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AN INSIGHT ON CHILDREN WITH SPECIAL NEEDS: A SYSTEMATIC REVIEW

[1]Anna Reenu Shaji, [2]Varsha Clara Varghese, [3]Dr. Seeja Thomachan Panjikkaran,

[4]Malavika Dileep M. , [5]Sachna Shah

[1*]Ph.D. Scholar, [2*]Ph.D. Scholar, [3]Associate Professor and Head, [4] Ph.D. Scholar, [5] Ph.D. Scholar
College of Agriculture, Department of Community Science, Kerala Agricultural University, Vellanikkara, Thrissur

ABSTRACT

Numerous children who require special medical attention are susceptible to one or more nutritional status issues, which can range from inadequate food and delayed growth to more serious gastrointestinal issues and metabolic diseases. Numerous factors influence nutritional risk, including as preconception/prenatal nutrition, maternal and paternal nutritional status, and physiological, medicinal, and behavioral risk factors after delivery. Down syndrome is a genetic condition where a person is born with an extra copy of chromosome 21. This means that they have a total of 47 chromosomes instead of 46. Prader-Willi syndrome is a rare genetic condition that causes a wide range of physical symptoms, learning difficulties and behavioural challenges. It's usually noticed shortly after birth. Reduced eye contact, facial expressions, and body movements during the first three years of life are among the social behaviors and nonverbal interactions that define autism spectrum disorder (ASD), a collection of neurodevelopmental diseases. Impulsivity, hyperactivity, and inattention are the hallmarks of attention deficit hyperactivity disorder (ADHD). ADHD affects as many as 5% of kids in elementary school. Both the environment and genes influence the genesis of ADHD. Cerebral palsy (CP) is a group of disorders that affect a person's ability to move and maintain balance and posture. CP is the most common motor disability in childhood. The most prevalent congenital deformity of the head and neck are orofacial clefts, which include a variety of congenital abnormalities. The quality of life of patients with clefts is greatly impacted psychologically and socioeconomically, necessitating a multidisciplinary team approach to management.

Keywords: Down Syndrome, Prader-Willi Syndrome, ADHD, Cerebral Palsy, Autism, Cleft lip

1. INTRODUCTION

Children with Special Needs (CWSN) are those who have some type of disability and require exceptional care and extra help. The special needs of these children depend on the nature of their disability. The Special Needs of CWSN may include frequent medical testing, hospital stays, 5cerebral palsy impair movement development and limit one's range of activities. Cerebral palsy is caused by non-progressive abnormalities that appear in the developing fetus or infant brain. It is the most typical reason why children have disabilities. Depending on the cause, there are differences in the kind and severity of motor impairment as well as functional capacities. Numerous comorbidities, such as epilepsy, musculoskeletal issues, intellectual incapacity, eating issues, anomalies in vision and hearing, and communication challenges, are linked to cerebral palsy [1].

A collection of neurodevelopmental diseases known as autism spectrum disorder (ASD) are typified by a deficiency in verbal and nonverbal communication as well as social interaction during the first three years of life.

One of the distinguishing social practices is avoiding eye contact managing one's emotions or comprehending them of others, as well as a noticeably constrained selection of hobbies and pursuits The incidence of ASD as of right now in the most recent extensive studies roughly 1%–2% [2]. Despite the rise in prevalence is partly the outcome of modifications made to the DSM diagnostic criteria an increase in risk variables cannot be ruled out at a younger age of diagnosis [3].

The symptoms of Prader-Willi syndrome (PWS) include short stature if growth hormone (GH) treatment is not received, childhood-onset obesity if excessive eating is not curbed, behavioral findings, neonatal hypotonia with poor suck and poor weight gain without nutritional support, developmental delay, mild cognitive impairment, and typically a characteristic facial appearance [4].

Although Down syndrome was initially identified in 1866 by the English physician John Langdon Down, its connection to chromosome 21 was not proven until nearly a century later in Paris by Dr. Jerome Lejeune. The most prevalent chromosomal anomaly in humans, Down syndrome, is caused by the presence of all or part of the third copy of chromosome 21. It is also discovered that trisomy 21, which produces this disease, is the most common live-born aneuploidy [5]. Maladaptively high levels of impulsivity, hyperactivity, and inattention are hallmarks of ADHD. Over time, there have been considerable changes in the way these symptoms are conceptualized for diagnosis. Children who were hyperactive were diagnosed with a severe moral control deficiency during the start of the 20th century [6].

After Down syndrome, CLP is the second most frequent congenital birth condition in the United States. Every year, in the United States, about 7,000 newborns are born with orofacial clefts [7]. In addition to the medical consequences on the patient, CLP has important psychological and socioeconomic repercussions on the patient and family, which include lowered quality of life (QOL) and disruption of psychosocial functioning [8,9]. It is linked to higher mortality rates from a variety of causes, including suicide [10], as well as high medical expenses. The alveolus or palate may be involved in unilateral or bilateral cleft lips. Affected people may exhibit additional congenital defects or may belong to a hereditary syndrome.

1.1 Autism spectrum disorder

Etiology

ASD is not a solitary illness. Nowadays, most people agree that it is a multifactorial condition caused by interacting hereditary and non-genetic risk factors. 10%–20% of people with ASD have chromosomal abnormalities and gene deficiencies, among other genetic reasons [11,12].

Siblings born into families where there is an ASD subject are 50 times more likely to get ASD themselves, and the recurrence incidence is 5%–8% [13]. In monozygotic twins, the concordance rate can reach 82%–92%, but in dizygotic twins, it is only 1%–10%. Single gene mutations may change the developmental paths of neuronal and axonal structures involved in synaptogenesis, according to genetic research [14]. The most likely mechanisms in cases of tuberous sclerosis and fragile X syndrome are assumed to be aberrant neuronal synchronization and hyper excitability of neocortical circuits brought on by changes in the neocortical excitatory/inhibitory balance [15,16]. Less than 5% of people with ASD also have metabolic abnormalities, such as phenylketonuria, creatine deficiency syndromes, adenylosuccinate lyase deficiency, and metabolic purine disorders [17].

ASD is also caused by a variety of environmental factors, including as prenatal, perinatal, and postnatal factors [18]. Prenatal exposure to teratogens like thalidomide, certain viral infections (such as congenital rubella syndrome), and maternal anticonvulsants like valproic acid are among the factors linked to ASD [19,20]. The perinatal factors include low birth weight, excessively short gestation length, and birth hypoxia [20]. Autoimmune disorders, viral infections, hypoxia, mercury exposure, and other post-natal conditions have been linked to ASD [21,22].

