the way children grow

A guide for parents
Introduction

Watching a child grow from the moment of birth through his teen years—and beyond—is a special experience and one of the great joys of parenthood. Despite its many complexities, the way children grow actually remains quite steady and predictable. Just as each child is a unique individual, his or her rate of growth is unique as well, with a wide range of normal growth patterns. Occasionally, though, children may have growth problems.

This booklet has been developed to help you understand what takes place during these important growing years. It may also help you recognize the possibility that your child might be experiencing a growth problem. And finally, it will explain the various things you and your healthcare professional can do together to help your child grow.
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Likewise, a baby’s measurements can also alert the healthcare team to the possibility of a problem. Infancy is a time of incredible changes. Most babies grow an astonishing 7 to 10 inches during their first 12 months and reach their first birthday usually having tripled their birth weight. But don’t worry, children do not continue at this rapid pace. Their rate of growth does begin to slow down after the age of 1 and becomes more steady.
Growing Steadily

Between a child’s first and second birthdays, another growth spurt takes place. At this stage both boys and girls usually stand as tall as one another.

After the age of 2, however, a child’s growth becomes fairly stable. From this point forward, and up until puberty, each year should bring with it an average 2 1/2 inches of growth and a weight gain of approximately 5 to 7 pounds.

Of course, no one grows at an absolutely stable rate, so over the years there will be growth spurts that intermingle with periods of slower growth. And, there are seasonal variations too.

To help children maintain good health and a regular rate of growth, it is necessary for them to eat healthful, nutritious foods, get enough sleep, and exercise on a regular basis.

The normal growth charts—the ones pediatricians use to plot your child’s growth—on pages 12 and 13 can give you a guideline of average heights and weights for children and young adults 2 to 20 years of age.

Reaching Puberty

After years of relatively stable, predictable growth, a new set of physical changes is preparing to take place. Somewhere between the ages of 8 and 13 in girls, and 9 and 14 in boys, a child’s body begins to show signs of sexual development and maturation. Known as puberty, it marks the important transition from childhood to adolescence.

During this time children also experience rapid growth that ultimately ends when their final adult height has been reached. In girls, this rapid growth usually takes place anywhere between 9.5 and 14 years of age. The period of most rapid growth for boys takes place between the years of 12 and 15—on average, about two years later than girls.

It is interesting to note that in both boys and girls, growth comes to a stop because the hormones produced during puberty cause the ends of the bones or “growth plates” to fuse. This means the bones can no longer grow in length but increase in density (thickness) only.
Keeping Track of Your Child’s Growth

Throughout the critical stages of your child’s development, you may wonder if his or her height is normal. That’s why your pediatrician keeps a close watch over your child’s height and weight at each visit. Recording these numbers on a chart helps your doctor compare your child’s measurements to those of other children the same age. These numbers tell your doctor if your child’s rate of growth is appropriate or if there could be a problem.

Several charts are used to do this. The one on page 11, compiled by Columbia University using data from the Centers for Disease Control and Prevention (CDC), gives the average ranges of weight and height according to age. It’s important to remember that children come in all kinds of shapes and sizes. Being outside this range does not necessarily mean anything is wrong. It just means your child may not fall within these numbers at this particular time.

