بسم الله الرحمن الرحيم

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SHORT STATURE

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The world's tallest man, Sultan Kosen (R) standing at 8 ft 1 in (246.5 cm) poses with shortest man in the world He Pingping standing at 2 ft 5.37 in (74.61 cm) during celebrate the launch of the Guinness World Records live roadshow in Istanbul, on January 14, 2010. Kosen, 27, was awarded the title of the world's tallest man last September, surpassing China's Bao Xishun who stood in at a mere 7-foot-9. Kosen also holds the records for the world's largest hands and feet. Turkey January 2009
Definition

Height below 5th percentile
Height below 3d percentile
More than 2 SDs below the mean.
Below -2.25 SD
Approximately 3% children in any population will be short

Growth Velocity
Growth Velocity

• A single point on a growth chart often does not define a worrisome growth pattern.
• Previous growth data should be plotted whenever available.
• Any suggestion of growth deceleration should be reviewed.
• Standard growth charts do not incorporate pubertal stage.
VELOCITY CHARTS

The danger line is 25th and NOT 3rd percentile

25th centile

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Causes of Short Stature

Normal:

- Constitutional growth delay
- Genetic/familial short stature
- Combined constitutional growth delay and familial short stature
Pathological:

Nutritional

Micronutrient deficiency
  Zinc deficiency
  Iron deficiency

Macronutrient deficiency: decreased intake
  Hypocaloric diet
  Kwashiorkor
  Anorexia nervosa and other eating disorders
  Nutritional dwarfing (fear of obesity, fear of hypercholesterolemia)

Macronutrient deficiency: decreased absorption
  Inflammatory bowel disease
  Celiac disease
  Cystic fibrosis
  Malabsorption
Endocrine

- Hypothyroidism
- Isolated GH deficiency
- Neurosecretory GH deficiency
- GH insensitivity (primary insulin-like growth factor deficiency)
- Hypopituitarism
- Cushing’s syndrome
- Precocious puberty
Chromosome defects

- Turner syndrome
- Noonan Syndrome
- Down syndrome
- Prader–Willi syndrome
IUGR

- Sporadic

- Characteristic appearance
  - Russell–Silver syndrome
Defects in bone Development

- Achondroplasia, hypochondroplasia
- Other skeletal disorders

Metabolic

- Mucopolysaccharidoses
- Other storage disorders
Chronic diseases

- Chronic renal disease

- Chronic liver disease

- Congenital heart disease (especially cyanotic conditions)

- Pulmonary (cystic fibrosis, bronchial asthma)

- Poorly controlled diabetes mellitus

- Chronic infections (including human HIV, tuberculosis) associated with birth defects or mental retardation
Psychosocial Deprivation

Chronic drug intake:

- Glucocorticoids
- Estrogens or androgens
Another classification of the etiologies of short stature (IS NICE)

- Idiopathic (constitutional), intrauterine (TORCH, fetal Alcohol syndrome)
- Skeletal causes (dysplasia), spinal defect (scoliosis, kyphosis)
- Nutritional (malabsorption)
- Iatrogenic (steroids, radiation)
- Chronic diseases (CRF, congenital heart dis., IBD)
- Endocrine (growth hormone deficiency, hypothyroidism, Cushing’s syndrome)
Assessment of body proportion

→ Upper segment: Lower segment ratio
  Increase: rickets, achondroplasia, untreated hypothyroidism
  Decrease: spondyloepiphyseal dysplasia, vertebral anomalies

→ Comparison of arm span with height
Body Proportions

- The upper to lower body ratio starts at 1.7 at birth, but as the legs grow, the ratio drops to 1.0 by 10 years of age.
- If the growth plates fuse early, as in precocious puberty, the proportions remain childlike, with short limbs compared to the trunk.
- On the other hand, if growth is prolonged as in hypogonadism, a long-limbed shape results.
Body proportion

The lower body segment is measured by measuring the distance between the upper border of the symphysis pubis and the floor in a patient who is standing. Preferably, the sitting height can be measured to represent the upper segment. The trunk may be disproportionately shorter due to scoliosis, or spinal injury from total body irradiation.
Body proportion

Arm span is another helpful measurement in determining body proportions. The distance between the distal ends of both middle phalanges is measured to determine the arm span.

