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# IPA+

Autism- training for inclusion

## Module 2: Aetiology of autism and comorbid conditions



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2. Risk factors
3. Autism genetics
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# 1. Epidemiology of autism spectrum disorder – prevalence

- The estimated prevalence tends to be around 1% with considerable variability across geography, methodological approach, and time.
- Most recent studies show higher prevalence than those conducted in the past.
- In the last decade much of the increase could be attributed to milder cases of ASD.
- Prevalence estimated under DSM-5 are not yet available.
- Male to female ratio is 3-4:1.

# Epidemiology of autism spectrum disorder – prevalence

- Recent research indicates that autism spectrum disorder affects around 1 in 100 people.
- Some studies have found higher and lower prevalence rates of autism. This is to be expected, given that prevalence studies vary in their scientific method and most are based on a limited sample of a country's population, rather than on national statistics.

# Explanation of changing prevalence

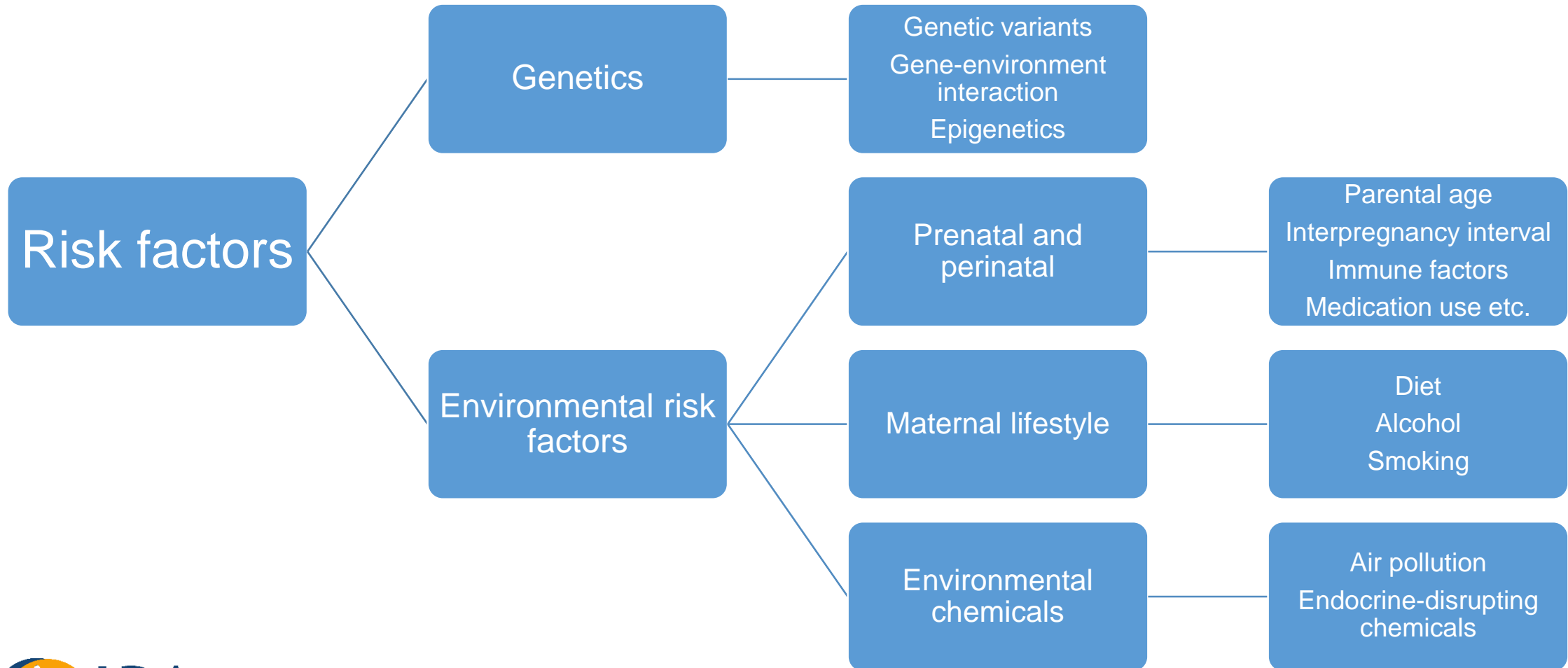
The increase is partly a result of:

- increased awareness of autism among health care professionals, parents and the broader population
- changes to the diagnostic criteria for autism
  - children being diagnosed at a younger age;
  - broadening diagnostic criteria.
- differences in research methodology
- demographic and geographical variables

It is also possible that environmental factors contribute to the increased prevalence of autism, though this requires further research.



## 2. Risk factors



# Environmental risk factors – prenatal and perinatal

- Advanced parental age is associated with risk for ASD as well as increasing differences in parental ages.
- Increases in risk of ASD with a short (<12 months) interpregnancy interval have been consistently reported.
- Infection during pregnancy, familial history of autoimmune diseases and altered levels of some immune markers are also associated with higher risks for ASD.
- There is association between ASD and prenatal exposure to antidepressants, antiasthmatics, antiepileptics and acetaminophen.
- Premature birth also increases risk for ASD.

# Environmental risk factors – maternal dietary and lifestyle

- Two studies have suggested an approximately 40% reduction in risk for ASD with periconceptional folic acid supplement use.
- There is no firm evidence that maternal smoking during pregnancy and alcohol consumption are associated with elevated risk for ASD.
- Maternal obesity as well as underweight may also be associated with an increased risk for ASD.