Ranges of Normal Growth in Children—Ages 1–18

<table>
<thead>
<tr>
<th>Age</th>
<th>Height–Females</th>
<th>Height–Males</th>
<th>Weight–Females</th>
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<tr>
<td>1</td>
<td>27 to 31 inches</td>
<td>28 to 32 inches</td>
<td>15 to 20 pounds</td>
<td>17 to 21 pounds</td>
</tr>
<tr>
<td>2</td>
<td>31.5 to 36 inches</td>
<td>32 to 37 inches</td>
<td>22 to 32 pounds</td>
<td>24 to 34 pounds</td>
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<tr>
<td>3</td>
<td>34.5 to 40 inches</td>
<td>35.5 to 40.5 inches</td>
<td>26 to 38 pounds</td>
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<tr>
<td>4</td>
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<td>37.5 to 43 inches</td>
<td>28 to 44 pounds</td>
<td>30 to 44 pounds</td>
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<tr>
<td>5</td>
<td>42 to 49 inches</td>
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<td>6</td>
<td>47 to 54 inches</td>
<td>47 to 54 inches</td>
<td>44 to 80 pounds</td>
<td>46 to 78 pounds</td>
</tr>
<tr>
<td>7</td>
<td>50 to 59 inches</td>
<td>50.5 to 59 inches</td>
<td>54 to 106 pounds</td>
<td>54 to 102 pounds</td>
</tr>
<tr>
<td>8</td>
<td>55 to 64 inches</td>
<td>54 to 63.5 inches</td>
<td>68 to 136 pounds</td>
<td>66 to 130 pounds</td>
</tr>
<tr>
<td>9</td>
<td>59 to 67.5 inches</td>
<td>59 to 69.5 inches</td>
<td>84 to 160 pounds</td>
<td>84 to 160 pounds</td>
</tr>
<tr>
<td>10</td>
<td>60 to 68 inches</td>
<td>63 to 73 inches</td>
<td>94 to 172 pounds</td>
<td>104 to 186 pounds</td>
</tr>
<tr>
<td>11</td>
<td>60 to 68.5 inches</td>
<td>65 to 74 inches</td>
<td>100 to 178 pounds</td>
<td>116 to 202 pounds</td>
</tr>
</tbody>
</table>

Your doctor uses two other tools to check your child’s height: a growth chart for girls and a growth chart for boys. Measurements are taken to show the height and weight of a child based on his or her age and compared to other children of the same age and gender. They are graphed on a special grid. Often, doctors will continue to take these measurements and put them on the graph until a child turns 20. Doctors read them as percentiles of average. For instance, if your child is in the 60th percentile, that means 40% of the children are taller and 60% are shorter. Both charts are shown on the next 2 pages.
Source: Height and weight charts developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000), all part of the Centers for Disease Control and Prevention (CDC).
Could My Child Have a Growth Problem?

What Is Growth Hormone Deficiency (GHD)?

Growth Hormone Deficiency (GHD) occurs when a child’s body does not produce enough of a hormone called somatropin, also known as growth hormone. When this happens, a child’s growth begins to slow down.

At this point, it might help to talk a little bit about the parts of the body involved in the growth process. In order for a child to grow properly, an important gland called the pituitary must release enough growth hormone.

Because the pituitary gland controls many other important hormones within the body, it is also known as the master gland. It sits at the base of the brain right in the middle of the skull, right under the hypothalamus. The hypothalamus is in charge of body functions that we have no control over, such as body temperature and the release of hormones.

There are two regions in the pituitary gland: the front section, called the anterior lobe, and the back section, called the posterior lobe. The hypothalamus commands both lobes of the pituitary and tells them when to release their hormones.

Many factors influence the release of growth hormone from the pituitary gland in a child. For example, these may include:

- Nutrition
- Sleep
- Exercise
- High levels of physical and mental stress
- Types of prescription medications taken
- Amounts of other hormones produced in the body, such as antidiuretic hormone, vasopressin, growth hormone-releasing peptide
- Amount of blood sugar released after eating
- Elevated levels of insulin-like growth factor-1 (IGF-1)
Signs and Symptoms of Growth Hormone Deficiency

The first and most noticeable symptom—and the one that causes most parents to seek a doctor’s help—is slow growth (less than 2 inches per year) or no growth. Other symptoms can also include:

• An immature face—making the child look younger than he or she actually is, especially when compared to peers
• A history of low blood sugar as an infant

Keep in mind that each and every child experiences his or her symptoms differently. And it should be stressed that a child’s intelligence is not affected by having a growth hormone deficiency. However, being small for one’s age can cause social and psychological issues. These are discussed on pages 18 and 19.

Causes of Growth Hormone Deficiency

When describing the causes of growth hormone deficiency, there are two important terms that are used: congenital and acquired.