Normally, the arm span is shorter than the height in boys before age 10 to 11 years and girls before 11 to 14 years, after which the arm span exceeds the height.
PROPORTION CHARTS

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**DIAGNOSIS**

- Detailed history
- Careful examination
- Laboratory evaluation
<table>
<thead>
<tr>
<th>History</th>
<th>Etiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>History of delay of puberty in parents</td>
<td>Constitutional delay of growth</td>
</tr>
<tr>
<td>Low Birth Weight</td>
<td>SGA</td>
</tr>
<tr>
<td>Neonatal hypoglycemia, jaundice, micropenis</td>
<td>GH deficiency</td>
</tr>
<tr>
<td>Dietary intake</td>
<td>Under nutrition</td>
</tr>
<tr>
<td>Headache, vomiting, visual problem</td>
<td>Pituitary/hypothalamic SOL</td>
</tr>
<tr>
<td>Lethargy, constipation, weight gain</td>
<td>Hypothyroidism</td>
</tr>
<tr>
<td>Polyuria</td>
<td>CRF, RTA</td>
</tr>
<tr>
<td>Social history</td>
<td>Psychosocial dwarfism</td>
</tr>
<tr>
<td>Diarrhea, greasy stools</td>
<td>Malabsorption</td>
</tr>
</tbody>
</table>
## Clues to Etiology from Examination

<table>
<thead>
<tr>
<th>Examination finding</th>
<th>Etiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disproportion</td>
<td>Skeletal dysplasia, rickets, hypothyroidism</td>
</tr>
<tr>
<td>Dysmorphism</td>
<td>Congenital syndromes</td>
</tr>
<tr>
<td>Hypertension</td>
<td>CRF</td>
</tr>
<tr>
<td>Goitre, coarse skin</td>
<td>Hypothyroidism</td>
</tr>
<tr>
<td>Central obesity, striae</td>
<td>Cushing syndrome</td>
</tr>
</tbody>
</table>
mid-parental target height (in cm):

**For males:**
(Mother + father height + 13 cm) divided by 2

**For females:**
Mother + father height - 13 )divided by 2
Skeletal Maturation and Predicted Final Height

1-Bayley and Pinneau method.

bone age
Height
This correlation is more accurate after nine years of age.

2-The Tanner–Whitehouse (TW) method

bone age
height
parental heights
in girls, the occurrence of menarche.
INVESTIGATIONS
General Screening

- TSH
- general chemistries including BUN, creatinine
- liver function tests
- urinalysis
- complete blood count with differential
- blood gas
- sedimentation rate and C-reactive protein
- tissue transglutaminase antibody or antiendomyseal antibody
- sweat testing for cystic fibrosis
- karyotype in girls
- bone age
Endocrine

- Thyroid function tests.
- ACTH and cortisol level in blood and urine when adrenal disease is suspected.
- Examination of the eye grounds and visual fields
- MRI scan if hypopituitarism is suspected.
Management of short stature

- Treatment of the cause
  - GH
  - IGF1
  - GH+IGF1
  - Combined IGF1+IGFBP3
  - GnRHa (+GH)
  - GH+ Aromatase inhibitor
  - Tamoxifen
Testosterone may be given to improve the psychological problem resulted from delayed puberty.

Oxandrolone is a nonaromatized androgen can be given instead to enhance the growth and to stimulate puberty.
FAMILIAL SHORT STATURE

(Genetic Short Stature)
The child is growing at a normal rate below the 3rd percentile.
One or the two parents are short.
Tend to have puberty at a normal age and to achieve an adult height within 2–3 inches of their adult target height.
Growth rate decreases between 6 and 18 months of age, and then follows a steady line below the fifth percentile after two to three years of age.
PATHOLOGICAL (SYNDROMIC) SHORT STATURE

- with a growth velocity of less than 4.5 cm/yr after age five years and/or marked short stature.
- Bone maturation is usually quite delayed, often behind that expected for height.
- Pathological short stature accounted for over one-third of the short patients referred to a pediatric endocrinology center.
TURNER SYNDROME

Girls with Turner syndrome have sex chromosome abnormalities, either pure 45 X, 46 XX with a variety of X chromosome abnormalities, or mosaicism.

