

Growth Hormone Deficiency



**Human
Growth
Foundation**

The mission of HGF is to help children and adults with disorders related to growth or growth hormone through education, research, support and advocacy.

- Support of research
- Family education and service
- Public education
- Education of health care professionals

Author: Patricia A. Reiser, Family Nurse Practitioner-C
From original text by: Ruth P. Owens, MD and Allen W. Root, MD

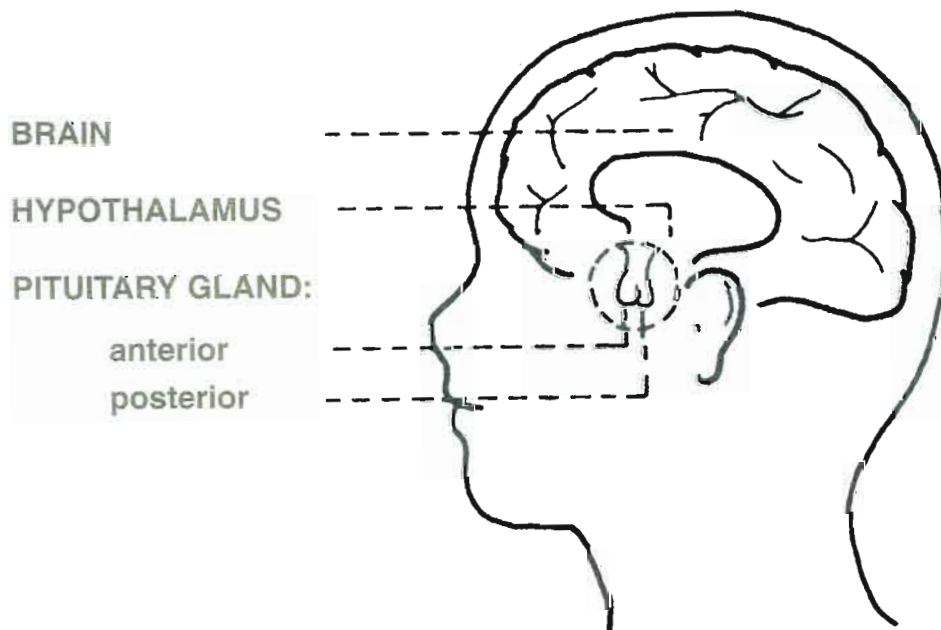
*This booklet is
dedicated to the
memory of Lisa Kraft.*

Copyright © 1979, 2002, 2007, Human Growth Foundation, Inc.
All rights reserved.

GROWTH HORMONE DEFICIENCY

Most short children do not have a serious growth problem. Many grow at a normal rate and reach an adult height that is about the same as their parent's. A child's rate of growth is an important clue to the presence or absence of a growth problem: A child who is growing at a slower than normal rate may have a serious problem, regardless of his or her height. There are many conditions and diseases that can cause poor growth; this booklet gives facts about one cause of growth failure – growth hormone deficiency.

It is estimated that approximately one out of 3,500 children in the United States have growth failure due to **growth hormone deficiency**. Growth hormone is a protein that is produced by the pituitary (“master”) gland and is vital for normal growth. Growth hormone deficiency exists when this hormone is absent or produced in inadequate amounts. If other pituitary hormones are lacking, the condition is called **hypopituitarism**. When all the pituitary hormones are missing, the child has **panhypopituitarism**.



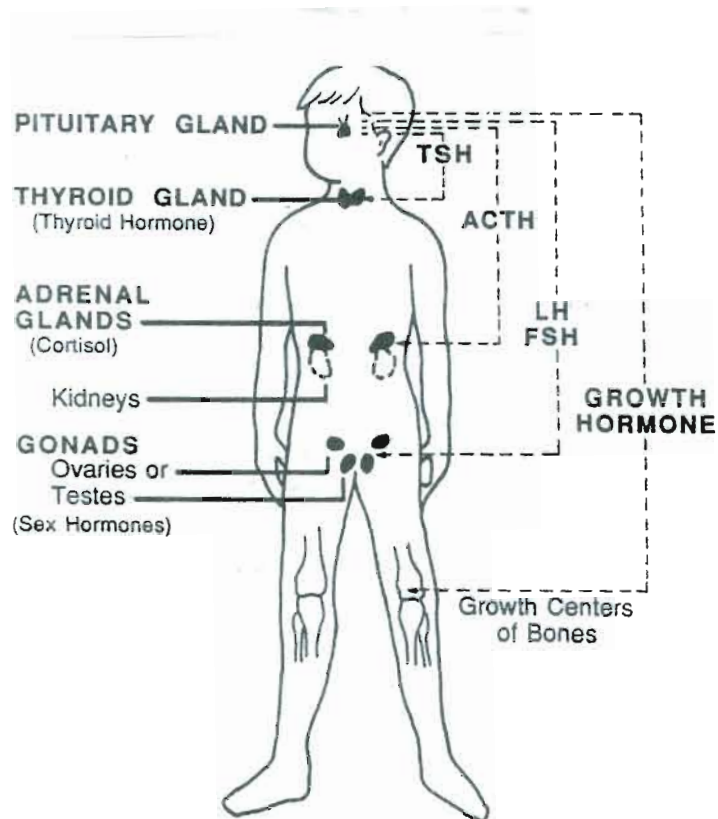
Location of the hypothalamus and pituitary gland