Congenital means something that is present at birth. The child is born with the disorder. This can be due to a genetic abnormality that involved the formation of the pituitary gland, which is responsible for producing growth hormone.

Acquired means the disorder develops later in life. The child was not born with it. There are a variety of reasons for this. Risk factors can include:

• A pituitary gland or hypothalamus tumor
• Damage to the pituitary gland or hypothalamus from radiation treatment around the head or neck
• Trauma to the head that caused brain damage
• Meningitis (an infection of the central nervous system)

Occasionally, doctors cannot find any reason for a child’s growth hormone deficiency. The cause seems truly to be unknown. When that happens, the growth problem is referred to as idiopathic.
Chapter 2

Social and Psychological Considerations

At School…
Each year, 4% to 5% of normal-statured school children have academic problems. Studies have shown that this rate quadruples in children who have growth problems. As many as 18% to 20% may not be achieving their full potential in spelling, reading, or arithmetic. In addition, others have problems with social skills that can include attention deficits, shyness, and a deliberate withdrawal from friends and classmates.

One reason for these problems is the fact that throughout our lives, we are all judged on our appearance—which includes height. But for children who are shorter than their peers, this judgment is often more severe. If they are perceived as younger because they are smaller, they will be treated that way. This only serves to encourage and reinforce immature behavior in the child. Eventually it interferes with his or her ability to develop mature social skills. The child’s internal thinking might go something like this: “If they only see me as six, then I’ll act like I’m six.”

These issues can be traumatic for any child, but are worse for those who may see themselves as being different in the first place. Parents need to watch out for, and be especially sensitive to, the physical and psychological problems that can be caused by these interactions and seek help from professionals when needed. One of the important things you can do is to stay in touch with your child’s teachers about his or her academic and social progress so problems can be taken care of quickly, before they become serious.

At Home…
Home should be the one place where your child feels secure and loved. Because a short-statured child can quickly develop low self-esteem and a lack of confidence, it becomes very important for parents—a child’s biggest fans—to bolster his or her self-image.

You can start by praising and encouraging your child at every opportunity. Try not to be overly negative, critical, or sarcastic. Your child has many strengths. Discover them together. With encouragement, you can make each one stronger.

Perhaps your child feels he or she needs to be taller in order to participate in certain sports. Let them know there are other sports where height does not matter and their participation would be greatly welcomed. Swimming, tennis, or track may be the answer.

Encourage your child’s creative gifts. Art, music, and writing have nothing to do with being short or tall. Offer praise and support when your child does something good for himself, herself, or others. All of these things contribute to a self-esteem that is strong enough to get past the hurt of rejection or feelings of being different. They can only help put your child on the path to a happy and successful adult life.

And finally, never be afraid to seek professional help, counseling, and support, should it be needed.
Chapter 3

Diagnosing Pediatric Growth Hormone Deficiency

Referral to a Pediatric Endocrinologist

If your child appears to have a growth problem, your pediatrician may refer you to a pediatric endocrinologist. A pediatric endocrinologist is a doctor who specializes in diagnosing, treating, and managing disorders that are related to hormones and the glands that make them, as well as the effects they can have on the body. Many years of special training make a pediatric endocrinologist able to deal with hormone disorders through every stage of childhood up through, and including, the teen years.

As mentioned earlier, the hormone problems that affect growth have a significant impact on the physical and emotional well-being of a child. Pediatric endocrinologists are particularly sensitive to these feelings. They offer much-needed support, and what’s more, they surround themselves with other support people as well—psychologists, nurses, nutritionists, and disease educators.

Patient History

As you begin the important relationship with your child’s pediatric endocrinologist, you can expect a number of things to take place. First, a comprehensive patient history will be taken. That means a lot of questions.

Birth history…

Was the pregnancy normal? Did it go full term? How was the child delivered? What was the child’s birth weight and birth length? Were there any complications?