Clinical features and Diagnosis

Along with deficiencies in social behaviors and nonverbal interactions, such as decreased eye contact, facial expressions, and body motions, ASD is usually detected in the first three years of life [23]. Children can also present with nonspecific symptoms such motor clumsiness, sleeplessness, and unique sensory perception abilities and experiences. Mental retardation, emotional apathy, hyperactivity, violence, self-harm, and repetitive behaviors like body rocking or hand flapping are associated phenomena. Cognitive impairment, seizures or epilepsy, gastrointestinal ailments, disturbed sleep, and other issues are frequently linked to repetitive, stereotyped activities. Deafness, learning disabilities, and childhood schizophrenia are examples of differential diagnoses [24]. The epidemiology of pervasive developmental disorders. In: Recent developments in autism research [25,26].

Clinical diagnosis of ASD is made in response to the existence of core symptoms. ASD patients exhibit abnormal behaviors in the areas of visual attention, imitation, social responses, motor control, and reactivity by the time they are 12 months old [27].

Treatment

The foundation of ASD management has been a variety of behavioral and educational interventions. Individualized treatment is recommended for ASD, according to the majority of doctors. Educational and behavioral interventions may go more smoothly if incapacitating symptoms like hostility, agitation, hyperactivity, inattention, impatience, and repetitive and self-injurious conduct are treated [28]. Typical and atypical antipsychotics, antidepressants, selective serotonin reuptake inhibitors, α2-adrenergic agonists, β-adrenergic antagonists, mood stabilizers, and anticonvulsants are among the medications used in medical management [29,30].

Spectrum disorders: a chart review study. Knowledge of unique individual medical, behavioral, or psychiatric problems coexisting with ASD, such as obsessive-compulsive disorder, schizophrenia, mood disorder, and intellectual disability, has a significant role in the choice of pharmacologic treatment [31.] The most often utilized medications were antidepressants, which were followed by stimulants and antipsychotics.

Nonetheless, some patients' autistic symptoms continue to be unresponsive to pharmacological therapy [32]. These people's quality of life has been negatively impacted by their numerous comorbidities and severely advanced disease [29]. For these patients, another therapeutic option could be interventional therapy, such as deep brain stimulation (DBS). ASD has been treated with two types of interventions: comprehensive therapies and focused intervention techniques [29]. Prompting, reinforcement, discrete trial instruction, social tales, or peer-mediated interventions are examples of targeted intervention techniques. These are employed for a brief period of time with the aim of demonstrating a change in the targeted behaviors, and they are made to achieve certain behavioral or developmental results for individual children with ASD.

1.2 Attention Deficit Hyperactivity Disorder (ADHD)

Etiology

The widely held belief is that these kids are just the products of dysfunctional families, abusive childhood experiences, or poor parenting. This is a contentious issue that is very important. So far, the research suggests that both environmental and genetic variables influence the genesis of ADHD. Gene mutations in the dopamine D4 receptor gene and the dopamine transporter gene (DAT1) are linked to the ADHD phenotype [33]. Long into adulthood, there is persistent disruption of neurotransmission, dopamine and noradrenaline metabolism, and the prefrontal cortex and related subcortical regions.

Gene mutations in the dopamine D4 receptor gene and the dopamine transporter gene (DAT1) are linked to the ADHD phenotype. Long into adulthood, there is persistent disruption of neurotransmission, dopamine and noradrenalin metabolism, and the prefrontal cortex and related subcortical regions. Environmental effects, including maternal stress and smoking during pregnancy, poor quality early caregiving, perinatal complications and prematurity also play a role in the etiology of ADHD. However, there is not enough evidence to say that the children with symptoms of ADHD, who come from chaotic environments, are fundamentally different from those who come from stable families [33].

Problems associated with ADHD

Comorbidity with behavioral disorders (25%) and oppositional defiant disorder (35–50%) is common. In a similar vein, there is a higher incidence of comorbid learning difficulties, anxiety, depression, and tic disorders. While children with ADHD are more likely to have epilepsy and other brain pathologies, the majority of these youngsters do not exhibit any neurological symptoms [34].

Diagnosis

GPs, or general practitioners, are essential in the early detection of potential cases. GPs are the ones that recommend most patients to the specialty services for ADHD, even though only a child health professional should make that diagnosis.

The age range of typical primary care presentations varies [35]. Preschoolers may exhibit short play periods (less than three minutes), abandoning tasks unfinished, giving the impression that they are not listening, moving very constantly, and showing no signs of danger. Primary school-aged children often exhibit the inability to focus for

longer than ten minutes while engaged in moderately difficult activities, changing activities too soon, and being disoriented, forgetful, and easily distracted by their surroundings. Furthermore, they frequently behave inappropriately, interrupt other kids and respond without thinking, become agitated when composure is desired, and carelessly disobey the rules [36].

Management of ADHD

The initial line of treatment is psychological. PTP should be made available to the parents, and group cognitive behavioral therapy (CBT) or social skills instruction should be taken into consideration for the child. Consider individual CBT or social skills training for teenagers. If psychological approaches are rejected or if symptoms are not resolved, drug treatment may be taken into consideration [37].

Treatment for children with ADHD involves modifying the teaching program and providing extra support; close collaboration between the school and health experts is necessary [37].

Pharmacological treatment of ADHD

The management of ADHD in primary and secondary care is becoming more and more common. The three main pharmaceutical therapy choices are dexamphetamine, atomoxetine, and methylphenidate. For children with ADHD, methylphenidate is the first-line pharmaceutical treatment (response rate: 60–80%). The effects start to show up 30 minutes after the injection. Headaches and stomach aches are frequent side effects, though they normally go away [38].

Although its precise mode of action in ADHD is unknown, atomoxetine is a selective noradrenalin reuptake inhibitor. If a child is not receptive to stimulants or has a tic disorder that is made worse by stimulant treatment, atomoxetine can be a good first-line alternative [6]. The least researched of the three medications, dexamphetamine is only used when methylphenidate and atomoxetine are intolerable or ineffectual, or when the patient's epilepsy worsens [39].

1.3 Cleft lip and cleft palate

A variety of congenital abnormalities are referred to as orofacial clefts; the most common presentation is either solitary cleft palate (CP) or cleft lip with or without cleft palate (CLP). After Down syndrome, CLP is the second most frequent congenital birth condition in the United States. Every year, in the United States, about 7,000 newborns are born with orofacial clefts [7]. In addition to the medical consequences on the patient, CLP has important psychological and socioeconomic repercussions on the patient and family, which include lowered quality of life (QOL) and disruption of psychosocial functioning [8,9].

It is linked to higher mortality rates from a variety of causes, including suicide [10] as well as high medical expenses. The alveolus or palate may be involved in unilateral or bilateral cleft lips [40].

Classification

Traditionally, CLP has been categorized according to its phenotypic, which can affect the palate and alveolar ridge and manifest in a variety of ways, from microform to complete clefting. There may be a correlation since certain genetic linkage patterns have been linked to particular phenotypes. Both CLP and CP have discrete genetic and epidemiological characteristics and are embryologically distinct processes that are disrupted at different times of development [41,42].