Control of Growth

Hormones are chemicals produced by special cells in glands and other organs of the body; most hormones are produced by cells in the **endocrine** glands. These hormones, which are produced in very small amounts, are released into the bloodstream and travel to the "target organ" or tissue where they exert their effect.

Several hormones are involved in regulating growth. Some act directly on target organs, while others act by triggering the production of other hormones, which activate specific organ functions necessary for growth. This finely tuned system can malfunction in several ways, causing abnormal growth.

The pituitary gland is often called the master gland because it produces several hormones that control the functions of other glands. It is located in the middle of the skull below the part of the brain called the hypothalamus. The pituitary gland has two distinct parts: An anterior (front) lobe and a posterior (rear) lobe. The pituitary gland secretes its hormones in response to chemical messages from the hypothalamus, the part of the brain to which it is connected.



The "master gland" and the glands and organs it controls

Growth hormone is an anterior pituitary hormone whose main effect is to promote growth of body tissues. Other anterior pituitary hormones affect growth indirectly by working through other glands. These other hormones include:

Thyroid Stimulating Hormone (TSH) - causes the thyroid gland to produce thyroid hormone, which regulates body metabolism and is essential for normal growth.

Adrenocorticotrophic Hormone (ACTH) - causes the adrenal glands to produce cortisol (stress hormone) and other hormones that enable the body to respond to stress. Too much cortisol will cause growth failure in a child.

Luteinizing Hormone (LH) and Follicle Stimulating Hormone (FSH) - cause the sex glands (ovaries or testes) to produce sex hormones, which are necessary for adolescent sexual development and the growth spurt that accompanies puberty.



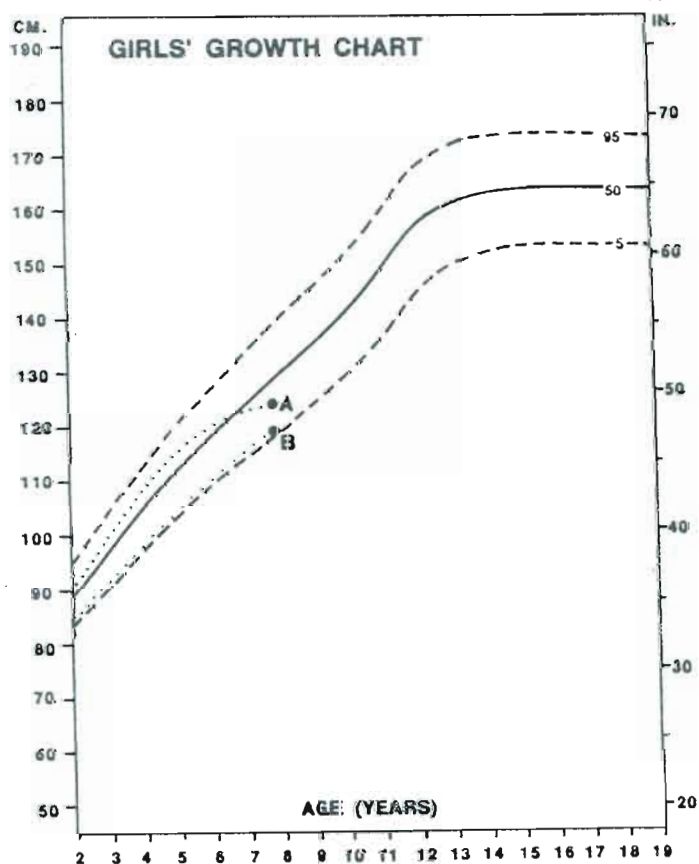
Two five-year-old girls. The one on the right has growth hormone deficiency. (Photo courtesy of Bill Garlow, Dayton [Ohio] Journal Herald).