# Environmental risk factors – environmental chemicals

- There is some evidence that certain air pollutants (e.g. nitrogen dioxide, ozone, cadmium, lead, mercury, solvents, methylene chloride and styrene and diesel particulate matter), endocrine-disrupting chemicals (e.g. pesticides, polychlorinated biphenyls) and other chemicals may be associated with higher risk for ASD.
- At this point the research findings are inconsistent.
- Further investigation of associations between environmental chemicals and ASD risk is warranted.

# Protective factors

- Good physical health
- High level of intellectual development
- Family acceptance and commitment
- Early intervention
- Good teamwork and coordination between different professionals
- Good social support network throughout life

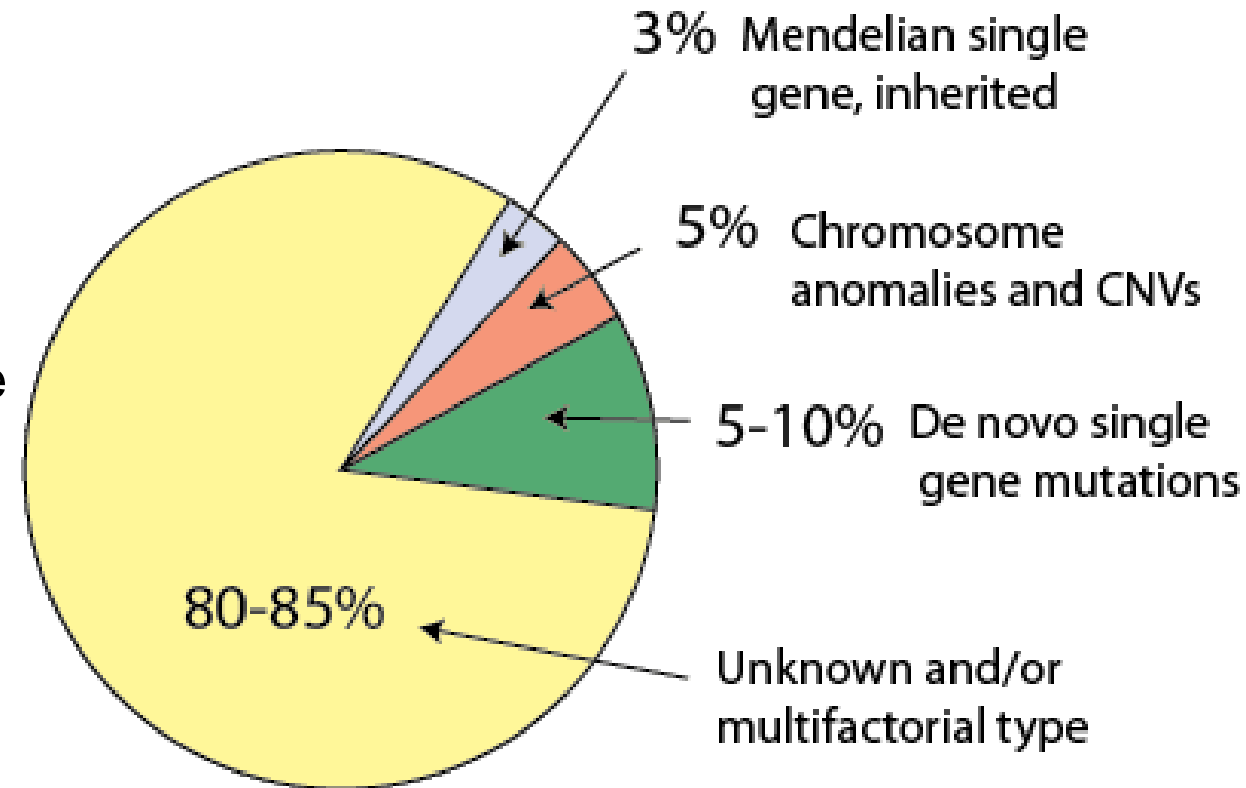
### 3. Autism genetics

- The genetics of autism is complex.
- For each person with autism, a mutation of large number of genes is possible, interaction between mutations, interactions of the environment and mutated genes (monogenetic or polygenetic).
- Some of the genes (or gene families) known and associated with ASD are: Neuroligin (NRLG), Neurexin (NRKSN), SHANK (1,2,3), NLGN 4 and PCDH10
- Possession of identified mutations increases the risk but not the likelihood of autism.
- The studies should show that the ASD genetic base is made up of hundreds of small variations in the human genome.
- The genetic base is not the only cause of ASD.

# Autism genetics

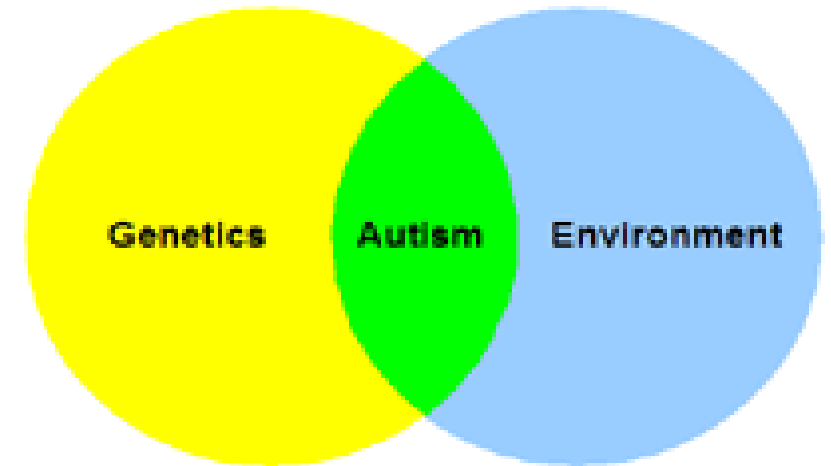
- 80 to 85% of individuals with ASD have unknown causes or multifactorial causes of autism
- 15 to 20% of cases have specific (determinable) causes of autism:
  - monogenic inheritance – individual genes are mutated (e.g. fragile X chromosome in which there is only one mutation)
  - chromosome anomalies or variations in the number of copies
  - newly generated gene mutations - de novo

## Autism Genetic Landscape



# Autism genetics – multifactorial causes of ASD

- Apart from the genes, the cause of ASD can be the simultaneous effects of genes and other risk factors
- Current research relates to the study of the **relationship** between genetic and external risk factors
- Research makes it possible to get **acquainted with the biological mechanisms** of these relationships
- This leads to the development of new diagnostic methods.
- For example, the degree of development of individual parts of the brain in the first year of life in typically developed and children at risk of autism is monitored.