A clinical spectrum of cleft lip with or without concomitant cleft palate is referred known as CLP. Despite some epidemiologic variations, palate involvement often indicates a related but more severe variant of this abnormality [42]. There are two types of lip clefting: total (encompassing the lip's entire vertical height) and incomplete. Alveolar clefts are frequently linked to complete cleft lips. Simonart's band, a soft tissue bridge that spans the cutaneous lip or alveolus in an incomplete cleft lip, is mainly made up of skin with varying numbers of orbicularis oris muscle fibers [43]. Unilateral cleft lip (Figure 1) is associated with typical deformities caused by asymmetric forces on the premaxilla during facial growth.

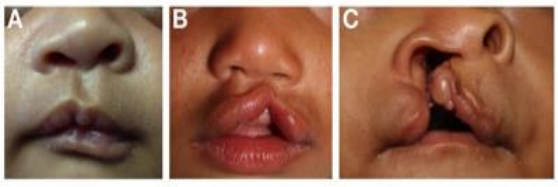

Figure 1: Unilateral clept lip. A) Microform type, B) incomplete type

In bilateral cleft lip, the premaxilla grows independently of the maxillae on either side and may protrude considerably, particularly in complete clefts (Figure 2) [44]. The prolabium, consisting of soft tissues of the premaxilla without muscle fibers, also lacks Cupid's bow and philtral columns bilaterally. The columella is severely shortened or absent while the lateral crura are displaced laterally, producing a broad, flat nasal tip.

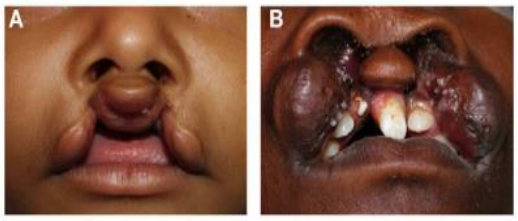

Figure 2: Bilateral cleft lip A) Incomplete type, B) Complete type

Unlike CLP, cleft palate (CP) is largely characterized by palatal muscle disorientation, which can cause speech, velopharyngeal insufficiency, and feeding challenges. A submucosal cleft to a whole cleft of the primary and secondary palate are within the spectrum. Compared to CLP, they are more likely to be syndromic.

Etiology

Genetics, environmental variables, and teratogens are some of the multiple causes [45]. One of the main components of CLP that has long been recognized is genetic susceptibility. According to research on monozygotic twins, 40–60% of orofacial clefts may be inherited [46]. However, variability, non-Mendelian inheritance patterns, and small sample sizes make it difficult to identify potential genes. The interferon regulatory factor 6 (IRF6) gene is the source of van der Woude syndrome, the most prevalent syndromic cause of cleft lip, and has been consistently linked to non-syndromic CLP in several investigations [47].

Numerous environmental elements have been examined through epidemiological research. Up to 30% more women who smoke have been shown to have CLP [48], and a dose-response effect has been repeatedly documented [49,50]. Exposure to secondhand smoke does not appear to raise risk [51]. Although binge drinking may increase risk, maternal alcohol use is a contentious topic [52].

Retinoids, phenytoin, and valproic acid are among the substances that have been implicated as potential teratogens [53]. Various chemical and occupational exposures, stress, obesity in mothers, oral hormone supplementation, ionizing radiation, and maternal infection are other risk factors that have been suggested [54].

Complications

Lack of a "shake-down cruise," during which pediatricians have not had enough time to accurately assess and diagnose the patient with other congenital anomalies, is blamed for the early mortality in the first few days of life of cleft lip patients, estimated to be 10-15% from reported literature [55,56]. But modern doctors usually follow the 10–10–10 rule, or in certain situations, they have the patient undergo pre-surgical orthopedics, which delays surgery until the patient is older. According to early research, the only major risks associated with primary lip repair are postoperative hemorrhage, lip repair collapse, and pneumonia (4.3%). Less common concerns include otitis media, diarrhea, partial suture line rupture, and moderate upper respiratory infections [57].

Goals of surgical repair

Multiple anatomical structures can be distorted, sometimes severely, complicating Cleft Lip Repair. Reconstruction difficulties might be as varied as cleft patient presentations. Every patient has a unique set of difficulties for the physician trying to close the gap. Nonetheless, treating the functional and aesthetic deformities of cleft lip is still the major objective of surgery. Repair of the underlying muscular structure for normal oral competence and function, primary repair of nasal deformity, and creation of an intact and appropriately sized upper lip to compensate for the loss of philtral height on the cleft side are all necessary to achieve this goal [58].

1.4 Down syndrome

Down syndrome was initially identified in 1866 by the English physician John Langdon Down, its connection to chromosome 21 was not proven until nearly a century later in Paris by Dr. Jerome Lejeune. The most prevalent

chromosomal anomaly in humans, Down syndrome, is caused by the presence of all or part of the third copy of chromosome 21[59].

Types of Down syndrome

Three varieties of Down syndrome exist. The outward characteristics and behaviours of each type are typically similar because of which people frequently cannot distinguish between them without looking at the chromosomes. Trisomy 21: Trisomy 21 affects approximately 95% of individuals with Down syndrome [60]. Instead of the normal two copies of chromosome 21, each cell in the body with this kind of Down syndrome has three copies [61].
Translocation Down syndrome make up just around 3% of the total population [60]. This happens when an additional portion or entire chromosome 21 is found, but it is joined to another chromosome or "trans-located" to another chromosome, without existing as a separate chromosome 21 [61].
Down syndrome mosaic: Approximately 2% of individuals with Down syndrome have mosaic Down syndrome [60]. Some of the cells in children with mosaic Down syndrome have three copies of chromosome 21, whereas other cells in the same child have the normal two copies. Down syndrome and children with mosaic Down syndrome have similar characteristics. They might, however, have fewer symptoms of the illness since some (or many) of the cells have normal number of chromosomes [61].

Causes and Risk Factors

As multiple systems are impacted by Down syndrome, various health disorders are linked to it. Numerous indications and symptoms are present in these people, including neurological traits, congenital heart defects, gastrointestinal (GI) abnormalities, abnormalities, distinctive facial features, and intellectual and developmental difficulties.

Congenital Cardiac Defects (CHD)

Among patients with Down syndrome, congenital heart abnormalities are by far the most prevalent and significant cause of morbidity and mortality, particularly during the first two years of life. Up to 50% of newborns with Down syndrome will have congenital heart disease (CHD). Atrioventricular septal defect (AVSD) is the most prevalent heart defect linked to Down syndrome; it accounts for up to 40% of all congenital cardiac problems in the condition [62]. According to reports, it is linked to a mutation in the non-Hsa21 CRELD1 gene [62].