The major hormone produced by the posterior pituitary gland is called vasopressin, or anti-diuretic hormone (ADH). It controls water output through the kidneys.

Causes of Growth Hormone Deficiency

Growth hormone deficiency may occur by itself or in combination with one or more other pituitary hormone deficiencies. It may be total (no growth hormone is produced) or partial (some growth hormone is produced, but not enough to support normal growth).

Hypopituitarism may be **congenital**, resulting from abnormal formation of the pituitary or hypothalamus before the child is born, or **acquired**, stemming from damage to the pituitary or hypothalamus during or after birth. Congenital hypopituitarism is present at birth, although it may not be apparent for many months. Acquired hypopituitarism may become evident any time during infancy or childhood, and may occur after a severe head injury or a serious illness such as meningitis or encephalitis. Many cases of acquired hypopituitarism result from a tumor called craniopharyngioma. This tumor may press on the hypothalamus or pituitary, causing one or more hormone deficiencies. Treatment



Growth charts are used to follow a child's growth over time. The line connecting several height measurements should fall along or parallel to one of the lines on the growth chart.

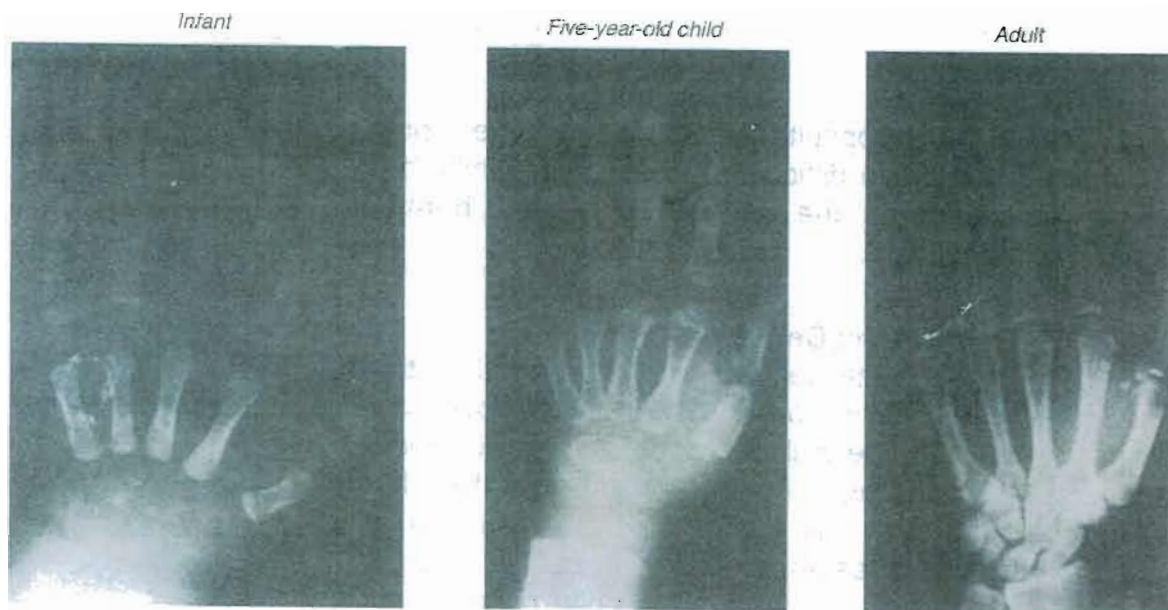
The growth curves of two girls are plotted on this growth chart. Although girl A is taller than girl B, she is more likely to have a growth problem, because her rate of growth has slowed down considerably over the past two years. Girl B is shorter than about 95 percent of girls her age, but she is continuing to grow at a steady, normal rate.

consists of surgical removal of the tumor, which usually results in permanent hypopituitarism.

Sometimes no cause for hypopituitarism can be identified, or if a cause is suspected, it may be difficult to prove. Researchers are trying to learn more about the causes of growth hormone deficiency and hypopituitarism.

Diagnosis of Growth Hormone Deficiency

The child with growth hormone deficiency is often small, with an immature face and chubby body build. The rate of growth of all body parts is slow, so that the child's proportions remain normal. Intelligence usually is normal. If the child's height has been plotted on a growth chart, it will appear to be leveling off and falling away from the child's established growth curve. If growth failure has been present for a long time, the child may be much shorter than other children the same age. This is why height and weight measurements plotted on a growth chart are so important - the earlier a treatable growth problem is detected, the better the child's chance of maintaining a normal height throughout childhood and realizing his or her full growth potential.



