Nevertheless, ASD cannot presently be diagnosed by medical testing like brain scans or blood tests. Rather, the patient's history and actions are used by medical professionals to make the diagnosis.

This diagnosis can be made by a variety of professionals, including certain neurologists, pediatricians, and psychologists. The diagnosis procedure frequently involves psychologists, notably neuropsychologists, who specialize in the connection between human cognitive, behavioral, and emotional functioning and the brain. It is crucial that the specialist diagnosing the condition has a great deal of expertise managing the diverse array of ASD symptoms.

6.1. In order to diagnose ASD, psychologists use a variety of sources

- Cognitive and linguistic exams;
- Medical tests to rule out other disorders;
- Patient interviews;
- Behavior observations;
  Talking with parents, educators, or other adults who are able to respond to inquiries on the social, emotional, and behavioral development of the patient [15]

6.2. How can we detect ASD early?

The typical age of diagnosis is four years old, despite the fact that over 80% of children with ASD have observable behavioral symptoms by the time they are two years old and a diagnosis may be established with reliability at this age. An earlier diagnosis would speed possibilities for many families to benefit from specialist care and ease their long-standing worries, which would lower costs to families and society as a whole.

Parental reports, home video analysis, and, more recently, prospective studies with children at higher risk for autism spectrum disorders have shown a number of warning signs that set apart toddlers with ASD from those with typical developmental delays. These indicators were just examined in-depth in a review of the literature. Early in infancy, abnormal sleep and feeding regulation patterns may indicate autism spectrum disorder (ASD). [16]

7. Ratio of Male and Female in ASD:-

Although the rationale for the 4/1 male to female ratio in ASD is not completely understood, it is crucial. ASD is thought to be caused by a variety of epigenetic phenomena, including heterogeneity in allelic and total gene expression regulation, sex-specific effects of Y-linked genes, balanced and skewed X-inactivation, and parent of origin allelic genes. Due to variations in how they react to and interact with different environmental variables including nutrition, stress, illness, and medicines, these sex differences may be the result of genetic and hormonal variances that might have started early in development. Several X-linked genes involved in placenta development and placenta-specific epigenetic processes make the placenta a key player in sex-specific responses to illness states and environmental stimuli later in life. Environmental influences, both internal and external, have long been linked to the genesis of ASD. Prenatal stress caused by early maternal immune activation may be more severe for males because of their sensitive genotype. [17]

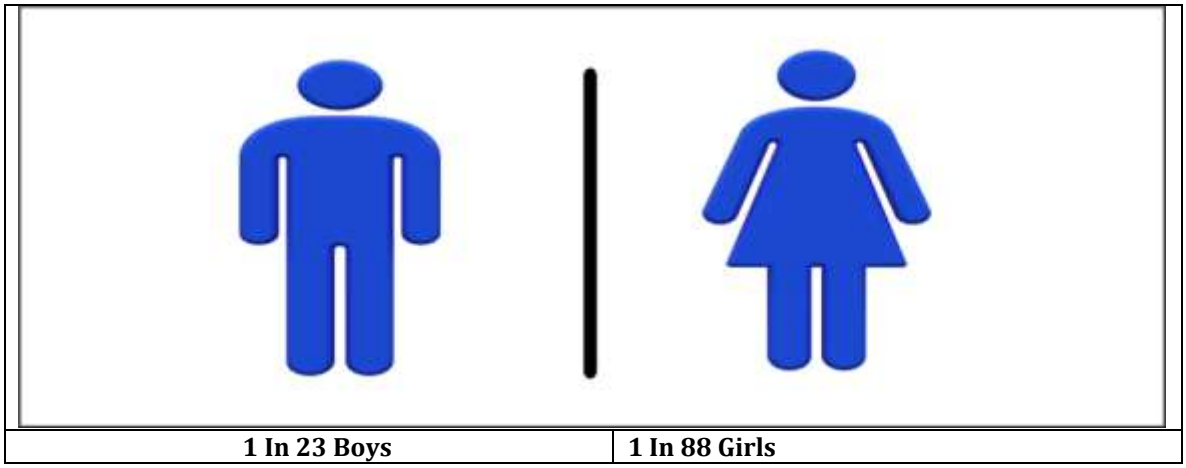

Figure 5 Ratio of ASD in Male and Female [18]