Hematologic Disorders

The Down syndrome is linked to many haematological diseases. Haematological abnormalities in Down syndrome newborns (HANDS) include polycythemia, thrombocytopenia, and neutrophilia, which affect 80%, 66%, and 34% of babies with Down syndrome, respectively [63]. In Leukaemia, which accounts for 10% of paediatric acute myeloid leukaemia and 2% of paediatric acute lymphoblastic leukaemia, is ten times more common in patients with Down syndrome [64]. Mutations in the Janus Kinase 2 gene have been linked to acute lymphoblastic leukaemia in thirty percent of Down syndrome patients [65].

Neurologic Disorders

Reduced brain volume has been linked to trisomy of Hsa21, particularly in the cerebellum and hippocampal regions [66]. The defining characteristic of nearly all infants with Down syndrome is hypotonia. Hypotonia in Down syndrome patients results in joint laxity, which lowers gait stability and raises the energy needed for physical activity [67]. Due to their lack of physical activity, these individuals are more likely to have decreased bone mass and fractures [67], and their ligamentous laxity makes them more vulnerable to atlantoaxial subluxation [68]. people with Down syndrome have a greatly increased risk of getting early-onset Alzheimer disease; by the time they reach 60 years of age, 50% to 70% of people will have dementia [69].

Endocrinological Disorders

Thyroid gland dysfunction is most commonly associated with Down syndrome. Hypothyroidism can be congenital or acquired at any time during life [68]. About half of the patients with Down syndrome have been shown to have

subclinical hypothyroidism with elevated TSH and normal thyroxine levels [70]. Hyperthyroidism is much less frequent in patients with Down syndrome as compared to hypothyroidism, although the rate of it still exceeds the incidence of hyperthyroidism in the general pediatric population [71]. The insulin-like growth factor is also responsible for the delay in skeletal maturation and short stature in patients with Down syndrome [68].

Other Health Problems

Some of the more common health problems among children with Down syndrome are:

- Obstructive sleep apnea
- Ear infections
- Eye diseases
- Hearing loss
- Heart defects present at birth [72]

Screening Test

Screening tests include a combination of a blood test, which measures the amount of various substances in the mother's blood and an ultrasound, which creates a picture of the baby. During an ultrasound, the technician looks at is the fluid behind the baby's neck and an extra fluid in this region could indicate a genetic problem. These screening tests helps to determine the baby's risk of Down syndrome [61].

Diagnostic Tests

Diagnostic tests are usually performed in order to confirm a Down syndrome diagnosis. Types of diagnostic tests include:

- Chorionic villus sampling (CVS)- this test examines material from the placenta
- Amniocentesis- the amniotic fluid is examined
- PUBS- examines blood from the umbilical cord.

These tests look for any changes in the chromosomes that would indicate a Down syndrome diagnosis [61].

Treatment/Management

OT or Occupational Therapy: OT is enabling the youngster to carry out his or her routine on their own. OT includes teaching the kid fine motor skills for tasks like buttoning, turning pages, tearing, holding, folding, tying, and so on.

Physiotherapy (PT): Neck holding, rolling over, sitting, standing, and walking can all be achieved with the help of physiotherapy. This can be started when the muscles are strong enough to support the weight of the body, If attempted too soon, it causes aberrant gait, bending of the spinal column, and early joint deterioration. People with Down syndrome have flat feet. Walking requires the use of the medial arch in the sole.

Speech therapy (ST): Speech development is delayed due to weak oral muscles, a thick and short tongue, a tight oral cavity, and breathing issues. Exercises using the oral muscles, such as blowing, sucking, licking, and chewing etc.

Sensory integration (SI): SI focuses on arousing the senses of taste, touch, smell, hearing, and vision. Enhancement of these senses can be achieved through exposure to objects with colour, various frequencies of noises, tastes, textures, smells, and body motions. For coordinated and comprehensive care, it is crucial to assign these Down syndrome kids to a team that includes a developmental paediatrician, occupational therapist, and physiotherapist.

1.5 Prader Willi Syndrome

Prader Willi Syndrome was initially identified in 1956 [73] by Prader, Labhart, and Willi, is thought to be the most prevalent hereditary cause of obesity, with an incidence of 1:15,000 to 1:25,000 live births [74,75] Although reported prevalence rates differ between nations, both sexes seem to be equally impacted. The first human syndrome linked to genomic imprinting is Prader-Willi
syndrome (PWS) Short stature, hypotonia, hypogonadism, and mental retardation were among the symptoms of this disease that were first described [73]. When babies reach the age of two to four years old, their weak muscular tone and poor sucking, which contributed to their failure to thrive, give way to an increased hunger and food intake, which leads to obesity and its comorbidities. It is essential to receive an early diagnosis and start treatment to stop obesity and its related problems.

Symptoms of Prader-Willi syndrome

Typical symptoms of Prader-Willi syndrome include:

- An excessive appetite and overeating
- Restricted growth
- Hypotonia
- Learning difficulties
- Lack of sexual development
- Behavioural challenges, such as emotional outbursts and physical aggression [76].

Nutritional Phases in PWS

In the past, PWS was thought to have two clinical stages—failure to thrive, followed by hyperphagia and obesity—but more recent classification schemes based on natural history studies have suggested five main nutritional phases that are distinguished by the disorder's slow and intricate development. Growth hormone therapy started early in life may change how a person progresses through the nutritional stages.

•Phase 0: Growth restriction and reduced foetal mobility occur in utero.
•Phase 1: Birth to 15 months of age, hypotonic, non-obese infant
Subphase 1a: Feeding difficulties, either with or without growth failure
Subphase 1b: Consistent weight gain and growth of infants following a typical growth curve.
•Phase 2: Weight gain begins at around age 2
Subphase 2a: Gaining weight in the absence of hunger or calorie intake changes.
Subphase 2b: An increase in appetite leads to weight gain
•Phase 3: Hyperphagia, insufficient satiety, and food cravings (~8 years of age).
•Phase 4: The excessive appetite has subsided [77].

Causes

Prader-Willi syndrome is caused by genetic changes on an "unstable" region of chromosome 15 that affects the regulation of gene expression.
The genetic changes that cause Prader-Willi syndrome occur in a portion of the chromosome, around the time of conception or during early fetal development.[1] This region was identified in 1990 using genetic DNA probes. Although Prader-Willi syndrome is genetic, it usually is not inherited and generally develops due to deletions or partial deletions on chromosome 15 [78].

Specific changes to the chromosome can include the following:

Deletions. It is possible for a chromosome to lose or remove a section of it along with the functions it supported. A deletion in one area of the father's chromosome 15 causes multiple genes to stop functioning, which accounts for the majority of PWS instances. Because the genes of the corresponding mother on chromosome 15 are inactive all the time, they are unable to compensate for the deletion on the father's chromosome 15. Normally, appetite and fullness are fundamentally regulated by the absent paternal genes.

