MAYO CLINIC LABORATORIES

Test Definition: DHEA_

Dehydroepiandrosterone (DHEA), Serum

Overview

Useful For

Diagnosing and differential diagnosis of hyperandrogenism (in conjunction with measurements of other sex steroids)

As an initial screen in adults with bioavailable testosterone measurement. Depending on results, this may be supplemented with measurements of sex hormone-binding globulin and occasionally other androgenic steroids (eg, 17-hydroxyprogesterone).

An adjunct in the diagnosis of congenital adrenal hyperplasia (CAH); DHEA/DHEAS measurements play a secondary role to the measurements of cortisol/cortisone, 17 alpha-hydroxyprogesterone, and androstenedione

Diagnosing and differential diagnosis of premature adrenarche

Special Instructions

- Steroid Pathways

Method Name

Liquid Chromatography-Tandem Mass Spectrometry (LC-MS/MS)
Portions of this test are covered by patents held by Quest Diagnostics

NY State Available

Yes

Specimen

Specimen Type

Serum Red

Necessary Information

Patient's age and sex are required.

Specimen Required

Collection Container/Tube: Red top (serum gel/SST are **not** acceptable)
Submission Container/Tube: Plastic vial
Specimen Volume: 1 mL
Collection Instructions: Centrifuge and aliquot serum to plastic vial.

Specimen Minimum Volume

0.5 mL

Reject Due To

Gross hemolysis	Reject
Gross lipemia	Reject
Gross icterus	OK

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Serum Red	Frozen (preferred)	28 days	
	Refrigerated	21 days	
	Ambient	6 hours	

Clinical & Interpretive

Clinical Information

Dehydroepiandrosterone (DHEA) is the principal human C-19 steroid. DHEA has very low androgenic potency but serves as the major direct or indirect precursor for most sex steroids. DHEA is secreted by the adrenal gland and production is at least partly controlled by adrenocorticotropic hormone (ACTH). The bulk of DHEA is secreted as a 3-sulfoconjugate dehydroepiandrosterone sulfate (DHEAS). Both hormones are albumin bound, but DHEAS binding is much tighter. As a result, circulating concentrations of DHEAS are much higher (>100-fold) compared to DHEA. In most clinical situations, DHEA and DHEAS results can be used interchangeably. In gonads and several other tissues, most notably skin, steroid sulfatases can convert DHEAS back to DHEA, which can then be metabolized to stronger androgens and to estrogens.

During pregnancy, DHEA/DHEAS and their 16-hydroxylated metabolites are secreted by the fetal adrenal gland in large quantities. They serve as precursors for placental production of the dominant pregnancy estrogen, estriol. Within weeks after birth, DHEA/DHEAS levels fall by 80% or more and remain low until the onset of adrenarche at age 7 or 8 in girls and age 8 or 9 in boys. Adrenarche is a poorly understood phenomenon, peculiar to higher primates, that is characterized by a gradual rise in adrenal androgen production. It precedes puberty but is not casually linked to it. Early adrenarche is not associated with early puberty or with any reduction in final height or overt androgenization. However, girls with early adrenarche may be at increased risk of polycystic ovarian syndrome as adults and some boys may develop early penile enlargement.

Following adrenarche, DHEA/DHEAS levels increase until the age of 20 to a maximum roughly comparable to that observed at birth. Levels then decline over the next 40 to 60 years to around 20% of peak levels. The clinical significance of this age-related drop is unknown, and trials of DHEA/DHEAS replacement in older individuals have not produced convincing benefits. However, in younger and older patients with primary adrenal failure, the addition of DHEA/DHEAS to corticosteroid replacement has been shown in some studies to improve mood, energy, and sex drive.

Elevated DHEA/DHEAS levels can cause signs or symptoms of hyperandrogenism in women. Men are usually asymptomatic but, through peripheral conversion of androgens to estrogens, can occasionally experience mild estrogen excess. Most mild-to-moderate elevations in DHEAS levels are idiopathic. However, pronounced elevations of

DHEA/DHEAS may be indicative of androgen-producing adrenal tumors. In small children, congenital adrenal hyperplasia (CAH) due to 3 beta-hydroxysteroid dehydrogenase deficiency is associated with excessive DHEA/DHEAS production. Lesser elevations may be observed in 21-hydroxylase deficiency (the most common form of CAH) and 11 beta-hydroxylase deficiency. By contrast, steroidogenic acute regulatory protein (STAR) or 17 alpha-hydroxylase deficiency is characterized by low DHEA/DHEAS levels.

For more information see Steroid Pathways.

