MAYO CLINIC LABORATORIES

Test Definition: IGF1S

Insulin-Like Growth Factor 1, Serum

Overview

Useful For

First-tier test for evaluation of growth disorders

Evaluation of growth hormone deficiency or excess in children and adults

Monitoring of recombinant human growth hormone treatment

Follow-up of individuals with acromegaly and gigantism

Method Name

Chemiluminescence Immunoassay

NY State Available

Yes

Specimen

Specimen Type

Serum

Necessary Information

Indicate patient's age and sex.

Specimen Required

Patient Preparation: For 12 hours before specimen collection, patient **should not** take multivitamins or dietary supplements (eg, hair, skin, and nail supplements) containing biotin (vitamin B7).
Supplies: Sarstedt Aliquot Tube, 5 mL (T914)
Collection Container/Tube:
Preferred: Red top
Acceptable: Serum gel
Submission Container/Tube: Plastic vial
Specimen Volume: 0.8 mL Serum
Collection Instructions: Centrifuge and aliquot serum into a plastic vial.

Specimen Minimum Volume

Serum: 0.5 mL

Reject Due To

Gross	Reject

hemolysis	
Gross lipemia	OK
Gross icterus	Reject

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Serum	Frozen (preferred)	90 days	
	Ambient	7 days	
	Refrigerated	7 days	

Clinical & Interpretive

Clinical Information

Insulin-like growth factor 1 (IGF1) is a 70-amino acid polypeptide (molecular weight [MW] 7.6 kDa).IGF1 is the major mediator of the anabolic and growth-promoting effects of growth hormone (GH). IGF1 is mostly bound to protein, in particular insulin-like growth factor binding protein 3 (IGFBP3), which also controls its bioavailability and half-life. Noncomplexed IGF1 and IGFBP3 have short half-lives (t1/2) of 10 and 30 to 90 minutes, respectively, while the IGFBP3/IGF1 complex is cleared with a much slower t1/2 of 12 hours.

Insulin-like growth factor 1 is produced by many tissues, but the liver is the main source of circulating IGF1. IGF1 synthesis in the liver is under the control of GH. The secretion patterns of IGF1 and IGFBP3 mimic each other. Unlike GH secretion, which is pulsatile and demonstrates significant diurnal variation, IGF1 and IGFBP3 levels show only minor fluctuations. IGF1 and IGFBP3 serum levels therefore represent a stable and integrated measurement of GH production and tissue effect.

Low IGF1 and IGFBP3 levels are observed in GH deficiency or GH resistance. If acquired in childhood, these conditions result in short stature. Childhood GH deficiency can be an isolated abnormality or associated with deficiencies of other pituitary hormones. Some of the latter cases may be due to either pituitary or hypothalamic tumors or result from cranial radiation or intrathecal chemotherapy for childhood malignancies. Most GH resistance in childhood is mild-to-moderate, with causes ranging from poor nutrition to severe systemic illness (eg, kidney failure). These individuals may have IGF1 and IGFBP3 levels within the reference range. Severe childhood GH resistance is rare and usually due to GH-receptor defects. Both GH deficiency and mild-to-moderate GH resistance can be treated with recombinant human GH (rhGH) injections. The prevalence and causes of adult GH resistance are uncertain, but adult GH deficiency is seen mainly in pituitary tumor patients. It is associated with decreased muscle bulk and increased cardiovascular morbidity and mortality, but replacement therapy remains controversial.

Elevated serum IGF1 and IGFBP3 levels indicate a sustained over-production of GH, or excessive rhGH therapy. Endogenous GH excess is caused mostly by GH-secreting pituitary adenomas, resulting in gigantism, if acquired before epiphyseal closure, and in acromegaly thereafter. Both conditions are associated with generalized organomegaly, hypertension, diabetes, cardiomyopathy, osteoarthritis, compression neuropathies, a mild increase in cancer risk (breast, colon, prostate, lung), and diminished longevity. It is plausible, but unproven, that long-term rhGH overtreatment may result in similar adverse outcomes.