Maternal uniparental disomy: One pair of chromosomes from the mother and another set from the father typically make up a cell. A child typically has two copies of chromosome 15—one copy from each parent. The child has two copies of chromosome 15 from the mother and none from the father in about one-fourth of PWS cases. PWS is caused by the absence of active genes in the child's PWCR since these genes are typically inactive in the mother's chromosome [79].

An imprinting center defect. Mother-derived genes in the PWCR on chromosomes are typically inactivated because of a process called "imprinting" that determines whether or not the cell can "read" a gene. Prader-Willi syndrome results from inactive PWCRs on both of the child's copies of chromosome 15 [79].

Complications

PWS is associated with hyperphagia and obesity if access to food and weight is not adequately controlled. These include:

- Diabetes mellitus.
- Osteoporosis.
- Right-sided heart failure.
- Fatty liver.
- Hypoventilation.
- Obstructive sleep apnea and narrow airway.
- Stasis ulcers and cellulitis.

Pathophysiology

Metabolic Abnormalities

Growth hormone insufficiency has been linked to short height in PWS patients. Compared to typical obese children, growth hormone release in children with low serum levels of insulin, IGF-like growth factor (IGF)-1, and IGF-binding protein-1 is low.

Nutrition Assessment

Anthropometric Measures

Infants and young children with PWS typically have lower height measures, and between the ages of one and four, the pace of height gain tapers off. Plotting the standard weight, head circumference, and length or height data on the CDC growth curves is recommended. Skinfold measurements of the triceps and arm circumference are two more relevant metrics. Because of their small stature, people with PWS may have lower BMIs; nonetheless, tracking changes in BMI over time might help identify anomalous variations. Anthropometric measurements should be performed on a regular basis and should be reported to the parents or carer.

Dietary Intake

Nutritional consumption rises during the toddler years, weight growth may occur more quickly. This necessitates a meticulous evaluation of serving amounts, frequency of feeding, and food varieties. The child's interest in eating rises with age, and between the ages of five and twelve, they may exhibit challenging behaviours like tantrums and constant hunger.It has been suggested that a diet consisting of 25% protein, 50% carbohydrates, and 25% fat should be consumed.

Feeding Skills

During the first year of life, the infant with PWS frequently exhibits poor sucking and inadequate oral skills. Problems with swallowing and chewing are not common, though they could be related to the decreased muscular tone. An insatiable appetite and not receiving food are linked to behavioural feeding problems.

Intervention Strategies

Infancy

It is advised to provide appropriate nutrition in accordance with the guidelines set forth by the American Academy of Paediatrics (AAP) for nursing or formula feeding. In order to encourage sufficient weight gain, it might be required to concentrate the formula or breastmilk. The feeding intervention will help alleviate the hypotonic sucking issues. As the baby gets older, a concentrated formula is no longer required, and meals can be introduced once head control and trunk stability are attained, which is typically between the ages of 4 and 6 months.

Toddler and Preschool Age

Most kids start gaining too much weight between the ages of one and four. It is crucial to start the family and child on a regular nutritional programme and teach them that meals are served at set times. Early intervention for these children in the preschool years is highly crucial in helping with feeding disorders and intake control as they get older. Every month, measurements of height, weight, and nutrient consumption should be taken. If weight gain becomes severe, energy requirements should be modified. In addition, the IEP needs to promote physical exercise, and physical therapy treatments should be provided.

School Age

Working together with the school food service programme becomes crucial for the school-age child. Energy requirements are typically 50% to 75% of those of children who are not impacted and should be determined on the basis of their height.

Adulthood

It could be necessary to enrol in weight management programmes that offer a very low 6 to 8 kcal per centimetre of height. It is necessary to compute nutrient values and provide vitamin and mineral supplements, along with essential fatty acids (EFAs) if necessary.

It has also been suggested that a behaviour management strategy be used to carry out the physical activity and nutrition plans. MNT of PWS children and adults necessitates follow-up with numerous medical professionals and educational institutions [80].

1.6 Cerebral palsy

A collection of neurological conditions known as cerebral palsy (CP) first appear in infancy or early childhood and have a lifelong impact on motor coordination and bodily movement. Damage to or anomalies in the developing brain impair the brain's capacity to regulate movement, maintain posture, and maintain balance, which results in cerebral palsy (CP). Palsy is a term used to describe the loss or impairment of motor function, whereas cerebral refers to the brain [81].

Different Types of Cerebral Palsy

- Spastic CP: Increased muscle tone, persistent infant reflexes, increased deep tendon reflexes in one of three patterns: hemiplegia (arm and leg on one side of the body), diplegia (involving the lower extremities), and quadriplegia (all four extremities and may include the trunk, head, and neck)
- Dyskinetic CP: Abnormalities in muscle tone that affect the entire body
- Mixed CP: A condition in which both athetosis and spasticity are present
- Ataxic CP: Abnormalities of voluntary movement and balance such as unsteady gait
- Athetoid dyskinetic CP: Normal intelligence but difficulty walking, sitting, speaking clearly [80].

Risk Factors

Prenatal	Perinatal	Postnatal
Systemic Diseases During Pregnancy	Prematurity	Head Trauma Accidental/ Non-Accidental
Brain Abnormalities	CNS Infections, i.e. viral encephalitis Bacterial meningitis	CNS infections
Multiple Gestation Pregnancy	Stroke	Infections
Assisted Reproduction Technology	Hypoxic-Ischemic Insults	Stroke
Placenta Abnormalities, i.e. abruption	Prolonged Labor	Anoxic Insults

Source: Vova, J. Cerebral Palsy: An Overview of etiology, types and comorbidities [82]

Early signs

Delays in learning to roll over, sit, crawl, or walk are common in infants with cerebral palsy (CP). Hypotonia, or reduced muscular tone, can give them a laid-back, even floppy appearance. Their bodies may appear hard or stiff due to hypertonia, or increased muscular tone. Along with strange posture, children with cerebral palsy may also favour one side of their bodies when reaching, crawling, or moving.

Younger than 6 months of age:

- The head lags when you pick them up while they're lying on their back
- They feel stiff
- They feel floppy
- Their legs get stiff and cross or scissor when you pick them up

Older than 6 months of age:

- They don't roll over in either direction
- They cannot bring their hands together
- They have difficulty bringing their hands to their mouth
- They reach out with only one hand while keeping the other fisted

Older than 10 months of age:

- They crawl in a lopsided manner, pushing off with one hand and leg while dragging the opposite hand and leg
- They cannot stand even while holding on to support [81].

