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## **Genetic Aspects of Mental Retardation and Developmental Disabilities**

According to the 2002 definition by the American Association of Mental Retardation, mental retardation is a disability characterized by significant limitations both in intellectual functioning and in adaptive behavior as expressed in conceptual, social, and practical adaptive skills. This disability originates before age 18. There are five assumptions essential to the application of the definition:

- 1- Limitations in present functioning must be considered within the context of community environments typical of the individual's peers and culture
- 2- Valid assessment considers cultural and linguistic diversity as well as differences in communication, motor, sensory, and behavioral factors
- 3- Within an individual, limitations coexist with strengths
- 4- An important purpose of describing limitations is to develop a profile of needed supports
- 5- With appropriate personalized supports over a sustained period, the life functioning of the person with mental retardation generally will improve

Individuals with mental retardation may have other disabilities as well. These include cerebral palsy, seizure disorders, vision impairment, hearing loss, gastrointestinal conditions, and behavioral disorders. Mental retardation is also referred to as a cognitive or intellectual disability. Many people in the United States prefer such terms.

Assessment of intellectual functioning relies on Intelligence Quotients known as IQ tests, or by the types and amount of support they need. These tests typically include a range of items that assess one's general knowledge, vocabulary, problem-solving skills, and reasoning ability. Most IQ tests are structured so that a score of 100 is considered average. The recommended IQ cut-off score for mental retardation is approximately 70, which is roughly the lowest scoring 2% of the population. Based largely on IQ scores, traditionally mental retardation has been divided into four levels of severity:

- 1- Mild mental retardation: IQ scores from 70 to 55/50
- 2- Moderate mental retardation: IQ scores from 55/50 to 40/35
- 3- Severe mental retardation: IQ scores from 40/35 to 25/20
- 4- Profound mental retardation, IQ scores below 25/20

The incidence of mental retardation in the general population is roughly about 3%. The majority of individuals however function in the mild to moderate range of mental retardation.

The causes of mental retardation are quite heterogeneous or various. They can occur prenatally or before the child is born, during birth, and postnatally. Whereas the majority of individuals who function in the mild range of mental retardation do not have a specific cause for their mental retardation and generally do not display unusual physical features, individuals who function in the severe and profound range of mental retardation tend to have an increased incidence of medical and/or genetic causes. Some of the most common known causes of mental retardation are Down syndrome, fetal alcohol syndrome, and fragile X syndrome, all of which occur before birth. Other causes that take place before a child is born include genetic conditions (such as any chromosomal anomalies), infections (such as congenital cytomegalovirus, syphilis, rubella, toxoplasmosis), maternal environmental factors (maternal diabetes, or exposure to prescribed medications such as Dilantin, or substances such as alcohol) or birth defects that affect the brain (such as hydrocephalus or cortical atrophy). Other causes of mental retardation include decreased blood supply to the fetus during delivery or maternal infection while a baby is being born or soon after birth. Yet other causes of mental retardation can affect the child when he or she is older. These may include serious head injury, stroke, lead exposure, or certain infections such as meningitis or measles. It remains that for the majority of children and older individuals, the cause of their mental retardation is not known.

The identification of an etiology or a specific cause in children and adults with mental retardation is a major challenge and requires a comprehensive clinical process and occasionally multidisciplinary collaborations. Arriving at a correct diagnosis of a genetic disorder causing mental retardation is very important because it may have implications for treatment, anticipatory guidance, genetic counseling, and family planning. The importance of determining the specific cause or etiology of mental retardations can be summarized as follows:

- To assist parents in understanding the full implications of the cognitive disability
- To provide the parents with accurate genetic counseling regarding the recurrence risk of the condition among subsequent pregnancies and provide them with options for prenatal diagnosis and also for reproduction
- To allow therapeutic strategies

At the same time there is increasing awareness about the importance of specific genetic diagnoses for long-term educational and vocational planning. In addition, an accurate diagnosis is essential for prevention of mental retardation. Indeed one of the most important tools in preventing mental retardation is providing appropriate genetic counseling and recurrence risk to at-risk families. The following are examples of public health measures that aim at preventing mental retardation and developmental disabilities:

- Some metabolic conditions, such as phenylketonuria (PKU), galactosemia, and congenital hypothyroidism, can cause mental retardation and other disabilities if babies with these conditions do not begin treatment immediately or soon after

birth. Newborns in the United States are tested soon after birth via the Newborn Screening. Children that do have these conditions are usually treated with medicine or put on a special diet. If the correct treatment is started soon enough after the child is born and continues as long as needed, the child will not develop mental retardation, seizure disorder, or other developmental disabilities.

- Blood typing of pregnant women with emphasis on the Rh factor and the appropriate utilization of Rh-immunoglobulin to prevent Rh incompatibility between mother and fetus and prevent serious prenatal damage to the fetus.
- Prenatal triple screening for fetal markers is considered to be a part of routine obstetrical care and allows for assessment of the fetus for the presence of major disabilities.
- Prenatal diagnosis, in selected families and at-risk populations (such as advanced maternal age), is a major effort in the control of certain untreatable forms of genetic conditions.
- Heterozygote or carrier screening among at-risk populations to detect carriers and provide them with genetic counseling (e.g., sickle cell and thalassemia among African Americans and Mediterraneans and Tay-Sachs disease among Jewish Americans).
- The identification of environmental factors in the causation of multifactorial conditions allows for the manipulation of environment to prevent such disorders. Example: The fortification of diet of women of reproductive age with folic acid allows for prevention of almost 70% of all cases of neural tube defects.
- Rubella immunization program for the prevention of congenital rubella syndrome.

Some genetic syndromes with intellectual disability may also be associated with specific dysmorphic features, unique medical complications, and behavioral patterns. There are some key neurological and physical features that health care providers should be aware of that give clues to possible genetic disorders. These include:

- unusually short or tall stature
- abnormal facial features
- minor or major anomalies of extremities
- hearing and visual deficits
- endocrine disorders such as absent menses
- presence of congenital anomalies such as heart, kidney or other systemic abnormalities
- recurrence of mental retardation in more than one sibling in a family
- recurrent miscarriages
- having multiple affected males who are related which could suggest sex- linked conditions.

When an individual with mental retardation presents with a particular pattern of dysmorphic facies and distinctive physical features, a referral to a geneticist is indicated for a comprehensive genetic evaluation and possible diagnostic genetic testing. The process of making a genetic diagnosis is a complex one. It is similar in many ways to detective work, looking for many clues to arrive at a specific diagnosis. The clinical genetic evaluation includes:

- Obtaining a thorough medical and family history including review of previous medical records
- Careful physical and dysmorphological evaluation
- Diagnostic genetic laboratories (examples: chromosome studies, fragile X testing, gene testing, neurodiagnostic tests of the head, and metabolic studies of blood and urine).
- Eye and hearing assessments
- Appropriate developmental tests for children
- Referral to parent support group

## References:

[www.cdc.gov](http://www.cdc.gov)

[www.aamr.org](http://www.aamr.org)

<http://ghr.nlm.nih.gov/> Genetics Home Reference. Your Guide to Understanding Genetic Conditions. Excellent site for information on many genetic conditions including symptoms, frequency, related genes, treatment, and links to correlated resources. It is useful to learn about genetic testing, genetic counseling, and gene therapy.

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