# Autism genetics – monogenic autism inheritance

In monogenic inheritance, there is only one gene mutation.

In these cases, there is a specific determined genetic cause of ASD:

- Fragile X chromosome: FMR1 mutation
- Tuberous sclerosis: TSC 1 mutation
- Prader-Willi syndrome / Angelman syndrome: deletions of 15 chromosomes etc.

These disorders can lead to the clinical picture of ASD.

**Important:** It must be ascertained whether a child with ASD has any of these syndromes, as some of them have additional medical problems!

# Autism genetics – clinical monogenic autism

## Fragile X syndrome, FMR1 gene

- Large, protruding ears, long face, hyper extensible joint, macroorchidism, hypotonia, learning problem, intellectual disability, language impairment, developmental delay, attention problem, ASD

## Rett syndrome, MECP2 gene

- Developmental regression, microcephaly, cognitive and motor impairment, epilepsy, stereotyped hand movement, severe repetitive behavior, severe ASD

## Tuberous sclerosis, TSC1, TSC2 gene

- Brain tumors, multi-organ involvement (kidneys, lungs, heart, eyes and skin), learning difficulties, intellectual disability, self-injurious behavior, obsessive compulsive disorder, attention deficit hyperactivity disorder, aggression, epilepsy, ASD

## Prader-Willi syndrome, deletions 15q11–q13

- Specific face, hypogonadism, small hands and feet, hypopigmentation, hyperphagia, severe obesity, obsessive compulsive disorder, mood and behavior problem, ASD

## Angelman syndrome, deletions 15q11–q13

- Strabismus, unique facial dysmorphism, prominent mandible, wide mouth, sleep disturbance, severe developmental delay, speech impairment, ataxia, attention problem, frequent laughter, easily excitable personality, epilepsy, ASD

## DiGeorge syndrome, deletions 22q11.2

- Multi-organ involvement (heart, kidney, gastrointestinal system, skeletal abnormality), cleft palate, facial dysmorphism, immune system abnormality, low calcium level, hearing loss, developmental delay, learning difficulty, mental illnesses (schizophrenia, anxiety, mood disorders), attention deficit hyperactivity disorder, ASD

# Autism genetics – summary

Genetic etiology allows us to:

- Assess the risk for the emergence and development of ASD
- Set the diagnosis of ASD at the earliest age
- Determine and develop a therapeutic approach (early intervention, individual intervention)
- Develop of new therapeutic procedures
- Assess susceptibility to other illnesses/conditions
- Determine the forecast
- Use genetic counseling



# Autism genetics – genetic counseling

- Counseling is done prior to pregnancy in couples with problems with anomalies, hereditary diseases, chronic illnesses, developmental disorders etc.
- Important factors are also the age of spouses, taking medication during pregnancy, professional exposure to toxic substances...

The goals of genetic counseling are:

- getting information about the risk of childbirth with a hereditary condition,
- getting to know the consequences,
- obtaining information on the likelihood of transmitting and displaying of the condition,
- getting acquainted with the possibilities of treatment and prevention as well as the possibilities of setting diagnosis during pregnancy.

# Autism genetics – genetic testing

Two genetic tests reveal the most commonly known genetic causes of ASD:

1. **Cytogenetic sequence** – parts of chromosomes that are missing or duplicated are discovered
2. **Fragile X chromosome** – the most common inherited cause of intellectual disability, more often in boys

**Normal result** – does not invalidate the diagnosis of ASD. The cause of ASD remains unclear.

**Abnormal result** – a genetic difference was found, but it does not have to be the only cause of ASD.

# Autism genetics – genetic testing

## Goals of genetic testing:

- Ability to monitor comorbidity in ASD
- Genetics can influence the choice of pharmacotherapy
- Selection of appropriate interventions in solving behavioral problems

## 4. Neurobiological basis of autism

- An important place in the etiology of autism is taken by neurobiological markers
- Neurobiological factors never appear isolated, and are most common in interaction with each other or with another factor
- Neurodevelopmental changes in the brain are noticed before the first clinical signs of autism
- Differences in brain development in some people begin intrauterine
- The complexity of the behavior of people with autism (cognitive, sensory, speech difficulties) indicates that it is not about changing only one brain structure

# Neurobiological basis of autism – medical diagnostics

- Neuroanatomic and neurophysiological correlation of autism with certain brain structures are demonstrated by "imaging" techniques (CT, NMR, PET, SPECT) and EEG findings.
  - NMR shows brain tissue structures,
  - PET monitors blood flow to brain,
  - EEG determines electrical activity of brain.
- These techniques record the most common abnormalities in the brain in the cerebellum and corpus callosum.

# Neurobiological basis of autism – neurobiological differences

Neurobiological differences in persons with ASD include:

- Differences in neuronal brain structures
- Neurochemical differences
- Somatic dysfunction

# Neurobiological basis of autism – neuronal brain structure differences

## 1. Limbic system

- Includes: amygdala, hypothalamus, hippocampus, parts of the cerebral cortex.
- Function: experiencing and expressing emotions, learning and memory. The most important in modulation of fear, social interaction and anxiety are amygdala
- In ASD: Increased or reduced amygdala volume (Schuman et al., 2009)
- There are also full differences in modified amygdala: enlarged amygdala in girls with ASD are associated with the disorder of socialisation and communication.