These are x-rays of the hands of three individuals at different stages of life. In the five-year-old child, small oval bony structures are visible at the ends of many of the finger and hand bones. These structures are in the areas of the growth centers. They are not visible in the infant's x-ray because they are cartilage and not yet bone. They are not visible in the adult's x-ray because they have fused to the bones, meaning that growth is complete.

amount of blood may be drawn to look for evidence of thyroid hormone deficiency and kidney, bone and gastrointestinal (stomach and bowel) diseases. The amount of insulin-like growth factor I (IGF-I) in the blood may be measured. IGF-I is the "middle-man" in the growth process. Growth hormone stimulates the liver and other body tissues to produce IGF-I, which then acts as the link between growth hormone in the blood and the machinery inside cells that causes growth. The amount of IGF-I in the blood provides an indirect measure of the amount of growth hormone present.

This simple evaluation often provides the doctor with enough information to identify the cause of the growth problem or to decide that no growth problem exists. If the doctor suspects that a pituitary problem may exist, further testing is necessary. A series of blood tests may be performed to measure concentrations of hormones in the blood and assess the ability of the pituitary gland to respond to various stimuli. These tests may be done in the clinic or during a brief hospitalization.



Testing for growth hormone deficiency may be done in the clinic or during a brief hospitalization.

Any child who is only as tall as children two or more years younger or who falls away from a previously normal growth curve should be evaluated by a doctor. Pediatric endocrinologists are doctors who specialize in treating children with growth and hormone problems. Depending on the situation, the doctor may measure the child over six to twelve months in order to accurately determine the child's growth rate.

The evaluation starts with gathering information on the heights of relatives and the presence of any health problems in the family. A history of early or late puberty (sexual development and growth spurt) in family members should be mentioned. The doctor will want to know about the mother's pregnancy, labor and delivery. All measurements of the child's height and weight since birth should be gathered so the doctor can plot them on a growth chart. The doctor will ask questions about the child's general health and nutritional state, past illnesses, injuries and stresses.

A thorough physical **examination** will be performed, and an x-ray of the hand and **wrist may be** obtained to see how bone development compares to height and chronologic age. A small



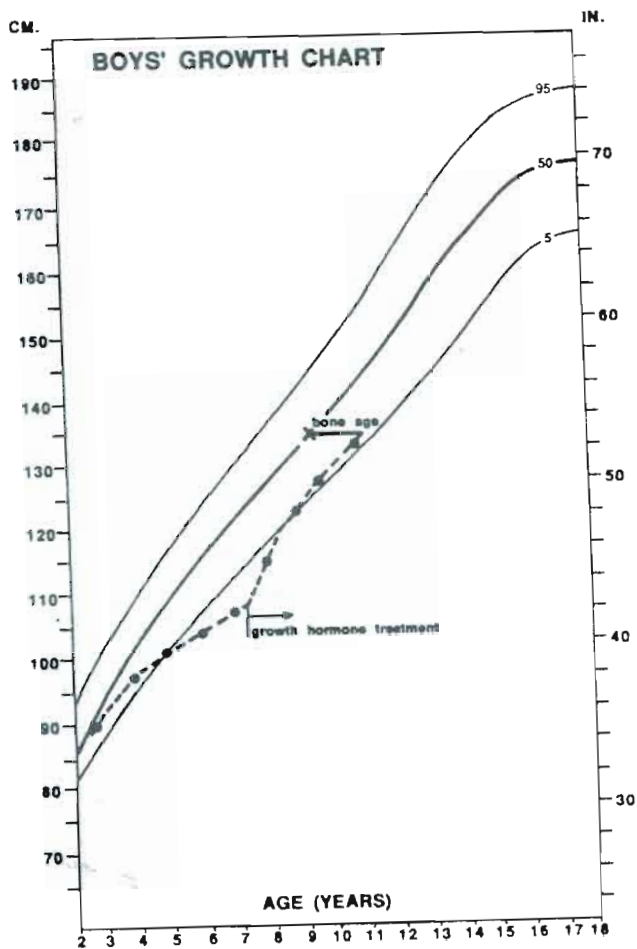
Accurate measurements are essential in determining growth patterns.

Growth failure requires the attention of a physician.



