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Wolters Kluwer

Normal reference ranges in pregnant women

	Nonpregnant females*	First trimester	Second trimester	Third trimester	References
Hematology					
Erythropoietin¶ (units/L)	4 to 27	12 to 25	8 to 67	14 to 222	1-3,105
Ferritin¶ (ng/mL)	10 to 150Δ	6 to 130	2 to 230	0 to 116	1-8
Folate, red blood cell (ng/mL)	150 to 450	137 to 589	94 to 828	109 to 663	6, 9, 10
Folate, serum (ng/mL)	5.4 to 18.0	2.6 to 15.0	0.8 to 24.0	1.4 to 20.7	1, 6, 9-13
Haptoglobin (mg/mL)	25 to 250	130±43	115±50	135±65	91
Hemoglobin¶ (g/dL)	12 to 15.8Δ	11.6 to 13.9	9.7 to 14.8	9.5 to 15.0	2, 3, 6, 7, 13
Hematocrit¶ (%)	35.4 to 44.4	31.0 to 41.0	30.0 to 39.0	28.0 to 40.0	1, 2, 5, 6, 13-15
Iron, total binding capacity¶ (mcg/dL)	251 to 406	278 to 403	Not reported	359 to 609	7
Iron, serum¶ (mcg/dL)	41 to 141	72 to 143	44 to 178	30 to 193	2, 7
Mean corpuscular hemoglobin (pg/cell)	27 to 32	30 to 32	30 to 33	29 to 32	5
Mean corpuscular volume (xm^3)	79 to 93	81 to 96	82 to 97	81 to 99	103
Platelet ($x10^9$/L)	165 to 415	174 to 391	155 to 409	146 to 429	5, 6, 14, 16, 17
Mean platelet volume (mcm^3)	6.4 to 11.0	7.7 to 10.3	7.8 to 10.2	8.2 to 10.4	5
Red blood cell count ($x10^6/mm^3$)	4.00 to 5.20Δ	3.42 to 4.55	2.81 to 4.49	2.71 to 4.43	5, 6, 13, 14
Red cell distribution width (%)	<14.5	12.5 to 14.1	13.4 to 13.6	12.7 to 15.3	5
White blood cell count ($x10^3/mm^3$)	3.5 to 9.1	5.7 to 13.6	5.6 to 14.8	5.9 to 16.9	5, 6, 13, 14, 18
Neutrophils ($x10^3/mm^3$)	1.4 to 4.6	3.6 to 10.1	3.8 to 12.3	3.9 to 13.1	5, 14, 16, 18
Lymphocytes ($x10^3/mm^3$)	0.7 to 4.6	1.1 to 3.6	0.9 to 3.9	1.0 to 3.6	5, 14, 16, 18
Monocytes ($x10^3/mm^3$)	0.1 to 0.7	0.1 to 1.1	0.1 to 1.1	0.1 to 1.4	5, 14, 18
Eosinophils ($x10^3/mm^3$)	0 to 0.6	0 to 0.6	0 to 0.6	0 to 0.6	14, 18
Basophils ($x10^3/mm^3$)	0 to 0.2	0 to 0.1	0 to 0.1	0 to 0.1	14, 18