8. Neuropathological changes of ASD

Abnormalities in many brain areas, including the frontal cortex, cerebellum, hippocampus, amygdaloid nucleus, and cerebello-thalamo-cortical connections, are observed in animal models of ASD, as well as in postmortem and neuroimaging investigations of the disorder. ASD is characterized by neuropathological abnormalities, such as localized cortical dysplasias, which may be caused by the heterochronic division of germinal cells, which results in aberrant daughter cell migration to target locations.

Smaller pyramidal neurons and interneurons are seen in the frontal lobe of the ASD human brain, which is characterized by confined foci of thin cortical regions due to abnormal neuronal migration. The sensory and motor deficiencies and epileptic seizures associated with ASD have been linked to these pathological abnormalities. It has recently been demonstrated that the phenotype of autism epilepsy is linked to macrocephaly, a pathologic condition caused by the accelerated expansion of the brain in early development that results in ASD. In certain cases with ASD, there is evidence that the brain's total size is larger.

8.1. Gastrointestinal Abnormalities in ASD

Numerous studies have shown that people with ASD are more likely to experience gastrointestinal issues include vomiting, constipation, persistent diarrhea, stomach discomfort, and gastroesophageal reflux disease. The breakdown of food particles' structure through digestion and reduction to their smallest molecules is one of the GI tract's well-established roles. Through a variety of transport methods, this digested material will be absorbed by the intestinal epithelium's luminal surface and moved into the lymphatic or blood capillaries on the opposite side of the intestinal mucosal cells.

In order to preserve homeostasis and defend our body against pathogens and external antigens, the GI tract collaborates closely with the immune system.

Numerous environmental microbes and external antigens provide a constant threat to the intestinal mucosa. Intestinal barrier organization preserves immunological function of the mucosa and inhibits inflammation.

The intestinal mucosa contains additional cells called microfold (M) cells, which have the capacity to absorb larger molecules. These cells are part of the group that makes up the mucosa's gut associated lymphoid tissue (GULT), which also includes the intestinal lymphoid follicles and Peyer's patches. Through other classes of immunoglobulins and cytokines studies show peripheral immune system abnormalities that support the notions of immune involvement in ASD; however, immune abnormalities, including microglial cell activation and the innate neuroimmune system, are also detected, M cells can transfer their ingested material to antigen-presenting cells like macrophages and dendritic cells in the subepithelial tissue that interact with lymphocytes, the B cells, to produce antibodies (i.e., intestinal IgA). They are also in charge of oral tolerance to the ingested material.

8.2. Immune System Imbalance in ASD

Although research has not yet reached a definitive conclusion, other co-morbid disorders like inflammation, inflammatory response, and immunological activation have long been linked to the pathophysiology of ASD. Numerous in the brain and cerebrospinal fluid (CSF) of patients with ASD, a condition known as neuroinflammation.

There have been new reviews of neuroimmune disorders elsewhere. The brain's homeostasis is significantly regulated by the blood-brain barrier (BBB). There is evidence that children with ASD have altered blood-brain barrier function as a result of immunological dysregulation, neurological inflammation, and elevated inflammatory cytokines in the brain. In patients with ASD, immunological response abnormalities are observed in the central nervous system (CNS), peripheral blood, and GI tract and other tissues. However, autoimmune illnesses and infections or inflammations in the mother have also been linked to immunological issues in the children of ASD families. In the next section, we address that in brief as maternal immune activation.