Anthropometric Measures

Children with cerebral palsy (CP) are frequently shorter than average children, and some may require standing or recumbent length boards for measuring their length as they get older, depending on the severity of their condition. Nevertheless, certain measuring tools are unsuitable for children with contractures who cannot extend their arms fully. When a person's arms are flexible, arm span as well as upper and lower leg length can be measured. Rather than utilising the disease-specific curves, the CDC advises using the CDC/WHO curves made for children who are not affected and graphing sequentially for signs of malnutrition. Weight measurements ought to be gathered gradually. Measures of the triceps skinfold and mid-upper arm circumference are advised as trustworthy methods to check for childhood fat reserves.

Biochemical Measures

When food intake is restricted and malnutrition is a risk, a complete blood count, including haemoglobin and hematocrit, should be performed even if no specific laboratory tests are recommended for the child with CP. Because bone fractures are a major concern for many people and children with spastic quadriplegia, an evaluation of bone mineral density may be necessary. Seizures may be treated with medications, many of which have issues with dietary interactions. It is advised to assess vitamin D, calcium, carnitine, and vitamin K levels.

Dietary Intake

Feeding techniques may limit the amount of food and liquids consumed; carers might not give enough food to meet dietary requirements. Depending on the type of CP, an individual's energy requirements change. According to studies, people with spastic quadriplegic CP had lower REE and TEE values than normal controls.

Intervention Strategies

Developing an intervention strategy that includes the parent as a member of the team, takes cultural differences into account, and acknowledges the significance of the feeding issue is most likely to be effective. Feeding issues are common in children with cerebral palsy (CP), and they are primarily caused by oral-motor, positional, and behavioural variables. The typical transition to solid foods occurs later than usual because babies have trouble swallowing and synchronising eating and chewing during their early years. All of this could result in restricted growth and insufficient intake. The team comprising the dietitian, nutritionist, occupational therapist, physical therapist, and speech therapist should assess the issue and collaborate in treatment planning for infants and kids with IEPs. These young children typically exhibit reflux from their stomachs. An IV feeding could [80].

2. CONCLUSION

Over the first part of the 20th century, people with developmental disabilities were primarily housed in institutions. Their education, health, and nutrition received scant attention. The Bill of Rights and Assistance for Developmental Disabilities Act was passed in 1963. Under this Act, university centres, protection and advocacy networks, state councils, and nationally significant projects were developed and run with the help of federal subsidies. The framework needed to help individuals with developmental disabilities lead fulfilling lives was made possible by this Act. The facilities that had been housing these people were either closed or shrunk in size. These people were receiving care at home, in schools, or in modest residential facilities by 1975. The person with developmental difficulties has been found to have multiple nutrition issues. The services provided by medical nutrition therapy (MNT) differ based on the physical or mental health issues of the patient. A licenced dietitian nutritionist's (RDN) position is crucial. Because there is a lot of untested scientific materials available on internet and through support groups for parents and carers. MNT should be offered in educational and career programmes in an interdisciplinary, family-centered, community-based, and culturally competent manner.

3. REFERENCES

1. MacLennan AH, Thompson SC, Gecz J. Cerebral palsy: causes, pathways, and the role of genetic variants. *Am J Obstet Gynecol*. 2015 Dec;213(6):779-88.
2. Kim YS, Leventhal BL, Koh YJ, Fombonne E, Laska E, Lim EC, Cheon KA, Kim SJ, Kim YK, Lee H, Song DH, Grinker RR (2011) Prevalence of autism spectrum disorders in a total population sample. *Am J Psychiatry* 168:904-912.
3. Elsabbagh M, Divan G, Koh YJ, Kim YS, Kauchali S, Marcín C, Montiel-Nava C, Patel V, Paula CS, Wang C, Yasamy MT, Fombonne E (2012) Global prevalence of autism and other pervasive developmental disorders. *Autism Res* 5:160-179.
4. Beygo J, Buiting K, Ramsden SC, Ellis R, Clayton-Smith J, Kanber D. Update of the EMQN/ACGS best practice guidelines for molecular analysis of Prader-Willi and Angelman syndromes. *Eur J Hum Genet*. 2019;27:1326-40.

5. Gardiner K, Herault Y, Lott IT, Antonarakis SE, Reeves RH, Dierssen M. Down syndrome: from understanding the neurobiology to therapy. *J Neurosci*. 2010 Nov 10;30(45):14943-5.
6. NCCMH NCCfMH. Attention deficit hyperactivity disorder: diagnosis and management of ADHD in children, young people and adults (CG 72). London: *National Institute for Health and Clinical Excellence*, 2008
7. Parker SE, Mai CT, Canfield MA, Rickard R, Wang Y, Meyer RE, et al. Updated national birth prevalence estimates for selected birth defects in the United States, 2004-2006. *Birth Defects Res A Clin Mol Teratol* (2010) 88(12):1008–16.
8. Wehby GL, Cassell CH. The impact of orofacial clefts on quality of life and healthcare use and costs. *Oral Dis* (2010) 16(1):3–10.doi:10.1111/j.1601-0825). 2009.01588.
9. Marcusson A, Akerlind I, Paulin G. Quality of life in adults with repaired complete cleft lip and palate. *Cleft Palate Carniofac J* (2001) 38(4):379–85. doi:10.1597/1545-1569(2001)038<0379:QOLIAW>2.0.CO;2.
10. Christensen K, Juel K, Herskind AM, Murray JC. Long term follow up study of survival associated with cleft lip and palate at birth. *BMJ* (2004) 328(7453):1405. doi:10.1136/bmj.38106.559120.7C.
11. Herman GE, Henninger N, Ratliff-Schaub K, Pastore M, Fitzgerald S, McBride KL (2007) Genetic testing in autism: how much is enough? *Genet Med* 9:268-274.
12. Miles JH (2011) Autism spectrum disorders--a genetics review. *Genet Med* 13:278-294.
13. Szatmari P, Jones MB, Zwaigenbaum L, MacLean JE (1998 Genetics of autism: overview and new directions. *J Autism Dev Disord* 28:351-368).
14. Chang J, Gilman SR, Chiang AH, Sanders SJ, Vitkup D (2015) Genotype to phenotype relationships in autism spectrum disorders. *Nat Neurosci* 18:191-198.
15. Clifford S, Dissanayake C, Bui QM, Huggins R, Taylor AK, Loesch DZ (2007) Autism spectrum phenotype in males and females with fragile X full mutation and premutation. *J Autism Dev Disord* 37:738-747.
16. Curatolo P, Bombardieri R (2008) Tuberous sclerosis. *Handb Clin Neurol* 87:129-151.
17. Manzi B, Loizzo AL, Giana G, Curatolo P (2008) Autism and metabolic diseases. *J Child Neurol* 23:307-314.
18. London EA, Etzel RA (2000) The environment as an etiologic factor in autism: a new direction for research. *Environ Health Perspect 108 Suppl* 3:401-404.
19. Kern JK, Jones AM (2006) Evidence of toxicity, oxidative stress, and neuronal insult in autism. *J Toxicol Environ Health B Crit Rev* 9:485-499.
20. Kolevzon A, Gross R, Reichenberg A (2007) Prenatal and perinatal risk factors for autism: a review and integration of findings. *Arch Pediatr Adolesc Med* 161:326-333.
21. Ashwood P, Van de Water J (2004) Is autism an autoimmune disease? *Autoimmun Rev* 3:557-562.
22. Davidson PW, Myers GJ, Weiss B (2004) Mercury exposure and child development outcomes. *Pediatrics* 113:1023-1029.
23. American Psychiatric Association (1980) Diagnostic and statistical manual of mental disorders. 3rd ed. *American Psychiatric Association, Arlington, VA*.
24. Fombonne, É. (2005). The changing epidemiology of autism. *Mental Handicap Research*, *18*(4), 281–294. https://doi.org/10.1111/j.1468-3148.2005.00266.x
25. Casanova MF, ed), pp 1-25. Nova Science Publishers Inc., New York, NY.
26. World Health Organization (2004) International statistical classification of diseases and related health problems. 10th ed. World Health Organization, Geneva.
27. Zwaigenbaum L, Bryson S, Rogers T, Roberts W, Brian J, Szatmari P (2005) Behavioral manifestations of autism in the first year of life. *Int J Dev Neurosci* 23:143-152.
28. Posey DJ, McDougle CJ (2001) Pharmacotherapeutic management of autism. *Expert Opin Pharmacother* 2:587- 600.
29. Adler BA, Wink LK, Early M, Shaffer R, Minshawi N, McDougle CJ, Erickson CA (2015) Drug-refractory aggression, self-injurious behavior, and severe tantrums in autism.
30. Stigler KA, McDonald BC, Anand A, Saykin AJ, Mc Dougle CJ (2011) Structural and functional magnetic resonance imaging of autism spectrum disorders. *Brain Res* 1380:146-161.
31. Kerbeshian J, Burd L, Avery K (2001) Pharmacotherapy of autism: A review and clinical approach. J Dev Phys. *Disabil*. 13:199-228.