# Neurobiological basis of autism – neuronal brain structure differences

## 2. Cerebellum

- Function: muscle coordination, maintenance of muscle tone and balance, performing harmonised and purposeful movements
- In ASD: neurons are atypical – small and densely distributed
- Abnormalities in the development of the cerebellum are present even before the end of the first year of life.



# Neurobiological basis of autism – neuronal brain structure differences

## 3. Frontal cortex

- Includes: primary motor cortex and prefrontal regions
- Function: the medial area is responsible for consciousness and motivation, behavior, linguistic functions, starting voluntary movements
- In ASD: excessive growth of the prefrontal cortex (mostly at age 2-4), increase in white and gray mass compared to other structures
- Postmortem testing: 67% more neurons PFK and difference in brain weight compared to the control group (age 2-16 years).

## 4. Neural connection

- In ASD: excessive neural connection in the frontal and temporal areas

# Neurobiological basis of autism – neurochemical differences

## 1. Neurotransmitters

- Serotonin: participates in neurogenesis, regulation of temperature, appetite, blood pressure, pain, respiration, leads to depression, in the myelination of axons, synaptogenesis
- In ASD: increased serotonin level, white brain matter abnormalities.
- Dopamine: plays an important role in repetitive movements in autism
- In ASD: decreased in the frontal cortex in relation to other areas, leading to imbalance between excitatory and inhibitory processes

## 2. Neuropeptides

- Oxytocin affects social interactions and behavior
- In ASD: low level.

# Neurobiological basis of autism – somatic dysfunctions in ASD

## 1. Immunological disorder

- Increase in immune factors in peripheral blood (IL-1b and IL-12, TNFa, TNFg)
- Increase in pro-inflammatory cells in the liquor

## 2. Autoimmune disorders

- High rate of autoimmune disorders in families of children with ASD.

## 3. Gastrointestinal problems

- Greater intestinal permeability, also known as “leaky gut syndrome”

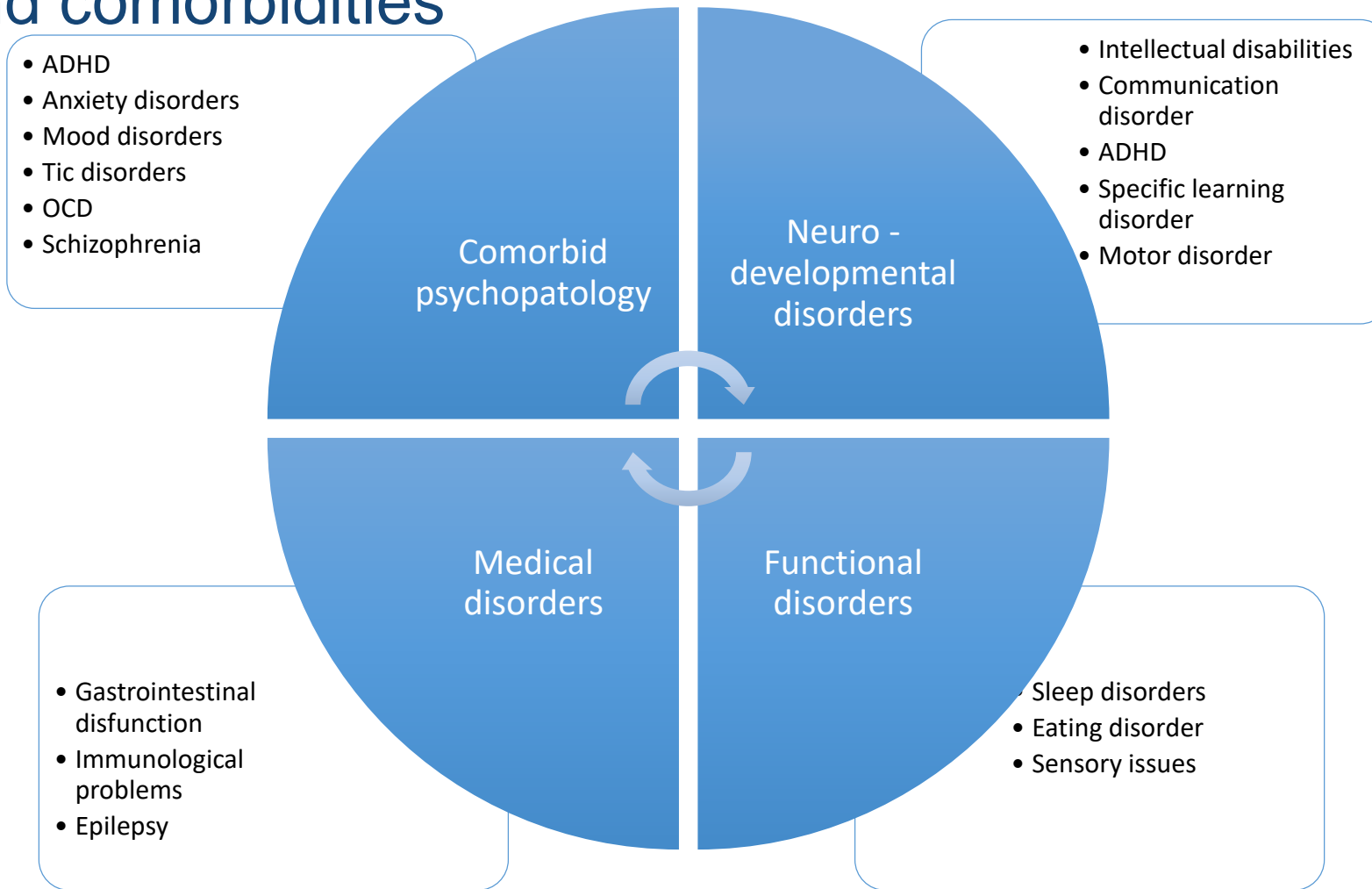
# Neurobiological basis of autism – summary

- Neurodiversity itself is not sufficient for the development of autism.
- At an early age (up to 12 months), there are subtle differences in brain structure, which makes it difficult to use them as an early biomarker in the diagnosis of autism in infants.
- Famous biomarkers still have an incompletely explained physiopathological significance.