Malnutrition results in low IGF1 levels, which recover with restoration of adequate nutrition.

Reference Values

Male:
<1 year: 27.0-157.0 ng/mL
1 year: 29.7-166.8 ng/mL
2 years: 33.9-183.9 ng/mL
3 years: 39.0-204.5 ng/mL
4 years: 44.3-225.0 ng/mL
5 years: 50.0-245.5 ng/mL
6 years: 56.2-267.1 ng/mL
7 years: 63.4-291.9 ng/mL
8 years: 72.4-323.1 ng/mL
9 years: 83.6-361.6 ng/mL
10 years: 96.9-406.6 ng/mL
11 years: 111.6-454.4 ng/mL
12 years: 126.1-498.7 ng/mL
13 years: 138.6-532.5 ng/mL
14 years: 147.5-551.2 ng/mL
15 years: 152.2-553.5 ng/mL
16 years: 152.9-541.8 ng/mL
17 years: 150.6-520.6 ng/mL
18 years: 146.2-493.6 ng/mL
19 years: 140.2-462.7 ng/mL
20 years: 133.1-430.0 ng/mL
21-25 years: 115.2-354.8 ng/mL
26-30 years: 97.9-281.6 ng/mL
31-35 years: 88.3-246.0 ng/mL
36-40 years: 83.4-232.7 ng/mL
41-45 years: 74.9-216.4 ng/mL
46-50 years: 66.9-205.1 ng/mL
51-55 years: 60.6-200.3 ng/mL
56-60 years: 54.3-194.2 ng/mL
61-65 years: 48.8-187.7 ng/mL
66-70 years: 46.5-191.9 ng/mL
71-75 years: 40.9-179.2 ng/mL
76-80 years: 37.1-172.0 ng/mL
81-85 years: 33.8-165.4 ng/mL
86-90 years: 32.2-166.1 ng/mL

Females:
<1 year: 17.9-125.6 ng/mL
1 year: 19.5-132.3 ng/mL
2 years: 22.2-145.4 ng/mL

3 years: 25.9-164.2 ng/mL
4 years: 30.7-187.8 ng/mL
5 years: 36.2-214.4 ng/mL
6 years: 42.0-240.4 ng/mL
7 years: 48.6-269.6 ng/mL
8 years: 56.9-305.3 ng/mL
9 years: 67.2-349.4 ng/mL
10 years: 79.5-400.3 ng/mL
11 years: 92.6-452.6 ng/mL
12 years: 105.3-499.1 ng/mL
13 years: 115.9-533.4 ng/mL
14 years: 123.4-552.0 ng/mL
15 years: 127.4-554.2 ng/mL
16 years: 127.9-541.5 ng/mL
17 years: 125.3-517.3 ng/mL
18 years: 120.5-485.8 ng/mL
19 years: 114.4-450.8 ng/mL
20 years: 107.8-416.0 ng/mL
21-25 years: 92.9-342.0 ng/mL
26-30 years: 78.4-270.0 ng/mL
31-35 years: 73.1-243.0 ng/mL
36-40 years: 69.0-227.0 ng/mL
41-45 years: 61.5-204.4 ng/mL
46-50 years: 56.8-194.5 ng/mL
51-55 years: 53.0-189.6 ng/mL
56-60 years: 45.6-172.4 ng/mL
61-65 years: 42.2-169.0 ng/mL
66-70 years: 38.3-162.5 ng/mL
71-75 years: 36.6-164.7 ng/mL
76-80 years: 34.7-164.8 ng/mL
81-85 years: 34.4-172.4 ng/mL
86-90 years: 33.6-177.8 ng/mL

Tanner stage reference intervals:
Males:
I : 81.3-255.3 ng/mL
II: 106.2-432.3 ng/mL
III: 244.9-511.4 ng/mL
IV: 222.6-577.7 ng/mL
V: 227.4-517.8 ng/mL
Females:
I: 85.9-323.0 ng/mL
II: 117.5-451.3 ng/mL
III: 258.3-528.5 ng/mL
IV: 224.2-585.8 ng/mL