Growth hormone deficiency is moderately difficult to diagnose because the pituitary gland produces growth hormone in bursts. This means that the level of growth hormone in a single random blood sample is likely to be very low. One way of testing for growth hormone deficiency is to give the child a substance that causes the release of a growth hormone burst in normal children and measure the amount of growth hormone present in several blood samples obtained over a period of time. Since any child may not respond to any given test on a given day, more than one stimulus may be needed to evaluate the child's ability to produce growth hormone. Several growth hormone stimulators have been identified. These include vigorous exercise and several chemicals and drugs (insulin, arginine, glucagon, L-dopa, clonidine).

Another way of testing growth hormone secretion involves hospitalizing the child and measuring the amount of growth hormone present in blood samples obtained overnight during sleep or even during an entire 24 hour period. Since about two-thirds of total growth hormone production occurs during deep sleep, this test provides a better reflection of how much growth hormone the child's pituitary gland normally produces.



The growth curve of a boy with growth hormone deficiency is plotted on this growth chart. His growth rate began to slow at about three years of age, but he was not evaluated by a growth specialist until his parents became concerned about his height when he entered first grade. His growth rate tripled during his first year on growth hormone therapy, and although it has slowed down since then, he is still growing at a normal rate. Because the maturity of his bones (bone age) is delayed by almost two years, his growth potential is more like a nine-year-old's than an eleven-year-old's. He has an excellent chance of reaching a normal adult height.

If several tests show that no growth hormone is present or that the amount of growth hormone being produced is not enough to support normal growth, the diagnosis of growth hormone deficiency is established. A great deal of research is being done to develop more accurate and reliable ways of diagnosing growth hormone deficiency. Even the definition of growth hormone deficiency is being revised as researchers learn more about conditions that may cause partial growth hormone deficiency.

Treatment of Growth Hormone Deficiency

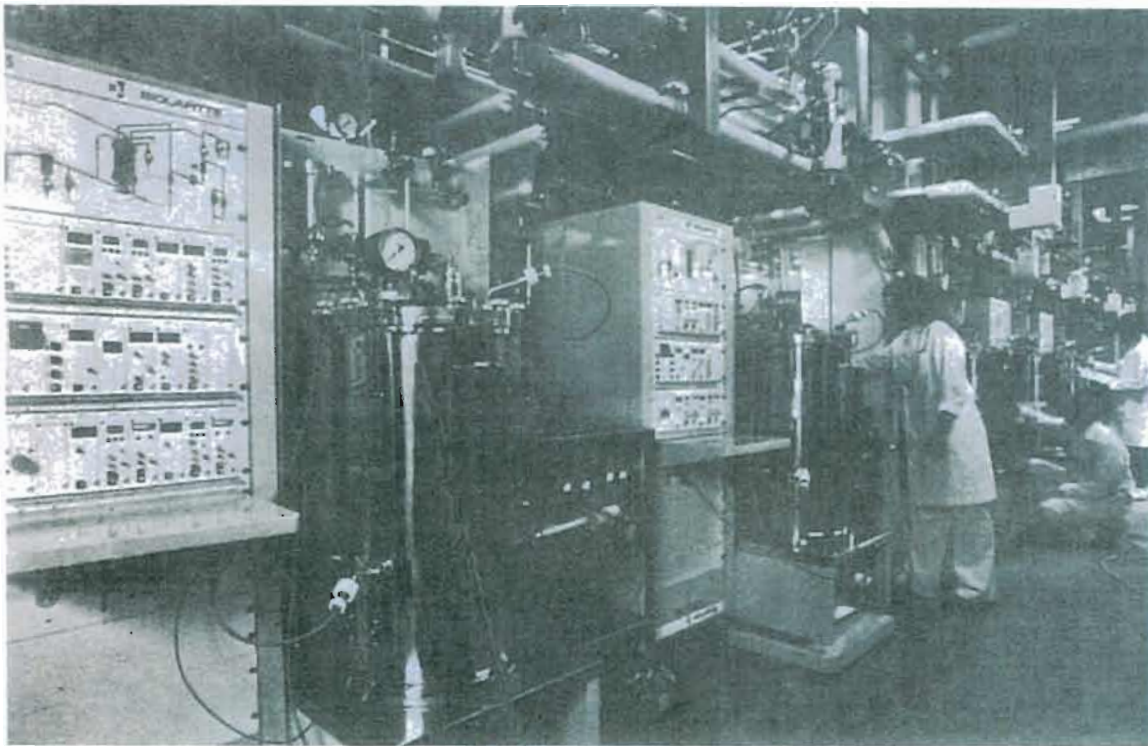
Growth hormone deficiency is treated with injections of growth hormone. Most children receive six or seven injections a week because research has shown that this schedule is most effective in promoting growth. There is usually a prompt increase in growth rate after treatment starts, which may be noticeable to the child and parent in 3 to 4 months. This faster-than-normal growth rate slowly declines over time, but it continues to be greater than it would be without treatment. Many parents notice an increase in the child's appetite and a loss of body fat after treatment begins.