## 5. Autism and comorbidities

- Comorbidities are associated significant bodily and/or psychopathological dysfunctions.
- The presence of comorbidity is often associated with a higher severity of the disorder, a poorer response to therapy, and a weaker prognosis.

# 5. Autism and comorbidities



# Common characteristics of autism and other neurodevelopmental disorders

- Onset in the developmental period.
- Typically manifest early in development.
- Developmental deficits produce impairment in personal, social, academic or occupational functioning.
- Neurodevelopmental disorders frequently co-occur.

# Autism and comorbidities - intellectual disabilities

- Both autism and intellectual disabilities are defined behaviorally and have an onset in developmental period.
- They share some common characteristics and are associated with many environmental and biological factors.
- These two conditions are known to be highly comorbid.
- Diagnosis of ASD in individuals with ID is appropriate when social communication and interaction are significantly impaired relative to their nonverbal skills.
- Prevalence of intellectual disabilities in children and adolescents with ASD tends to be around 50%, with highly variable rates reported in different studies.



# Autism and comorbidities - intellectual disabilities – gender differences

- Male to female ratio in ASD is highest when intellectual disability is not present.
- At the level of moderate to severe intellectual disability gender ratio approaches equality.
- It is possible that males and females have different thresholds for the genetic liability to autism.

# Autism and comorbidities - intellectual disabilities – core symptoms

- Intellectual disability moderates the presentation of core autistic symptoms, as well as associated features.
- There is evidence for negative correlation between level of intellectual functioning and number of ASD core symptoms.
- Children with very low nonverbal IQ tend to have the most severe ASD symptoms, particularly in domain of social communication.
- As the discrepancy between nonverbal and verbal IQ increased, so did the degree of social impairment.
- Repetitive sensory and motor behaviors are more frequent in children with lower level of intellectual functioning.
- On the contrary, there is no relationships between IQ and rigidity or resistance to change.

# Autism and comorbidities - intellectual disabilities – health issues

- The prevalence of epilepsy is higher in individuals with autism and comorbid intellectual disabilities as compared to those without intellectual disabilities; the prevalence of epilepsy increases with the severity of intellectual disabilities.
- Physical health-related needs of adults with comorbid autism and intellectual disability appear to be particularly overlooked in the literature.
- Low functioning individuals tend to have greater behavioral problems.
- The relation between IQ and psychiatric symptoms varies considerably across the studies.

# Autism and comorbidities - communication disorders

## Communication disorders

Specific language disorder

Pragmatic disorder

## Similarities

Problems of communication  
Secondary social difficulties  
Delayed symbolic play, theory of mind, declarative pointing...

Preserved nonverbal communication  
There are no restrictive or repetitive behavior, interests and activities.

## Differences

Difficulties in social use of verbal and nonverbal communication.

There are no restrictive or repetitive behavior, interests and activities, currently and in the past.

# Autism and comorbidities - ADHD

- Attention abnormalities may be seen in both conditions – overly focused or easily distracted.
- When attention difficulties or hyperactivity in children with autism exceeds the typically seen in individuals with comparable mental age, both diagnoses are appropriate.
- Peer rejection, frequently seen in children with ADHD, must be distinguished from social disengagement of children with autism.
- Tantrums in children with autism are frequently the result of their inability to cope with a change, while the same behavior in children with ADHD, represents the more substantial deficits of self-control.

# Autism and comorbidities - specific learning disorder

- Although autism affects learning, it is not specific learning disorder.
- A child with autism may have reading or writing problems unrelated to dyslexia and dyscalculia.
- Officially, ASD is an exclusionary criterion for diagnosis of specific learning disorders, and vice versa.
- In reality, it is possible, but unlikely, to have both conditions.

# Autism and comorbidities - motor disorders

## Motor disorders

Developmental Coordination Disorder

Stereotypic Movement Disorder

Tourette's Disorder

## Overlapping

Onset in early developmental period; clumsiness; difficulties in handwriting

Repetitive motor behavior; self-injurious behavior.

Stereotyped movements; echolalia; repetitive verbal behavior.

## Differences

Some children with ASD are not interested in participating in complex motor activities. They may have high motor abilities.

No social communication deficits.

Usually begins in middle childhood with facial tics; preserved language and intellectual abilities.