32. Richards C, Oliver C, Nelson L, Moss J (2012) Self-injurious behaviour in individuals with autism spectrum disorder and intellectual disability. *J Intellect Disabil Res* 56:476-489.
33. Swanson JM, Sergeant JA, Taylor E, Sonuga-Barke EJ, Jensen PS and Cantwell DP. Attention-deficit hyperactivity disorder and hyperkinetic disorder. *Lancet* 1998;351:429–33
34. Goodman R, Ford T et al. Using the Strengths and Difficulties Questionnaire (SDQ) to screen for child psychiatric disorders in a community sample. *British Journal of Psychiatry* 2000;177: 534–9.
35. S Taylor E and Sonuga-Barke E. Disorders of attention and activity. In: Rutter M et al (eds) Rutter's Child and Adolescent Psychiatry. 4th edn. Oxford: Blackwell, 2008 pp. 521–43
36. Faraone SV, Biederman J, Mick E, Faraone SV, Biederman J and Mick E. The age-dependent decline of attention deficit hyperactivity disorder: a meta-analysis of follow-up studies. *Psychological Medicine* 2006;36:159–65.
37. Jensen PS, Arnold LE, Swanson JM et al. Three-year follow-up of the NIMH MTA study. *Journal of the American Academy of Child and Adolescent Psychiatry* 2007;46:989–1002.
38. Swanson JM, Elliott GR, Greenhill LL et al. Effects of stimulant medication on growth rates across three years in the MTA follow-up. *Journal of the American Academy of Child and Adolescent Psychiatry* 2007; 46:1015–27.
39. Molina BS, Hinshaw SP, Swanson JM et al. The MTA at eight years: prospective follow-up of children treated for combined-type ADHD in a multisite study. *Journal of the American Academy of Child and Adolescent Psychiatry* 2009; 48:484–500.
40. Cassell CH, Meyer R, Daniels J. Health care expenditure among Medicaid enrolled children with and without orofacial clefts in North Carolina, 1995- 2002. *Birth Defects Res A Clin Mol Teratol* (2008) 82(11):785–94. doi:10.1002/ bdra.20522
41. Dixon MJ, Marazita ML, Beaty TH, Murray JC. Cleft lip and palate: synthesizing genetic and environmental influences. *Nat Rev Genet* (2011) 12(3):167–78. doi:10.1038/nrg2933.
42. Harville EW, Wilcox AJ, Lie RT, Vindenes H, Abyholm F. Cleft lip and palate versus cleft lip only: are they distinct defects? *Am J Epidemiol* (2005) 162(5):448–53.
43. Flint PW, Cummings CW. Cummings Otolaryngology Head & Neck Surgery. Philadelphia, PA: *Mosby/Elsevier* (2010).
44. Millard DR, editor. Bilateral cleft anatomy. In: Cleft Craft: The Evolution of Its Surgery. Boston, MA: Little Brown (1980) p. 19–40.
45. Murray JC. Gene/environment causes of cleft lip and/or palate. *Clin Genet* (2002) 61(4):248–56. doi:10.1034/j.1399-0004.2002.610402.x
46. Grosen D, Bille C, Petersen I, Skytthe A, Hjelmborg JV, Pedersen JK, et al. Risk of oral clefts in twins. *Epidemiology* (2011) 22(3):313–9.
47. Zucchero TM, Cooper ME, Maher BS, Daack-Hirsch S, Nepomuceno B, Ribeiro L, et al. Interferon regulatory factor 6 (IRF6) gene variants and the risk of isolated cleft lip or palate. *N Engl J Med* (2004) 351(8):769–80.
48. Shi M, Wehby GL, Murray JC. Review on genetic variants and maternal smoking in the etiology of oral clefts and other birth defects. *Birth Defects Res C Embryo Today* (2008) 84(1):16–29.
49. Lieff S, Olshan AF, Werler M, Strauss RP, Smith J, Mitchell A. Maternal cigarette smoking during pregnancy and risk of oral clefts in newborns. *Am J Epidemiol* (1999) 150(7):683–94.)
50. Chung KC, Kowalski CP, Kim HM, Buchman SR. Maternal cigarette smoking during pregnancy and the risk of having a child with cleft lip/palate. *Plast. Reconstr. Surg.* (2000) 105(2):485–91.
51. Honein MA, Rasmussen SA, Reefhuis J, Romitti PA, Lammer EJ, Sun L, *et al*. Maternal smoking and environmental tobacco smoke exposure and the risk of orofacial clefts. *Epidemiology* (2007) 18(2):226–33
52. DeRoo LA,Wilcox AJ, Drevon CA, Lie RT. First-trimester maternal alcohol consumption and the risk of infant oral clefts in Norway: a population-based casecontrol study. *Am J Epidemiol* (2008) 168(6):638–46.
53. Jentink J, Loane MA, Dolk H, Barisic I, Garne E, Morris JK, et al. Valproic acid monotherapy in pregnancy and major congenital malformations. *N Engl J Med* (2010) 362(23):2185–93.
54. Leite IC, Paumgartten FJ, Koifman S. Chemical exposure during pregnancy and oral clefts in newborns. *Cad Saude Publica* (2002) 18(1):17–13.