Medical history…

Have there been any major illnesses? Has the child ever been hospitalized? Are there any current problems? Does he or she take any prescription medications?

Family history…

A comprehensive medical history of the mother, father, and siblings will be recorded. Has anyone had any significant health problems? If so, what kinds of health problems? The height of both parents will be measured so the doctor can estimate the height your child may achieve as an adult.

All of this information may sound a bit overwhelming and does make for a long visit, but it provides the pediatric endocrinologist with a greater insight into your child’s growth problem.

The hormone problems that affect growth have a significant impact on the physical and emotional well-being of a child.
Physical Evaluation
After a complete history, your child will be given a thorough medical examination that usually includes the following:

An examination...
As part of an extensive physical exam, the endocrinologist will check your child from head to toe, including such important organs as the heart and lungs. Other parts of the body that can yield critical information will be checked as well.

Laboratory evaluation...
This may include a number of blood tests that help rule out the presence of other illnesses. To find out if the pituitary gland is functioning normally or not, growth hormone will be measured along with associated binding protein levels (IGF-1).

Bone age X-rays...
An X-ray of the left hand and wrist may be taken. The bone images that are produced will help determine the maturity of the bone and growth potential.

Stimulation (STIM) test...
The growth hormone stimulation test is a very important way for the pediatric endocrinologist to find out if your child’s body is producing enough growth hormone. During the test, the doctor or nurse will give your child a substance or substances that should increase growth hormone. Then, a small amount of blood is taken at timed intervals to determine whether the pituitary is producing a sufficient amount of growth hormone. If the stimulation test shows the pituitary is not producing enough growth hormone to make your child grow properly, then your healthcare team is one step closer to the diagnosis of growth hormone deficiency.
And, in case you’re wondering…the growth hormone used in treatment is manufactured using biotechnology. This process yields a product nearly identical with the growth hormone produced by the pituitary gland. GH is delivered subcutaneously via injection. When used at properly prescribed doses, the side effects are usually mild and are most often associated with pain and redness at the site where the injection was given. Of course, as with any prescription medication, your doctor will do a complete evaluation of your child’s health, discuss the benefits and risks of treatment with you, and determine the best course of treatment. Remember, this information is intended to better educate patients and caregivers. It is not intended to be a complete disclosure of all possible side effects. Growth hormone therapy must always be taken according to your doctor’s directions. If you think your child might be experiencing a reaction, call your doctor immediately.

What Kinds of Therapy Are Available for My Child?

There are many brands of growth hormones available on the market today. Some examples include:

- Saizen® [somatropin (rDNA origin) for injection]
- Humatrope® [somatropin (rDNA origin) for injection]
- Nutropin® [somatropin (rDNA origin) for injection]
- Genotropin® [somatropin (rDNA origin) for injection]
- Norditropin® [somatropin (rDNA origin) for injection]
- Tev-Tropin® [somatropin (rDNA origin) for injection]
- Omnitrope® [somatropin (rDNA origin) for injection]

After discussing therapy options with you and your family, your doctor will determine which therapy is best suited for your child.

See Saizen® full Prescribing Information enclosed in back pocket.
How Is Growth Hormone Administered?

Growth hormone must be given by injection. The injection is subcutaneous, which means the medication is delivered into the fatty tissue that lies just below the skin. Growth hormone can either be given by needle injection, or by a special injection device that does not use a needle.

As a general rule, most injections are given in the arms, legs, abdomen, or buttocks. Your doctor will explain the best injection sites for your child.

Most growth hormone treatments come with their own injection devices to help make the injections as easy as possible. The chart on pages 28–29 shows the current devices available for each brand of growth hormone therapy. You may want to review them with your doctor and choose the one that best meets the needs of you and your child.

Growth Hormone Therapy Is Often Long-term

Just as a child takes a number of years to naturally attain his or her adult height, treatment may be recommended for several years. Growth hormone treatment can also continue into and past puberty. It is more than likely your child will take growth hormone until:

- Full adult height has been achieved
- Bone maturation has occurred
- Growth rate has slowed to less than 2 cm per year

Some patients may require longer-term treatment depending on their medical condition.