Parents and often the children themselves are taught to administer the growth hormone injections.



The treatment of a child with growth hormone deficiency usually is carried out over several years, until the child achieves normal adult height or maximum growth potential is reached. As with other conditions, children and parents may become impatient to see faster or more impressive results from therapy. They may become discouraged, even when treatment is going according to plan. It is important to remember that growth is a slow process that is measured over months; children who expect to grow overnight when they start treatment will be disappointed. The child's doctor will discuss realistic short and long-term expectations of therapy with the family.

If testing reveals other hormone deficiencies, medications are available to replace them; thyroid hormone, cortisol and sex hormones can be administered easily when found to be lacking. It is important that these hormones are taken as directed, because normal growth can occur only when all hormones are present in the proper amounts. Good nutrition and adequate rest are important for normal growth in all children.



Biosynthetic growth hormone is produced using recombinant DNA technology. (Photo courtesy of Genentech, Inc.)

Source of Human Growth Hormone

Until the early 1980s, the only source of human growth hormone was the pituitary glands of deceased people, obtained at autopsy. In April, 1985, pituitary-derived growth hormone was removed from distribution in the United States and many foreign countries following the deaths of several young adults from a very rare disease that may have been transmitted through the pituitary growth hormone they had received many years earlier. Fortunately, the first biosynthetic growth hormone, which is produced using recombinant DNA technology, was in the final stages of testing and was approved as safe and effective for use in growth hormone deficient children by the Food and Drug Administration in October, 1985. Because this type of growth hormone does not come from human beings, there is little possibility that human disease can be transmitted through it.

Biosynthetic growth hormone is supplied as a powder in sterile vials. Parents and children are taught how to mix the powder into a solution and administer the injections. Treatment is continued as long as potential for growth exists and the child is responding to therapy. With early diagnosis and a good response to



The nine-year-old boy on the left has growth hormone deficiency; the boy on the right is his seven-year-old brother.



This twelve-year-old girl with growth hormone deficiency has had an excellent response to treatment during the two years she has been on growth hormone.

treatment, children with growth hormone deficiency can expect to reach normal adult height.

Psychosocial Aspects of Short Stature

Our society places great emphasis on height. Children who are short for their age sometimes have problems because playmates and teachers treat them as though they are younger rather than just smaller. Parents tend to do this too, and decrease their expectations of the child. These children then may not act their age because it's not expected of them. Teasing and name-calling may be hard to take. Some of these problems may be helped by frank and open discussion with teachers and classmates.

It is very important to provide emotional support for the child with GH deficiency and to emphasize the child's many good and valuable characteristics, so that the child's stature does not limit his horizons. More about psychosocial adaptation to short stature can be learned from parents of short children and from your growth clinic doctor, nurse and psychologist.

You can help your child and the thousands of children and adults with disorders related to growth or growth hormone by participating in the activities of HGF.

Write to:

Human Growth Foundation
997 Glen Cove Avenue — Suite #5,
Glen Head, N.Y. 11545

Or contact us at the following:

Phone: 516-671-4041

Toll Free: 1-800-451-6434

Website: www.hgfound.org

The Human Growth Foundation is a national organization of parents of short children and other interested people. Chapters of HGF are located in major cities across the nation. The members of these chapters help to:

- educate the public about growth problems
- refer children with growth problems for evaluation
- provide information about growth problems to affected families
- provide guidance for the physical, psychological and social development of children with growth problems
- help short children learn to cope with living in a bigger world
- sponsor research on growth
- raise funds for these activities

You may want to obtain more information about HGF activities from your local chapter or the national office by writing:

**Human Growth Foundation, 997 Glen Cove Ave., Suite #5,
Glen Head, NY 11545, (516) 671-4041, 1-800-451-6434.**

You can help your child and the thousands of children with growth problems by participating in the activities of HGF.



Human Growth Foundation

997 Glen Cove Avenue • Suite #5 • Glen Head, NY 11545

516-671-4041 • 800-451-6434

Contributions to the Human Growth Foundation are tax deductible.