55. Fogh-Anderson P. Incidence of cleft lip and palate: constant or increasing? *Acta Chir Scand* (1961) 122:106–11.
56. Ivy RH. Congenital anomalies; as recorded on birth certificates in the Division of Vital Statistics of the Pennsylvania Department of Health, for the period 1951-1955, inclusive. *Plast Reconstr Surg* (1946) (1957) 20(5):400–11
57. Wilhelmsen HR, Musgrave RH. Complications of cleft lip surgery. *Cleft Palate J* (1966) 3:223–31.
58. De La Pedraja J, Erbella J, McDonald WS, Thaller S. Approaches to cleft lip and palate repair. *J Craniofac Surg* (2000) 11(6):562–71.
59. Holmes G. Gastrointestinal disorders in Down syndrome. Gastroenterol Hepatol Bed Bench. 2014 *Winter*;7(1):6-8.
60. Shin M, Siffel C, Correa A. Survival of children with mosaic Down syndrome. *Am J Med Genet A.* 2010;152A:800-1
61. https://www.cdc.gov/ncbddd/birthdefects/downsyndrome.html#ref [18 November 2023]
62. Asim A, Kumar A, Muthuswamy S, Jain S, Agarwal S. "Down syndrome: an insight of the disease". *J Biomed Sci*. 2015 Jun 11;22(1):41.)
63. Henry E, Walker D, Wiedmeier SE, Christensen RD. Hematological abnormalities during the first week of life among neonates with Down syndrome: data from a multihospital healthcare system. Am *J Med Genet A*. 2007 Jan 01;143A (1):42-50.]In Hord JD, Gay JC, Whitlock JA. Thrombocytopenia in neonates with trisomy 21. *Arch Pediatr Adolesc Med*. 1995 Jul;149(7):824-5.]In [Miller M, Cosgriff JM. Hematological abnormalities in newborn infants with Down syndrome. *Am J Med Genet*. 1983 Oct;16(2):173-7.
64. Hasle H, Clemmensen IH, Mikkelsen M. Risks of leukaemia and solid tumours in individuals with Down's syndrome. *Lancet*. 2000 Jan 15;355(9199):165-9.].
65. Kearney L, Gonzalez De Castro D, Yeung J, Procter J, Horsley SW, Eguchi-Ishimae M, Bateman CM, Anderson K, Chaplin T, Young BD, Harrison CJ, Kempski H, So CW, Ford AM, Greaves M. Specific JAK2 mutation (JAK2R683) and multiple gene deletions in Down syndrome acute lymphoblastic leukemia. *Blood*. 2009 Jan 15;113(3):646-8.]
66. Wechsler J, Greene M, McDevitt MA, Anastasi J, Karp JE, Le Beau MM, Crispino JD. Acquired mutations in GATA1 in the megakaryoblastic leukemia of Down syndrome. *Nat Genet*. 2002 Sep;32(1):148-52.]
67. Agiovlasitis S, McCubbin JA, Yun J, Pavol MJ, Widrick JJ. Economy and preferred speed of walking in adults with and without Down syndrome. *Adapt Phys Activ Q*. 2009 Apr;26(2):118-30.].
68. Hawli Y, Nasrallah M, El-Hajj Fuleihan G. Endocrine and musculoskeletal abnormalities in patients with Down syndrome. *Nat Rev Endocrinol*. 2009 Jun;5(6):327-34.]
69. Janicki MP, Dalton AJ. Prevalence of dementia and impact on intellectual disability services. *Ment Retard*. 2000 Jun;38(3):276-88.]
70. Tüysüz B, Beker DB. Thyroid dysfunction in children with Down's syndrome. *Acta Paediatr*. 2001 Dec;90(12):1389-93.
71. Lavard L, Ranløv I, Perrild H, Andersen O, Jacobsen BB. Incidence of juvenile thyrotoxicosis in Denmark, 1982-1988. A nationwide study. *Eur J Endocrinol*. 1994 Jun;130(6):565-8.
72. Bull MJ, the Committee on Genetics. Health supervision for children with Down syndrome. *Pediatrics.* 2011;128:393-406
73. Prader A, Labhart A, Willi H. Ein syndrome von adipositas, kleinwuchs, kryptorchismus und oligophrenie nach myotonierartigem zustand im neugeborenenalter. *Schweiz Med Wochen.* 1956;**86**:1260–1261.
74. Vogels A, Van Den Ende J, Keymolen K, Mortier G, Devriendt K, Legius E, Fryns JP. Minimum prevalence, birth incidence and cause of death for Prader-Willi syndrome in Flanders. *Eur J Hum Genet.* 2004;**12**(3):238–240. doi: 10.1038/sj.ejhg.5201135.
75. Whittington JE, Holland AJ, Webb T, Butler J, Clarke D, Boer H. Population prevalence and estimated birth incidence and mortality rate for people with Prader-Willi syndrome in one UK Health region. *J Med Genet.* 2001;**38**(11):792–798. doi: 10.1136/jmg.38.11.792].
76. https://www.nhs.uk/conditions/prader-willi-syndrome/[24 November 2023]
77. Miller JL, Lynn CH, Driscoll DC, et al. Nutritional phases in Prader-Willi syndrome. *Am J Med Genet*. 2011; 155A: 1040-9.
78. https://www.nichd.nih.gov/health/topics/prader-willi/conditioninfo/causes [2 December 2023]

79. Prader-Willi Syndrome Association. (2016). The genetics of Prader-Willi syndrome: An explanation for the rest of us. Retrieved May 16, 2018, from https://www.pwcf.org/wp-content/uploads/2015/10/Genetic-of-PWS-Explanation-for-rest-of-us-20041.pdf

80. *Krause's Food and the nutrition care process* (14th ed.). (2 B.C.E.). *ELSEVIER.*

81. https://www.ninds.nih.gov/health-information/disorders/cerebral-palsy [3 December 2023]

82. Vova, J. (2022). Cerebral Palsy: An Overview of etiology, types and comorbidities. *OBM Neurobiology*, *6*(2), https://doi.org/10.21926/obm.neurobiol.2202120)

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