In addition to shielding us from pathogens, the immune system aids in the destruction of tumor cells or the inhibition of their proliferation. Immunotherapy, which employs molecules from the body's immune system to prevent the growth of cancer cells, has proven to be a successful treatment for brain cancers such metastatic melanomas. Nonetheless, the detrimental impact of immune activation against brain tissue and related structures is primarily observed in cases of neurological and psychiatric diseases. [17]

9. Diagram showing ASD risk genes and autistic phenotypes associates with different lobes of the brain

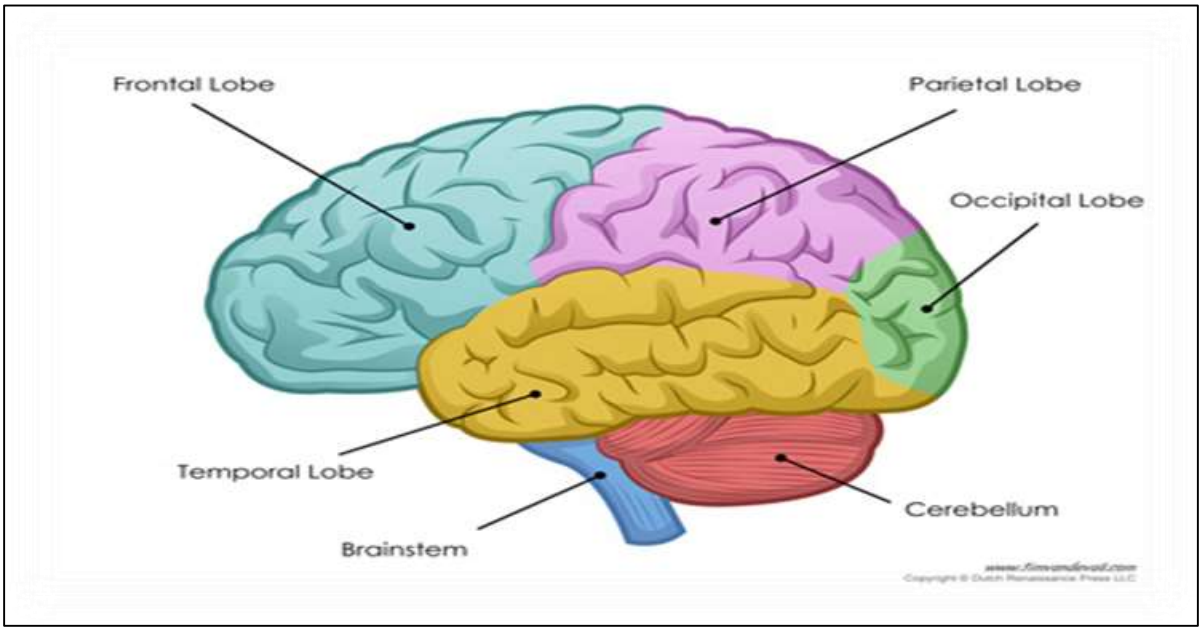

Figure 6 Diagram showing ASD risk genes and autistic phenotypes associates with different lobes of the brain [19]