Reference Values

Premature: <40 ng/mL*
0-1 day: <11 ng/mL*
2-6 days: <8.7 ng/mL*
7 days-1 month: <5.8 ng/mL*
>1-23 months: <2.9 ng/mL*
2-5 years: <2.3 ng/mL
6-10 years: <3.4 ng/mL
11-14 years: <5.0 ng/mL
15-18 years: <6.6 ng/mL
19-30 years: <13 ng/mL
31-40 years: <10 ng/mL
41-50 years: <8.0 ng/mL
51-60 years: <6.0 ng/mL
> or =61 years: <5.0 ng/mL

*Source: Dehydroepiandrosterone. In: Soldin SJ, Brugnara C, Wong Ed, eds. Pediatric Reference Ranges. 5th ed. AACC Press; 2005:75

For SI unit Reference Values, see www.mayocliniclabs.com/order-tests/si-unit-conversion.html

Interpretation

Elevated dehydroepiandrosterone (DHEA)/dehydroepiandrosterone sulfate (DHEAS) levels indicate increased adrenal androgen production. Mild elevations in adults are usually idiopathic, but levels 5-fold or more of the upper limit of normal can suggest the presence of an androgen-secreting adrenal tumor. DHEA/DHEAS levels are elevated in greater than 90% of patients with such tumors. This is particularly true for androgen-secreting adrenal carcinomas, as they have typically lost the ability to produce downstream androgens, such as testosterone. By contrast, androgen-secreting adrenal adenomas may also produce excess testosterone and secrete lesser amounts of DHEA/DHEAS.

Patients with congenital adrenal hyperplasia (CAH) may show very high levels of DHEA/DHEAS, often 5-fold to 10-fold elevations. However, with the possible exception of 3 beta-hydroxysteroid dehydrogenase deficiency, other steroid analytes offer better diagnostic accuracy than DHEA/DHEAS measurements. Consequently, DHEA/DHEAS testing should not be used as the primary tool for CAH diagnosis. Similarly, discovering a high DHEA/DHEAS level in an infant or child with symptoms or signs of possible CAH should prompt additional testing, as should the discovery of very high DHEA/DHEAS levels in an adult. In the latter case, adrenal tumors need to be excluded and additional adrenal steroid profile testing may assist in diagnosing nonclassical CAH.

For more information see Steroid Pathways.

Cautions

Currently the correlation of serum dehydroepiandrosterone (DHEA)/dehydroepiandrosterone sulfate (DHEAS) level with human well-being or disease risk factors have not been completely established.

There are currently no established guidelines for DHEA/DHEAS replacement/supplementation therapy or its biochemical monitoring. In most settings, the value of DHEA/DHEAS therapy is doubtful. However, if DHEAS therapy is used, then it seems prudent to avoid overtreatment, with its associated hyperandrogenic effects. These are particularly likely to occur in postmenopausal females if DHEA/DHEAS levels approach or exceed the upper reference range. Most supplements contain DHEA, but the in vivo conversion to DHEAS allows monitoring of either DHEA or DHEAS.

Clinical Reference

1. Ibanez L, DiMartino-Nardi J, Potau N, Saenger P: Premature adrenarche-normal variant or forerunner of adult disease? Endocrine Rev. 2000 Dec;21(6):671-696
2. Collett-Solberg PF: Congenital adrenal hyperplasia: from genetics and biochemistry to clinical practice, Part I. Clin Pediatr (Phila). 2001 Jan;40(1):1-16
3. Allolio B, Arlt W: DHEA treatment: myth or reality? Trends Endocrinol Metab. 2002 Sep;13(7):288-294
4. Salek FS, Bigos KL, Kroboth PD: The influence of hormones and pharmaceutical agents on DHEA and DHEA-S concentrations: a review of clinical studies. J Clin Pharmacol. 2002 Mar;42(3):247-266
5. Bertholf RL, Cooper M, Winter WE: Adrenal Cortex. In: Rifai N, Horvath AR, Wittwer CT, eds. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics. 6th ed. Elsevier; 2018:66
6. Ebeling P, Koivisto VA: Physiological importance of dehydro-epiandrosterone. Lancet. 1994 Jun;343(8911):1479-1481
7. Morales AJ, Nolan JJ, Nelson JC, Yen SS: Effects of replacement dose of dehydroepiandrosterone in men and women of advancing age. J Clin Endocrinol Metab. 1994 Jun;78(6):1360-1367

Performance

Method Description

Deuterated stable isotope d2 dehydroepiandrosterone (d2-DHEA) is added to a 0.4 mL serum sample as internal standard. The DHEA and internal standard are extracted from the sample by solid-phase extraction. This is followed by conventional liquid chromatography on a Cohesive LX4 System and analysis on a tandem mass spectrometer equipped with a heated nebulizer ion source.(Soldin OP, Guo T, Weiderpass E, Tractenberg RE, Hilakivi-Clarke L, Soldin SJ: Steroid hormone levels in pregnancy and 1 year postpartum using isotope dilution tandem mass spectrometry. Fertil Steril. 2005 Sep:84[3]:701-710; Soeborg T, Frederiksen H, Fruekilde P, Johannsen TH, Juul A, Andersson AM: Serum concentrations of DHEA, DHEAS, 17a-hydroxyprogesterone, d4-androstenedione and testosterone in children determined by TurboFlow-LC-MS/MS. Clin Chim Acta. 2013 Apr 18;419:95-101. doi: 10.1016/j.cca.2013.01.019)

PDF Report

No

Day(s) Performed

Monday, Thursday

Report Available

2 to 7 days

Specimen Retention Time

2 weeks

Performing Laboratory Location

Rochester

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 was developed and its performance characteristics determined by Mayo Clinic in a manner consistent with CLIA requirements. It has not been cleared or approved by the US Food and Drug Administration.

CPT Code Information

82626

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
DHEA_	Dehydroepiandrosterone, S	2193-1

Result ID	Test Result Name	Result LOINC® Value
81405	Dehydroepiandrosterone, S	2193-1