# Autism and comorbidities – epilepsy

- Particularly risky age for occurrence of epilepsy is early childhood or adolescence
- Prevalence among children is between 7% and 14%
  - Prevalence is significantly higher in children with intellectual disabilities
- Prevalence among adults is between 20% i 30%
- It is regulated by the introduction of pharmacological therapy
- Treatment does not differ from treatment in people without ASD



# Autism and comorbidities – gastrointestinal problems

- Common dysfunctions, unknown prevalence of symptoms
- Assumption: intolerance to certain foods and/or the presence of inflammatory processes
- Food ingestion disorder: a limited food choice – deficiency in nutrition
- Digestion disorders: constipation, diarrhea, flatulence, reflux, abdominal pain
- Consequences: states of agitation, aggression, self-aggression, mood swings

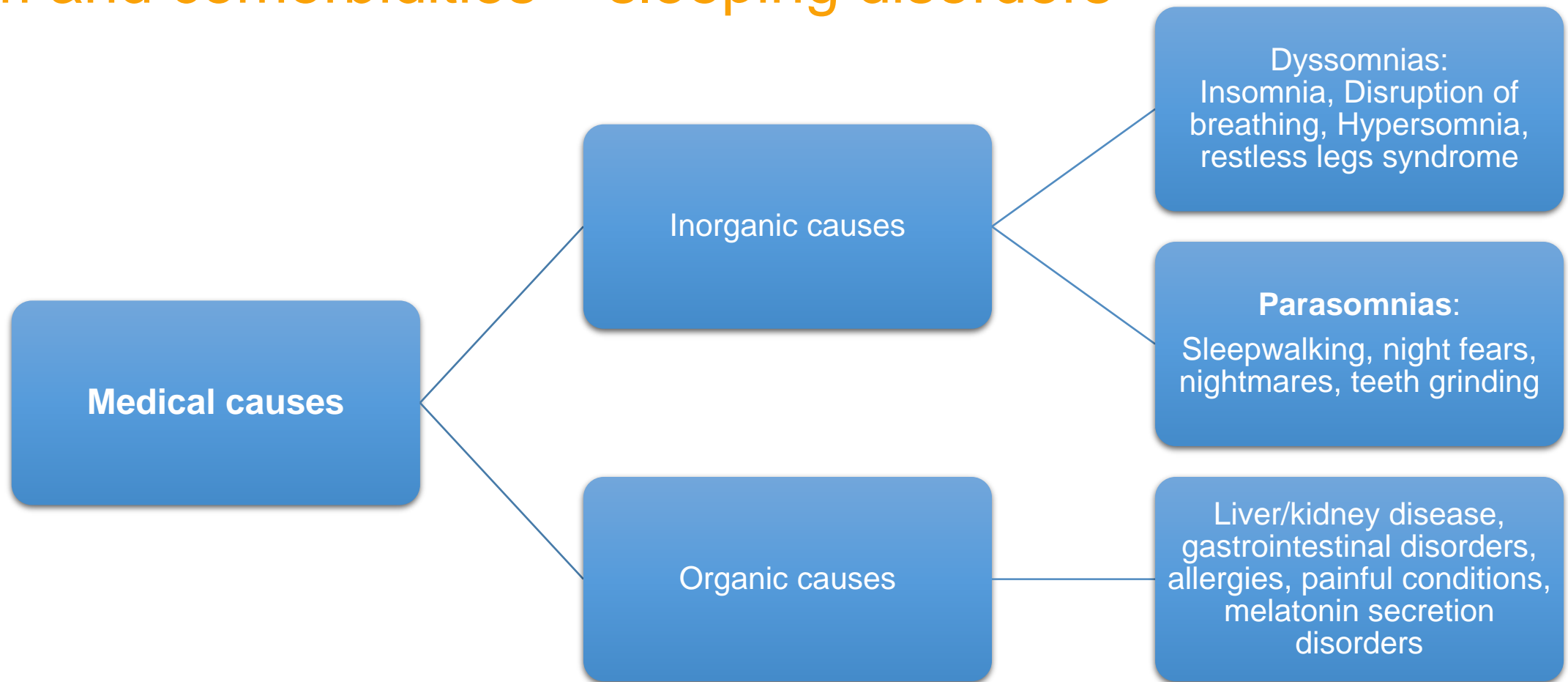
# Autism and comorbidities – immunological problems

- Increased prevalence of allergic and autoimmune diseases in ASD
- Increased risk of asthma, allergic rhinitis, atopic dermatitis, urticaria, type 1 diabetes and Crohn's disease
- Autoimmune diseases are more frequent in women with ASD

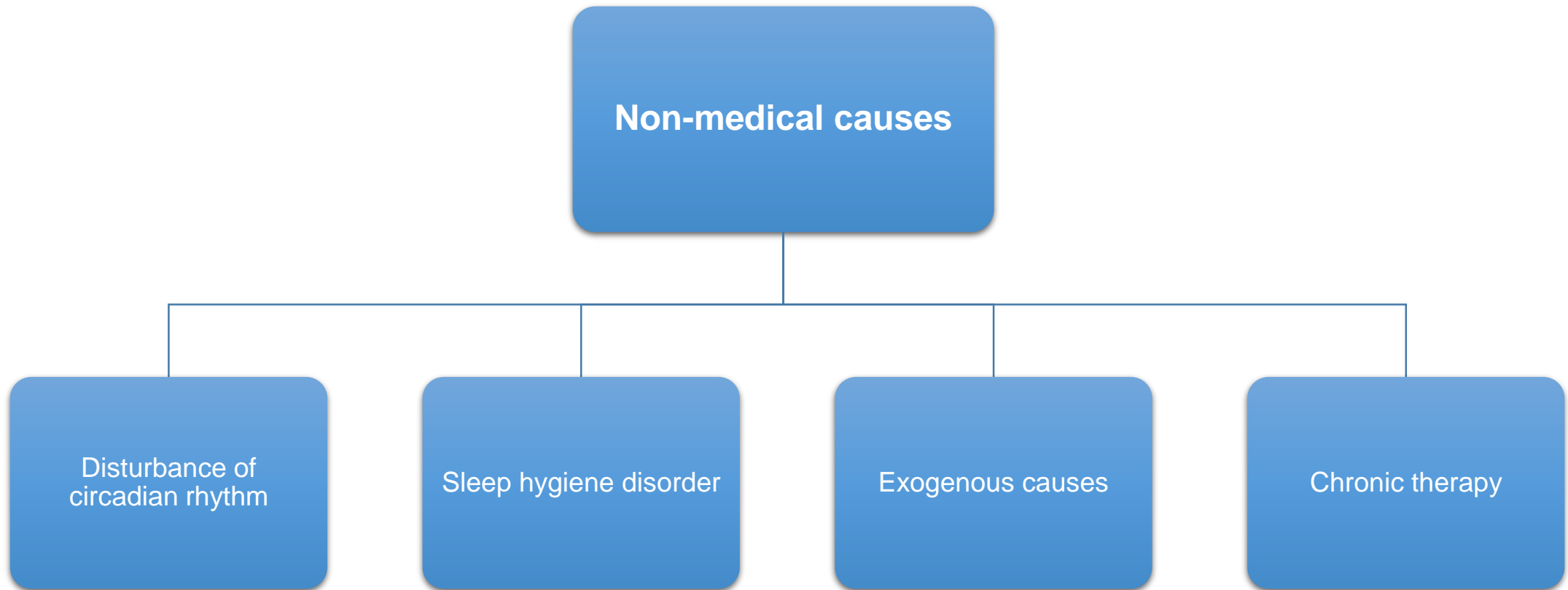
# Autism and comorbidities – sleeping disorder