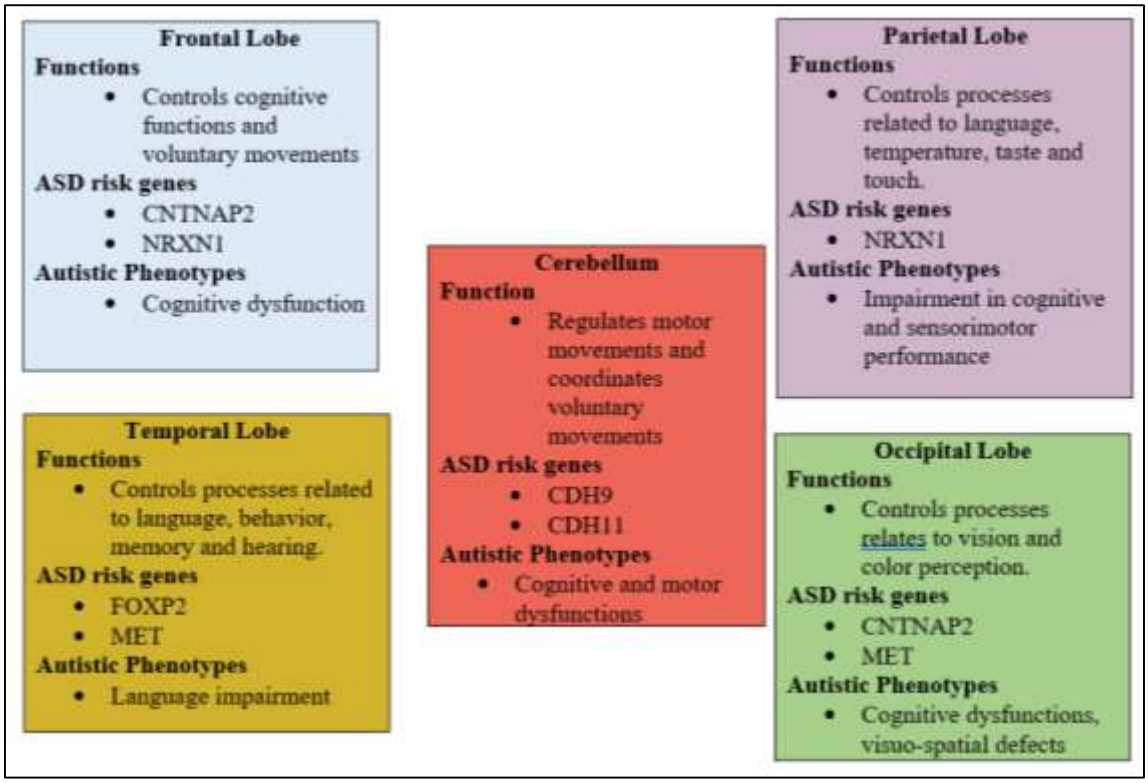

Figure 7 Diagram Showing ASD risk genes and autistic phenotypes associates with different lobes of the Brain [20]

10. Ratio of ASD

The frequency of autism is rising in our ever changing world. The most recent study from the Centers for Disease Control and Prevention (2018) states that in the US, autism affects about one in every 44 children. This is a rise from 2020, when it was anticipated that one in 54 children had autism. In the United States, it was thought that one in 150 children had autism about 20 years ago. How come autism rates are on the rise? There may be several reasons for this increasing number. Improvements in autism awareness and responsiveness, as well as initiatives to reach the underserved demographic, are some of the contributing reasons.

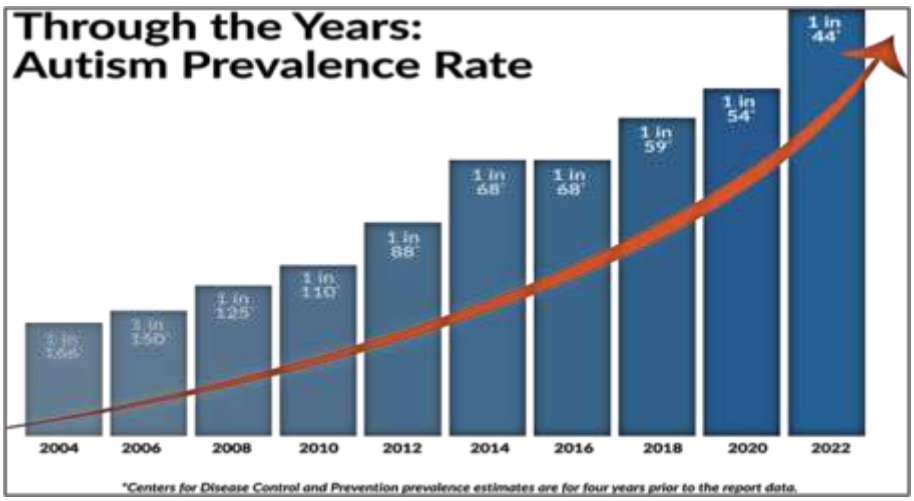

Figure 8 Ratio of ASD [21]

11. Multidisciplinary management of autism:-

A multidisciplinary approach and effective communication between therapists are necessary for autism. Depending on the child's particular needs at the moment, parents will frequently need to prioritize some therapies over others for practical reasons.