Short stature is the most frequently occurring physical finding, so many patients can present without the other classic dysmorphic features of the syndrome.

Turner patients are responsive to GHrh treatment, with final outcomes better the earlier GHrh treatment is initiated.
TURNER SYNDROME

- Short stature
- Characteristic facial features
- Fold of skin
- Constriction of aorta
- Poor breast development
- Elbow deformity
- Rudimentary ovaries
- Gonadal streak (underdeveloped gonadal structures)
- Brown spots (nevi)
- No menstruation

- Low hairline
- Shield-shaped thorax
- Widely spaced nipples
- Shortened metacarpal IV
- Small fingernails
Turner Syndrome Growth Chart

Height in Inches vs. Age in Years
Growth Chart for Turner Syndrome compared to normal female growth
Prader Willi Syndrome

- PWS is caused by loss of expression of paternally inherited imprinted genes on chromosome 15q11-q13.

- Many of its features—growth failure, hyperphagia and obesity, temperature instability, hypogonadotrophic hypogonadism- have implicated a hypothalamic defect as the primary pathogenic mechanism.

- Growth hormone can be given in selected cases.
Skeletal Dysplasia

Because some bones grow better than others, growth-promoting therapies may exacerbate the body disproportion in these cases.
Russell–Silver syndrome

- clinodactyly of the fifth finger
- small triangular facies
- Cafe-au-lait spots
Laron dwarfism

- a syndrome of primary IGF-I deficiency.
- caused by GH insensitivity due to mutations in the GH receptor.
- usually have a birth length that is 10% to 30% less than normal.
GROWTH HORMONE DEFICIENCY
(GHD)
CAUSES OF GHD

Genetic (GH or GHRH gene),

Anatomic or congenital [midline cranial defects, septo-optic dysplasia, vascular malformations]

Acquired Tumors (craniopharyngioma, glioma, germinoma)
  Histiocytosis
  Irradiation or chemotherapy for malignancies
  Traumatic brain injury
  CNS infection or irradiation
  Surgical damage to the pituitary and hypothalamus
Idiopathic GHD (usually occurs sporadically but may be familial)
Manifestations

- Prolonged Jaundice,
- Hypoglycemia
- Frontal Bossing, Immature Facies,
- Poor Development Of The Nasal Bridge,
- Delayed Dentition,
- High-pitched Voice
- Delayed Closure Of The Anterior Fontanel
- Micropenis.
- Delayed Puberty
Substances used in growth hormone stimulating tests

1. Insulin
2. Clonidine
3. Arginine
4. Levo dopa
5. Glucagon
IDIOPATHIC SHORT STATURE

Criteria for Diagnosis of ISS

- Height more than 2.0 SDS below the mean
- Normal size for gestational age at birth
- Normal body proportions
- No evidence of chronic organic disease
- No psychiatric disease or severe emotional disturbance
- Normal food intake
- No evidence of endocrine deficiency
Noonan S

- Delayed puberty
- Down-slanting or wide-set eyes
- Low-set or abnormally shaped ears
- Mild mental retardation
- Short Stature
- Small penis
- Undescended testicles
- Unusual chest shape (pectus excavatum)
- Webbed and short-appearing neck
FDA approved GH Treatment

1. Growth hormone deficiency
2. Turner syndrome,
3. End-stage renal failure before kidney transplantation
4. Prader-Willi syndrome
5. Idiopathic short stature.
6. Noonan Syndrome
7. Adult with growth hormone deficiency
How Is GH Given?

Subcutaneous daily GH administration is currently preferred, with the average GHD child in the United States receiving initial treatment with 0.3 mg/kg/wk divided into six to seven doses.
ADVERSE EFFECTS OF hGH TREATMENT

- Growth hormone treatment does not increase the risk for recurrence of brain tumors or leukemia
- slipped capital femoral epiphysis
- pseudotumor cerebri
- worsening of scoliosis
- gynecomastia
- increase in total body water during the first 2 wk of treatment
- DM
Thank you