V: 188.2-511.6 ng/mL

Tanner Stage reference source: Bindlingmaier M, Friedrich N, Emeny RT,et al. Reference intervals for insulin-like growth factor-1 (IGF-1) from birth to senescence: results from a multicenter study using a new automated chemiluminescence IGF-I immunoassay conforming to recent international recommendations. J Clin Endocrinol Metab. 2014;99(5):1712-1721

Note: Puberty onset (transition from Tanner stage I to Tanner stage II) occurs for boys at a median age of 11.5 (+/-2) years and for girls at a median age of 10.5 (+/-2) years. There is evidence that it may occur up to 1 year earlier in obese girls and in African American girls. For boys, there is no definite proven relationship between puberty onset and body weight or ethnic origin. Progression through Tanner stages is variable. Tanner stage V (young adult) should be reached by age 18.

Interpretation

Both insulin-like growth factor 1 (IGF1) and insulin-like growth factor binding protein 3 (IGFBP3) measurements can be used to assess growth hormone (GH) excess or deficiency. However, for all applications, IGF1 measurement has generally been shown to have superior diagnostic sensitivity and specificity and should be used as the primary test. In particular, in the diagnosis and follow-up of acromegaly and gigantism, IGFBP3 measurement adds little if anything to IGF1 testing. The combination of IGF1 and IGFBP3 measurements appears superior to determining either analyte alone in the diagnosis of GH deficiency and resistance, and in the monitoring of recombinant human GH (rhGH) therapy.

Insulin-like growth factor 1 and IGFBP3 levels below the 2.5th percentile for age are consistent with GH deficiency or severe GH resistance, but patients with incomplete GH deficiency or mild-to-moderate GH resistance may have levels within the reference range. In GH deficiency, GH levels may also be low and can show suboptimal responses in stimulation tests (eg, exercise, clonidine, arginine, ghrelin, growth hormone-releasing hormone [GHRH], insulin-induced hypoglycemia), while in severe GH resistance, GH levels are substantially elevated. However, dynamic GH testing is not always necessary for diagnosis. If it is undertaken, it should be performed and interpreted in endocrine testing centers under the supervision of a pediatric or adult endocrinologist.

The aim of both pediatric and adult GH replacement therapy is to achieve IGF1 and IGFBP3 levels within the reference range, ideally within the middle-to-upper third. Higher levels are rarely associated with any further therapeutic gains but could potentially lead to long-term problems of GH excess.

Elevated IGF1 and IGFBP3 levels support the diagnosis of acromegaly or gigantism in individuals with appropriate symptoms or signs. In successfully treated patients, both levels should be within the normal range. In both diagnosis and follow-up, IGF1 levels correlate better with clinical disease activity than IGFBP3 levels.

After transsphenoidal removal of pituitary tumors in patients with acromegaly, IGF1 concentration starts to decrease and returns to normal levels in most patients postoperatively by the fourth day.(1)

Individuals with anorexia or malnutrition have low values of IGF1. IGF1 is a more sensitive indicator than prealbumin, retinol-binding protein, or transferrin for monitoring nutritional repletion.

Cautions

Insulin-like growth factor 1 (IGF1) and insulin-like growth factor binding protein 3 (IGFBP3) reference ranges are highly age dependent, and results must always be interpreted within the context of the patient's age.

Increased concentrations of IGF1 are normal during pregnancy, however reference intervals on this population have not been formally established.

Discrepant IGF1 and IGFBP3 results can sometimes occur due to liver and kidney disease; however, this is uncommon and such results should alert laboratories and physicians to the possible occurrence of a preanalytical or analytical error.

The use of biotin-containing supplements may lead to inaccurately reduced IGF1 measurements.

Currently, IGF1 or IGFBP3 cannot be reliably used as risk indicators or prognostic markers in breast, colon, prostate, or lung cancer.

Insulin-like growth factor 1 and IGFBP3 assays exhibit variability among platforms and manufacturers. Results obtained with different assay methods or kits should not be used interchangeably.