- Evidence-based natural therapies and lifestyle recommendations:-

Numerous techniques that the natural therapist may use will be predicated on evaluating the patient's unique needs in conjunction with knowledge of the underlying pathophysiology of autism as it is now understood. The following treatments are supported by evidence, even though a large portion of this research is preliminary.

11.1. Gluten free casein free diet (GFCF):-

In 2010, a controlled, single-blind, Scandinavian study demonstrated that a gluten-free casein-free diet (GFCF diet) improved key autistic behaviors over an 8–12 month period (Whitely 2010). Adolescent patients had a greater dropout rate, according to this study. Hyperactivity, attention, concentration, social functioning, and communication all showed improvements. After 24 months, improvements were seen in repetitive and stereotyped behaviors as well as social interactiveness (Whiteley 2010). According to a pilot research conducted in 2012, behavior and gastrointestinal symptoms improved for 100% of parents whose children were following a GFCF diet; however, these findings could not be clinically confirmed (Harris 2012). Note that the diet utilized in this study was lower in gluten and casein (8.7 gluten or casein items per week, compared to 53 for the control). Rather than a strict GFDF diet.

A three-month research conducted in 2011 did not show these outcomes (Johnson 2011). The challenge of not blinding parents to the treatment regimen and the fact that a nutritious, low-sugar food was employed as the control were potential limiting factors.

The ability to offer suitable dietary substitutes for gluten-containing meals is essential to the success or failure of a gluten-free diet. The child's desire to try new foods and the parents' ability to adjust to a new diet are two other factors that could hinder success. A history of prior attempts at dietary exclusions, oro-sensory difficulties, additional food allergies or intolerances, and other circumstances could also be a constraint.

In order to evaluate these concerns, a pilot research was conducted in 2008 with the goal of creating a recognized procedure and approach for evaluating a GFCF diet (Adams 2008).The authors of this study made an effort to provide a variety of nutritionally appropriate, portable, and easily prepared dishes that kids would enjoy. Given that many kids with ASD have dietary preferences and habitual tendencies, the experiment sought to determine how open the kids were to trying new foods. 52 kids between the ages of 3 and 6 made up the recruitment group. 95% of the kids tried some of the new dishes, according to the study, and only three families left because their kids wouldn't eat the food. According to parents, a savory staple, like bread, should be served.

The authors came to the conclusion that finding appropriate food substitutes is essential for this type of study to be of clinical value and that families of these children were very motivated to engage in dietary research relevant to ASD (Adams 2008).

11.2. Vitamin C

A 30-week double-blind, placebo-controlled study revealed that children with ASD had less severe symptoms. The overall interaction scores and sensory motor scores significantly improved with an ascorbic acid intake of 8g/70kg/day. In addition to its antioxidant function, vitamin C may also have a dopamine-potentiating impact, as shown in previous research (Dolske 1993, Shin 1988).

11.3. Multivitamin-mineral supplement:-

Twenty children with ASD, age's three to eight, participated in a brief pilot study to examine the effects of a "moderate" multivitamin supplement. Sleep and gastrointestinal complaints significantly improved, according to the study (Adams 2004).

11.4. Vitamin B6

The neurotransmitters serotonin, GABA, and catecholamines are among the 113 enzymes for which vitamin B6 is a co-factor (Adams 2006). Vitamin B6 supplementation in ASD has been well investigated. Twenty-one out of twenty-two trials demonstrate improvement in ASD (Bihari 2006). It has been shown that children with autism exhibit extremely low levels of pyridoxal kinase activity (Adams 2006). Because of the poor conversion of pyridoxine and pyridoxal to PLP, low pyridoxal kinase activity leads to low levels of pyridoxal-5-phosphate (PLP) and high plasma levels of total B6 (Adams 2006). Children with autism have been found to have plasma levels of total B6 that are 75% higher (Meletis 2007).