- The prevalence is between 40% and 80%
- Insomnia (difficulty falling asleep, frequent night wakes and early morning awakening), restless leg syndrome and parasomnia (nightmares and nighttime fears) most commonly occur in childhood
- Problems with sleeping in childhood continue in adolescence (hypersomnia becomes the most common problem)
- In adulthood, the most common is insomnia (difficulty sleeping and early morning waking)
- Organic causes are more common in adults
- Melatonin secretion disorder is equally represented in all age categories

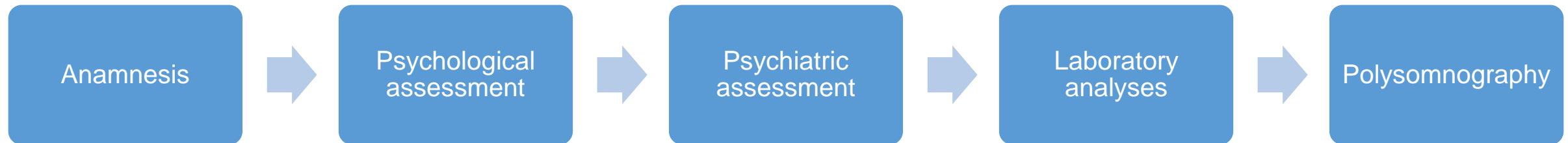
# Autism and comorbidities – sleeping disorders



# Autism and comorbidities – sleeping disorders



# Autism and comorbidities – sleeping disorders diagnostics



# Autism and comorbidities – sleeping disorders treatment

## Causal treatment

- Treatment of causes, most commonly health problems

## Symptomatic treatment

- Nonpharmacologically: Sleep hygiene, Chronotherapy, Behavioral interventions
- Pharmacologically: Benzodiazepines, Melatonin, Phytotherapy

# Autism and comorbidities – sleeping disorders strategies

Waking up/going to bed at the same time

Avoiding caffeine

Avoiding meals before bedtime

Avoiding beverages before going to bed

Aerobic exercise

Warm bath before bedtime

Avoid watching TV and playing games before bedtime

Recognizing and solving sensory disturbances

Following routines before bedtime

Melatonin

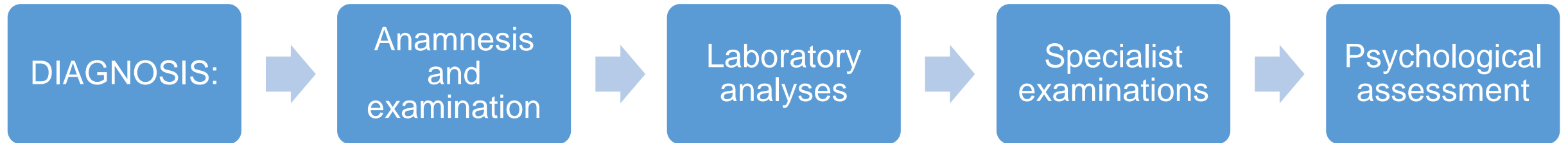


# Autism and comorbidities – eating disorders

Causes that lead to these problems can be:

- Health reasons (GIT problems, allergies, chronic diseases, drug intake, dental problems...)
- Sensory problems (eating only certain colors, textures, certain scents cause nausea, eating foods of similar taste, avoiding touching it etc.)
- Communication problems (whether a person can express what she likes, does not like, is she hungry or full etc.)
- Undeveloped social skills (whether a person uses cutlery, drinks from a glass, tolerates taking food in the presence of other people etc.)

# Autism and comorbidities – eating disorders diagnostics



In introducing strategies, it is important:

- to have individual approach
- to introduce one by one strategy and avoid using multiple strategies
- to give time, patience, understanding and sensory consciousness

# Autism and comorbidities – eating disorders strategies

eating in a quiet and comfortable environment

serving meals at the table

serving as a model

keeping a diet diary

making a menu

serving food as fun and attractive

serving meals always at the same time

including a person in food preparation

in introducing new food: gradually, small quantity, do not deprive meals

in food rejecting: put a small amount of food near the place where a person sits, do not persuade, remain consistent

in problem of overeating: reduce portions, intensify physical activity, control obsession

PICA treatment: restrict input of non-food items, health checks, correction of behavior by substitution

using cutlery: serve food that can not be eaten using fingers

general principles: 3 main meals + 2 snacks a day, do not skip meals, no snacking in between

# Autism and comorbidities – sensory issues

- Young age and adolescence: pronounced hypersensitivity, which is why easy disturbance and sudden aggressive behavior occur
- Adults: hyposensitivity is growing
  - Self-stimulating behaviors are less frequent
  - Loss of vision
  - The function of the vestibular system falls due to the decrease in the number and size of the vestibular neuron
  - The proprioception and tactile sensitivity are reduced
  - Progressive hearing loss
- Consequences: instability, falls, injuries

# Autism and comorbidities – comorbid psychopathology

- Around 80% of individuals with ASD met diagnostic criteria for psychiatric disorders at least once in their lives.
- Psychiatric problems are less prevalent in older age.
- Distinct patterns of change in psychopathology are associated with differential profiles of psychotropic medication use, co-morbid mental health diagnoses, and residential placement.