All immunometric assays can, on rare occasions, be subject to a hooking effect at extremely high analyte concentrations (falsely low results) or heterophilic antibody interference (most often falsely high results). If the laboratory result does not fit the clinical picture, these possibilities should be considered.

Clinical Reference

1. Bidlingmaier M, Friedrich N, Emeny RT, et al. Reference intervals for insulin-like growth factor-1 (IGF-1) from birth to senescence: results from a multicenter study using a new automated chemiluminescence IGF-1 immunoassay conforming to recent international recommendations. J Clin Endocrinol Metab. 2014;99(5):712-721
2. Yuen KCJ, Biller BMK, Radovick S, et al. American Association of Clinical Endocrinologists and American College of Endocrinology guidelines for management of growth hormone deficiency in adults and patients transitioning from pediatric to adult care. Endocr Pract. 2019;25(11):1191-1232
3. Grimberg A, DiVall SA, Polychronakos C, et al. Guidelines for growth hormone and insulin-like growth factor-I treatment in children and adolescents: growth hormone deficiency, idiopathic short stature, and primary insulin-like growth factor-I deficiency. Horm Res Paediatr. 2016;86(6):361-397
4. Molitch ME, Clemmons DR, Malozowski S, et al. Evaluation and treatment of adult growth hormone deficiency: an Endocrine Society clinical practice guideline. J Clin Endocrinol Metab. 2011;96(6):1587-1609
5. Kannan S, Kennedy L. Diagnosis of acromegaly: state of the art. Expert Opin Med Diagn. 2013;7(5):443-453
6. Katznelson L, Laws ER, Melmed S, et al. Acromegaly: an Endocrine Society clinical practice guideline. J Clin Endocrinol Metab. 2014;99(11):3933-3951
7. Melmed S, Colao A, Barkan A, et al. Guidelines for acromegaly management: an update. J Clin Endocrinol Metab. 2009;94(5):1509-1517
8. Tzanela M. Dynamic tests and basal values for defining active acromegaly. Neuroendocrinology. 2006;83(3-4):200-204
9. Clemmons DR, Bidlingmaier M. IGF-I assay methods and biologic variability: evaluation of acromegaly treatment response. Eur J Endocrinol. 2024;191(1):R1-R8. doi:10.1093/ejendo/lvae065

Performance

Method Description

The assay is based on chemiluminescence technology. Ten microliters of patient sample are incubated with an acidic solution to dissociate IGFI from the binding proteins. A portion of this, along with neutralization buffer is incubated with a biotinylated anti-IGFI monoclonal antibody, and an acridinium labelled anti-IGFI monoclonal antibody. Streptavidin labelled magnetic particles are then added. The magnetic particles are captured using a magnet and a wash step performed to remove any unbound analyte. Trigger reagents are added; the resulting light emitted by the acridinium label is directly proportional to the concentration of IGFI in the original sample.(Package insert: IDS-iSYS Insulin-like Growth Factor-I (IGF-I). Immunodiagnostic Systems Inc.; IS-3900PLv13. 3/15/2025)

PDF Report
No

Day(s) Performed
Monday through Friday

Report Available
1 to 3 days

Specimen Retention Time
2 weeks

Performing Laboratory Location
Mayo Clinic Laboratories - Rochester Superior Drive

Fees & Codes

Fees
- Authorized users can sign in to Test Prices for detailed fee information.
- Clients without access to Test Prices can contact Customer Service 24 hours a day, seven days a week.
- Prospective clients should contact their account representative. For assistance, contact Customer Service.

Test Classification
This test has been cleared, approved, or is exempt by the US Food and Drug Administration and is used per manufacturer's instructions. Performance characteristics were verified by Mayo Clinic in a manner consistent with CLIA requirements.

CPT Code Information
84305

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
IGF1S	Insulin-Like Growth Factor 1, S	2484-4

Result ID	Test Result Name	Result LOINC® Value
IGF1Z	Z-score	73561-3

IGFZ1	Z-score	73561-3
IGF1C	Insulin-Like Growth Factor 1, S	2484-4