Elevated B6 levels may enhance pyridoxal kinase action, which could account for better mental and physical functioning in people with ASD (Adams 2006). Studies employed doses between 100 and 600 mg per day (Pfeifferi 1995).

11.5. Magnesium and B6

Children with ASD have been found to have reduced red blood cell magnesium levels (Meletis 2007). A study utilizing magnesium (6 mg/kg/d) and vitamin B6 (0.6 mg/kg/d) in children with autism was carried out in 2006. Significant improvement was seen in 70% of the children (Meletis 2007). Furthermore, studies have shown that magnesium is effective in treating anxiety (Lakhan 2010). Thus, it is important taking into account when treating patients with ASD.

11.6. Vitamin B12 and Folic Acid

Reduced methylation of glutathione (GSH) to its oxidized form glutathione disuphide (GSSG) and S-adenosylmethionine (SAM) to S-adenosylhomocysteine (SAH) is seen in individuals with ASD. These ratios (SAM: SAH) and (GSH: GSSG) show elevated oxidative stress and decreased methylation ability. A 2009 trial combined 400 mg of folinic acid per day with 75 mcg/kg of injectable methylcobalamine for three months. Serum ratios improved as a result, but they did not return to normal levels for neurotypical individuals. Despite this, significant improvements in behavioural symptoms were observed. This finding is consistent with other studies (James 2009, Bertoglio 2010).

11.7. Carnosine

Behavior, communication, and social ASD features significantly improved after an eight-week study (n=31) with 800 mg L-carnosine (Chez 2002). There were also slight improvements noted in other ASD symptoms. According to Meletis (2007), carnosine binds heavy metals, has antiglycating properties, and is an antioxidant. Additionally, carnosine seems to have a neuroprotective impact and improve frontal lobe function (Chez 2002).

11.8. Omega 3 fats

Pregnancy is a time when appropriate amounts of EPA and DHA are particularly important. The fluidity these nutrients offer, however, may also be advantageous for neuroplasticity-based techniques. According to Kidd (2007), DHA is the most fluid component of cell membranes, and neuroplasticity depends on cell fluidity to form new axons, dendritic extensions, and synapses. To evaluate the clinical use of omega-3 fats in the treatment of autism, numerous studies have been carried out.

Boys with ASD ages 5 to 17 participated in a brief 6-week pilot trial (DBPC n=12) in 2007 (Amminger 2007). The test volunteers received 7g of fish oil (FO) in the form of capsules containing 700 mg of DHA, 840 mg of EPA, and 7 mg of vitamin E. 1g of coconut oil, 1 mg of vitamin E, and 1 mg of FO were used as a placebo to simulate the taste of fish. Stereotypy (72%) and hyperactivity (71%) showed greater gains than inappropriate speech (39%), according to the study's findings (Amminger 2007).

Only six of the 143 studies that were collected for a systematic review in 2009 met the inclusion criteria and were added (Bent 2009). Although FO supplementation is widely used in ASD, the authors noted that there is currently little high-quality evidence to support this claim (Bent 2009). Likewise, a Cochrane study conducted in 2011 found insufficient statistical support (James 2011). The impossibility to readily blind a benign placebo, the use of insufficient dosages, and the recruitment of small sample sizes are inherent challenges in properly evaluating the evidence for the use of omega-3 fats in ASD.

11.9. Exercise

According to the results of a 2012 meta-analysis, exercise greatly enhances social, communication, and motor skills (Sowa 2012). The majority of studies had no control group and only involved small groups. The majority of studies

produced favorable results in the intended field. Swimming, horseback riding, cycling, and aerobic activity were all part of the exercise regimens. [22]

12. Therapy of ASD

There are different therapy are used on autism spectrum disorder are follows.