# Comorbid psychopathology – mood disorders

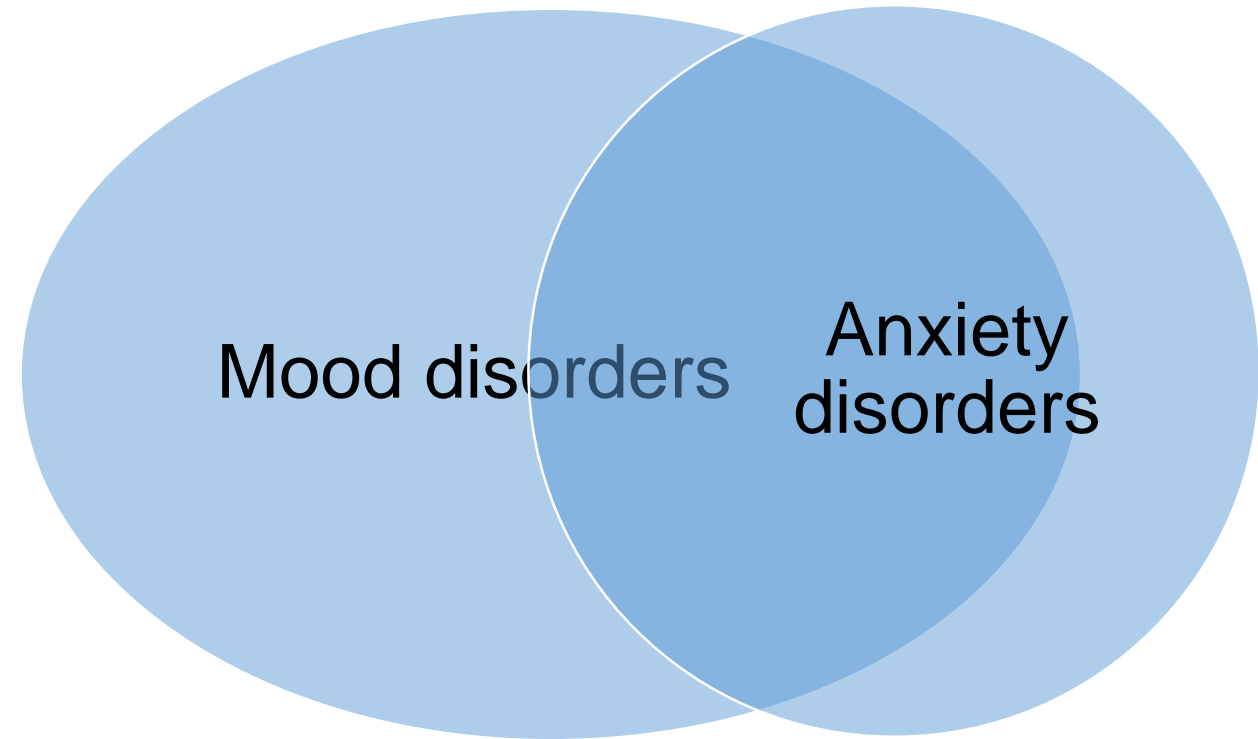
- The most common group of psychiatric disorders (involving major depression and dysthymia).
- Mood disorders are most prevalent in middle aged adults and in females.
- Depression may be related to ongoing bullying or recent environmental change.
- As a very common problem depression needs to be monitored in all patients at every follow-up point.

# Comorbid psychopathology– anxiety

- Up to 40% of individuals with ASD also suffer from anxiety.
- Among anxiety disorders, generalized anxiety disorder, social phobia and agoraphobia most frequently occur.
- In addition, an increased prevalence of anxiety disorders has been found in the relatives of individuals with ASD.

# Comorbid psychopathology – mood and anxiety disorders co-occurrence

- Over 65% of adults with ASD meeting criteria for any lifetime mood or anxiety disorder, also met criteria for the other co-occurring disorder.
- ASD severity is predictive of the amount of depression and anxiety symptoms.
- This is related to the greater difficulties for communication and the unpredictability of the environment that entails the severity degree.





# Comorbid psychopathology – other conditions

- Obsessive-compulsive disorder
- Premenstrual dysphoric disorder
- Schizophrenia
- Tic disorder

## Links and resources

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12. [https://ec.europa.eu/health/sites/health/files/major\\_chronic\\_diseases/docs/asds\\_eu\\_en.pdf](https://ec.europa.eu/health/sites/health/files/major_chronic_diseases/docs/asds_eu_en.pdf)

# Links and resources

# The IPA + Partnership



## **Main authors:**

**Sunčica Petrović, Nenad Glumbić & Milica Jacevski**

## **Contributors:**

**Celia Gil, Christian García, Conchita Garate, Isabel Cottinelli, Rita Soares, Inês Neto, Aurélie Baranger, Cristina Fernández, Haydn Hammersley, José Luis Cuesta & Ascensión Doñate**

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