Hormone Binding Proteins

	Sex Hormone Binding Globulin (SHBG)	Thyroid (thyroxine) Binding Globulin (TBG)	Cortisol Binding Globulin (CBG) (or transcortin)	Albumin (serum)
Production	Liver (also brain, uterus, testes, placenta) 1,2,4	Liver 9,10	Liver 13	Liver 16
Purpose	Binds: -Dihydrotestosterone -Testosterone -Estradiol/estrone (DHEA & androstenedione bound almost completely to albumin) 1,3,4	Binds: -Thyroid hormone in circulation (T3 and T4 primarily, also T1 and T2) 10	Binds: -Cortisol -Progesterone -Aldosterone -11-Deoxycorticosterone (DOC)--aldosterone precursor 13, 14	Transports: -Thyroid Hormones -Fat soluble hormones -Fatty-acids to liver -Unconj. bilirubin -Various drugs (influences $t_{1/2}$) -Various minerals 21
Hormone affinities	--binds biologically active androgens and estrogens only (4-5x better than albumin) DHT>TE>E1/E2 1,2,3,4	--carries the majority of T4 T4>T3>T1/T2 10	--carries >90% of cortisol in plasma --somewhat lower for progesterone 13,14	--Binds all steroid hormones the same/low affinity --99% of albumin binding sites remain open 1,2

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Conditions that cause an increase in production	Increased levels of human growth factor, estrogens or thyroxine Hyperthyroidism -Thyroid hormones may indirectly increase expression by increasing hepatic transcription factor Pregnancy Anorexia nervosa -nutritional status is inversely related to SHBG level 1,2,3	Acute intermittent porphyria HIV Severe liver disease Hypothyroidism Pregnancy (normal) 12	Pregnancy -or the administration of estrogens 13,14,15	Dehydration Congestive heart failure Poor protein utilization Glucocorticoid excess (meds, adrenal overproduction of cortisol, tumor) 16
Conditions that cause a decrease in production	Increased androgen or transcortin levels Polycystic ovary syndrome Diabetes -increased levels/resistance of insulin and insulin-like growth factor 1 (ILF-1) Hypothyroidism 1,2,3,5	Kidney failure Acute illness Acromegaly Hyperthyroidism Malnutrition 12	Hypoproteinemia Cushing's syndrome Corticoid treatment Some cases of vitamin B12 deficiency Septic Shock 14	Kidney Disease Liver Disease Pregnancy Conditions of decreased nutrients: -Crohn's -Low protein diet -Sprue -Whipple's disease Insufficient anabolic hormone (DHEA, Growth Homone, Testosterone) 16

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Implications of age/gender	Levels change throughout life -influenced by hormonal and metabolic factors Levels in prepubertal children higher than adults -18% SHBG occupied in females -56% SHBG occupied in men, due to more androgens -also, age related increase in men --In pregnancy SHBG levels increase 5-10x and may protect mother from the sex steroids produced by fetus (especially androgens) 1,3	Newborn infants will present with high TBG levels 12	Prepubertal children present somewhat higher levels 14	Levels commonly decrease in elderly 17
Usual lab values	Males: 10-57nmol/L Female: (non-pregnant): 18-144 nmol/L 3	Males: 12-26mcg/ml Females: 11-27mcg/ml 12	Males: 22-55mcg/ml Females: 40-154mcg/ml 14	~3.4-5.4g/dL 16

Hormone Binding Proteins

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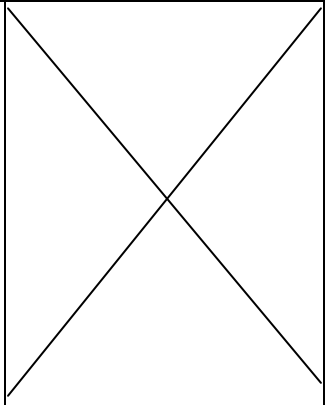
Drugs that increase production	Estrogens Soy Isoflavones (licorice) Synthetic progestins Glucocorticoids Growth hormone Phenytoin (hepatic stimulation) **OC's increase SHBG and decrease free testosterone concentrations (reason for decrease in acne)** Yaz/Yasmin (drospirenone (DRSP)/ethinyl estradiol(EE)) -doesn't bind DRSP, only EE 1,2,8, 20	Estrogens -increase total circulating thyroid/ free T3 + T4 unchanged Tamoxifen Heroin Mitotane Methadone Fluorouracil Phenothiazines 12,18	Estrogens Yaz/Yasmin (drospirenone(DRSP)/ethinyl estradiol(EE)) -DRSP causes effect not EE 14, 20	Anabolic steroids Androgens Growth hormone Insulin 21
Drugs that decrease production	Exemestane (Antineoplastic Agent) -Doses >2.5mg QD Testosterone Anabolic steroids 19	Testosterone -decreases $T4_{total}$ -Free T3 + T4 unchanged Valproic Acid Phenytoin Slow release nicotinic acid Anabolic steriods Glucocorticoids (Prednisone) 12,18	Androgens 14	

Hormone Binding Proteins

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Drugs/supplements that remove bound hormone from receptor	Nettle Root Danazol 6,7	Furosemide Fenclofanac Mefanamic acid Salicylates 18	Licorice (possible) 8	Many possible

This chart was prepared by pharmacy students Laura Burt and Megan Goldberg with direction from pharmacists Susan Goetzke and Michele Esser.

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