12.1. Behavior therapy

One popular ABA treatment that tries to promote desired behaviors and decrease undesirable ones is behavior therapy. Applied behavior analysis's (ABA) methods are used in the majority of behavior therapies. Helping a child with ABA comprehend the relationship between actions and outcomes is the goal of ABA.

A therapist may give praise to a kid who tries to respectfully ask for assistance in ABA-based therapy, which aims to achieve desired behavior. A youngster is more likely to repeat an action because they will receive a reward for it. If the youngster loses their temper, however, there is no reward. ABA is a method based on evidence. Additionally, it is quite flexible, allowing it to accommodate every child's demands. Research indicates that prolonged, rigorous therapy can enhance a child's social, intellectual, and life skills.

12.1.1. Early Start Denver Model (ESDM)

ESDM is a technique that adheres to ABA practices and is most effective for children aged 12 to 48 months. The main focus of the sessions is on cooperative activities and spontaneous play between parents and therapists. A youngster with ASD could be taught to recognize body parts through a mimicking game or encouraged to vocalize through singing. The goal of ESDM is to foster constructive social interactions while improving cognitive and communicative abilities.

Participation in your child's ESDM sessions is crucial. Thankfully, the sessions are adaptable enough to be held at your house or at a clinic. You can get the assistance you need from a therapist. Research, including brain scan studies, indicates that ESDM enhances adaptive behavior and language and communication abilities.

12.1.2. Pivotal Response Treatment (PRT)

PRT is another play-based method that adheres to ABA guidelines. PRT focuses on wider areas, such as motivation, self-management, responding to various cues, and initiating social contacts, rather than focusing on individual behaviors. Through an emphasis on these critical areas, PRT helps kids develop their communication and social skills in general. A therapist may place the child's favorite snack or toy right in front of them during a session, but out of reach. A scenario such as this teaches the child to ask for the item by speaking up. PRT has been employed in sessions as well as one-on-one settings and has been researched since the 1970s. Research indicates that it may help children develop their communication skills.

12.1.3. Discrete Trial Training (DTT)

Compared to PRT, DTT is a more structured ABA-based method. Split up into smaller pleces. A DTT technique may break down the procedure letter by letter when teaching a child with ASD to write their name. Additionally, the process of producing each letter might be split down into individual strokes. Positive reinforcement is given to the youngster as they progress through each step.

Since the 1970s, DTT has been used to teach skills to children with ASD and has proven to be beneficial. Compared to ESDM or PRT, this kind of training involves less naturalization.

You have more possibilities than just the three ABA-based therapy kinds. When thinking about treatment choices for ASD, you'll encounter strategies like early intensive behavioral intervention (EIBI) and positive behavioral support (PBS).

12.2. Speech-language therapy

The verbal and nonverbal abilities of your child can be improved with speech-language therapy if they have communication difficulties. A speech-language pathologist could lead your kid through activities that require them to recognize objects and people and describe emotions in order to enhance their linguistic abilities. Additional exercises enhance the child's vocabulary, sentence structure, and speaking rhythm. For instance, to draw attention to syllable count and pace during an exercise, your child can be told to clap as they speak.

A speech-language pathologist can instruct your youngster in hand signals, sign language, or communication through visuals when it comes to nonverbal communication abilities. Speech-language therapy can also help with other nonverbal indicators, such maintaining eye contact.

12.3. Physical therapy and occupational therapy

It can be challenging for some kids with ASD to control their body language. For instance, they can struggle with penmanship or have an odd walk. Your child's motor skills can be improved with physical therapy. A child's social life and sense of well-being can be enhanced by focusing on posture, balance, coordination, and muscle control.

Occupational therapy assists autistic children in developing daily skills like dressing, grooming, and feeding themselves that are helpful in the home or at school. Occupational therapy can improve motor skills, much like physical therapy does.

Because each session is tailored to the individual's needs, your child may also learn how to use assistive technology to accomplish activities and adjust to changing circumstances. A speech-to-text app for a child who has trouble writing by hand and a dry-erase board for a youngster who has trouble communicating verbally are two examples of such gadgets.