During treatment, your child will continue to have routine visits with the pediatric endocrinologist several times a year. Blood testing may be recommended occasionally to monitor such things as thyroid function, adrenal function, and indicators of bone and insulin level. An X-ray of the child’s hand to assess bone age may be done annually. Your doctor will determine the best follow-up plan for your child.

Growth hormone therapy requires a long-term commitment, and this can be especially difficult for a child. It is perfectly understandable that there may be times when your child/teen wants to discontinue treatment. During these times you should offer all the encouragement you can. Find out what’s driving your child. Why does he or she want to stop treatment? Could it be the injections? Is it a combination of factors? Help your child see the many benefits treatment is providing. Let them know they have more growing to do and the growth hormone will help them do that. It may also be helpful for you and/or your child to discuss these feelings with the healthcare team. Together, you may be able to find an easier way.

Growth hormone can be given either by needle injection or by a special injection device that does not use a needle.
Chapter 5

Available Devices

Once your child has been diagnosed with growth hormone deficiency, you will probably want to consider treatment and injection device options. The charts below will assist you. Each injection device is listed by category along with the growth hormone it was designed to deliver. There are 3 categories shown here:

• Electronic
• Pens
• Needle-free

After you have taken the time to look over these injection devices, you will want to discuss them with your doctor, nurse, or pharmacist. Together, you can select the one that fits your child best.

### Electronic Device

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<tr>
<th>Device name</th>
<th>Growth hormone used with device</th>
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</thead>
<tbody>
<tr>
<td>easypod® from EMD Serono</td>
<td>Saizen® [somatropin (rDNA origin) for injection]</td>
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### Pens

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<td>Saizen® [somatropin (rDNA origin) for injection]</td>
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<td>HumatroPen™ from Eli Lilly</td>
<td>Humatrope® [somatropin (rDNA origin) for injection]</td>
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<tr>
<td>Nutropin AQ Pen® 10 from Genentech</td>
<td>Nutropin® [somatropin (rDNA origin) for injection]</td>
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<tr>
<td>Genotropin Pen® from Pfizer</td>
<td>Genotropin® [somatropin (rDNA origin) for injection]</td>
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<tr>
<td>NordiFlex® from Novo Nordisk</td>
<td>Norditropin® [somatropin (rDNA origin) for injection]</td>
</tr>
<tr>
<td>NordiPen® from Novo Nordisk</td>
<td>Norditropin® [somatropin (rDNA origin) for injection]</td>
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### Needle-free

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<td>cool.click® from EMD Serono</td>
<td>Saizen® [somatropin (rDNA origin) for injection]</td>
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easypod® is a trademark of EMD Serono, Inc. or its affiliates.
cool.click® is a registered trademark of EMD Serono, Inc.
HumatroPen™ is a trademark of Eli Lilly and Company.
Nutropin® is a registered trademark of Genentech, Inc.
Genotropin® is a registered trademark of Pfizer Inc.
NordiFlex® and NordiPen® are registered trademarks of Novo Nordisk A/S, Denmark.
Chapter 6

All the Support You’ll Need

Human Growth Foundation
997 Glen Cove Avenue
Glen Head, NY 11545
Phone: 1-800-451-6434
Web site: www.hgfound.org

The Human Growth Foundation (HGF) is a national, nonprofit organization dedicated to helping individuals with growth-related disorders and their families. It provides education and support for the family as well as education for healthcare professionals. HGF also acts as an advocate for those with growth problems.

The MAGIC Foundation
6645 W. North Avenue
Oak Park, IL 60302
Phone: 1-800-3-MAGIC 3 or 1-800-362-4423
1-708-383-0808
Web site: www.magicfoundation.org

The MAGIC Foundation is a nonprofit, national organization created to provide support and educational services for the families of children who have a wide variety of chronic and/or critical disorders, syndromes, and diseases that affect growth.