12.4. Nutritional therapy

Some autistic children have problems with both bone density and digestion. Furthermore, some kids could exhibit a dislike for particular tastes or textures, such the lumpy texture of oats or the soft, squishy texture of tomatoes. Therefore, providing for their nutritional needs is essential, but it can also be challenging.

Nutritional therapy can assist make sure your child is still eating a nutritious diet even if they have dietary preferences. A nutritionist can collaborate with you and your kid to tailor meals to their individual requirements and interests.

Additionally, there are things you can do at home to help your child eat better.

Think about the foods your youngster enjoys the most. Consider providing them with meals that have comparable flavors or sensations. For added variation, serve them a side of sweet potato fries if they enjoy French fries, for instance.

Serve new foods in addition to your regular favorites. This lets you preserve some familiarity while incorporating new ingredients. Until your youngster truly begins to enjoy the new dish, keep the servings minimal.

Let your youngster choose from a variety of new food alternatives to give them a sense of control. Green beans, asparagus, or broccoli could be in the lineup.

12.5. Cognitive behavior therapy

Children with ASD can benefit from cognitive behavior therapy (CBT) by learning how ideas affect behavior. The youngster learns from a therapist how to identify, assess, and control feelings like anxiousness. Children can benefit from this kind of therapy by learning coping mechanisms for challenging social situations and other life obstacles.

CBT sessions are tailored to the child's needs, unlike other autism therapy alternatives. The method might possibly help with sleep problems, although additional research is required. [23]

13. Plants used in Autism Spectrum Disorder

Many herbal remedies, such as Gingko Biloba, Zingiber officinale (ginger), Asparagus racemosus (shatavari), and Acorus Calamus (Calamus), may be beneficial for patients with ASD because of their somatic effects, which include improving cognitive function, increasing cerebral blood flow circulation, calming or sedative effects, and boosting the immune system's response. [24] Many researchers have focused on the role of natural medications in the treatment of ASD. [25]

13.1. Herbals used to treat the symptoms of ASD

Table 2 Herbals used in ASD

Sr. No.	Herbs	Dose	Treated ASD Model and Human	Beneficial result
1.	Zingiber officinale	100 mg/kg and 200mg/kg	PPA autistic rat model	A protecting result against social behavior limitation induced by PPA in rats.
2.	Acorus Calamus	600mg/kg	Lipopolysaccharide (LPS) model of neuroinflammation	Improved the passive avoidance memory test result and reserved anxiety through the elevated maze model
3.	Ginkgo biloba	4 week treatment 100mg.	Autistic male patient (age 19.4-22.4)	Enhanced week speech, inadequate eye contact and hyperactivity.
4.	Asparagus racemosus (Shatavari)	100 mg/kg and 200 mg/kg	ASD offspring of VPA exposed rat	Reduced anxiety, memory impairment, hyperlocomotion, Amplified sensitivity to pain and depression like behaviour

14. Conclusion

Autism spectrum Disorder is a significantly increasing disease in around the world. Autism spectrum disorder is a pervasive developmental disorder with a multifactorial etiology affecting 1/44 children worldwide. It continues to remain a challenging condition for children and their families, however, significant advances have been made regarding identification and management. It is important to understand that the etiology of autism is unknown and at present, there is no cure. It can safely be concluded that there is a lack of awareness and deficient knowledge about autism among parents. Other than the signs and symptoms, parents are also unaware of diagnosis and treatment procedure.

Future Scope

In autism spectrum disorder which are used in a herbal medicinal drug to give a better effect than medicinal drug treatment. In ASD the herbal drug are used to give a less side effect. More research is needed to prove the efficacy of Zingiber officinale, Acorus Calamus, Ginkgo biloba and Asparagus recemosus (Shatavari) in ASD treatment. Vitamins that may present as effective supplements for ASD patients are Vitamin D and the combination of vitamin B6 and magnesium.

Compliance with ethical standards

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There is no conflict of interest, according to the authors.

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