Transferrin (mg/dL)	200 to 400	254 to 344	220 to 441	288 to 530	4, 5
Transferrin, saturation without iron (%)	22 to 46[¶]	Not reported	10 to 44	5 to 37	3
Transferrin, saturation with iron (%)	22 to 46[¶]	Not reported	18 to 92	9 to 98	3
Hepcidin (ng/mL)	Not reported	4 to 97	6 to 36	1 to 43	98, 100
Coagulation					
Antithrombin, functional (%)	70 to 130	89 to 114	78 to 126	82 to 116	17, 19, 20
Factor V (%)	50 to 150	75 to 95	72 to 96	60 to 88	25
Factor VII (%)	50 to 150	100 to 146	95 to 153	149 to 211	17
Factor VIII (%)	50 to 150	90 to 210	97 to 312	143 to 353	17, 25
Factor IX (%)	50 to 150	103 to 172	154 to 217	164 to 235	17
Factor XI (%)	50 to 150	80 to 127	82 to 144	65 to 123	17
Factor XII (%)	50 to 150	78 to 124	90 to 151	129 to 194	17
Fibrinogen (mg/dL)	211 to 496	244 to 510	291 to 538	301 to 696	5, 17, 20, 21, 23, 24, 85
Homocysteine (mmol/L)	4.4 to 10.8	3.34 to 11	2.0 to 26.9	3.2 to 21.4	6, 9, 10-12
International Normalized Ratio	0.9 to 1.04[◊]	0.86 to 1.08	0.83 to 1.02	0.80 to 1.09	19, 24
Partial thromboplastin time, activated (seconds)	26.3 to 39.4	23.0 to 38.9	22.9 to 38.1	22.6 to 35.0	5, 17, 19, 24
Plasminogen activator inhibitor-1 (PAI-1) antigen (pg/mL)	17.3±5.7	17.7±1.9	Not reported	66.4±4.9	85
Plasminogen activator inhibitor-1 (PAI-1) activity (arbitrary units)	9.3±1.9	9.0±0.8	Not reported	31.4±3.0	85
Prothrombin time (seconds)	12.7 to 15.4	9.7 to 13.5	9.5 to 13.4	9.6 to 12.9	5, 17, 24
Protein C, functional (%)	70 to 130	78 to 121	83 to 133	67 to 135	19, 25, 26
Protein S, total (%)	70 to 140	39 to 105	27 to 101	33 to 101	17, 25, 26
Protein S, free (%)	70 to 140	34 to 133	19 to 113	20 to 65	25, 26
Protein S, functional activity (%)	65 to 140	57 to 95	42 to 68	16 to 42	25
Tissue plasminogen activator (ng/mL)	1.6 to 13[§]	1.8 to 6.0	2.36 to 6.6	3.34 to 9.20	17, 19, 85
Tissue plasminogen activator inhibitor-1 (ng/mL)	4 to 43	16 to 33	36 to 55	67 to 92	17
Activated protein C resistance (APC-r)	2.12 to 5.00	1.79 to 4.75	1.00 to 2.83	1.61 to 5.00	104
D-Dimer (DDU) (ng/mL)	<500	200 to 900	200 to 1600	400 to 500	21-23, 97

von Willebrand measurements					
von Willebrand factor antigen (%)	75 to 125	62 to 318	90 to 247	84 to 422	20, 27, 28
ADAMTS-13, von Willebrand cleaving protease	40 to 170[¥]	40 to 160	22 to 135	38 to 105	20, 28
Blood chemical constituents					
Alanine transaminase (units/L)	7 to 41	3 to 30	2 to 33	2 to 25	4, 5, 8, 29
Albumin (g/dL)	4.1 to 5.3[Δ]	3.1 to 5.1	2.6 to 4.5	2.3 to 4.2	29-32
Alkaline phosphatase (units/L)	33 to 96	17 to 88	25 to 126	38 to 229	4, 5, 8, 29, 30
Alpha-1 antitrypsin (mg/dL)	100 to 200	225 to 323	273 to 391	327 to 487	5
Alpha-fetoprotein (ng/mL)	—	—	Approximately 130-400	Approximately 130-590	93
Ammonia (microM)	31±3.2	—	—	27.3±1.6	92
Amylase (units/L)	20 to 96	24 to 83	16 to 73	15 to 81	4, 5, 33, 34
Anion gap (mmol/L)	7 to 16	13 to 17	12 to 16	12 to 16	5
Aspartate transaminase (units/L)	12 to 38	3 to 23	3 to 33	4 to 32	4, 5, 8, 29
Bicarbonate (mmol/L)	22 to 30	20 to 24	20 to 24	20 to 24	5
Bilirubin, total (mg/dL)	0.3 to 1.3	0.1 to 0.4	0.1 to 0.8	0.1 to 1.1	4, 29, 99
Bilirubin, unconjugated (mg/dL)	0.2 to 0.9	0.1 to 0.5	0.1 to 0.4	0.1 to 0.5	5, 29
Bilirubin, conjugated (mg/dL)	0.1 to 0.4	0 to 0.1	0 to 0.1	0 to 0.1	29
Bile acids (micromol/L)	0.3 to 4.8[‡]	0 to 4.9	0 to 9.1	0 to 11.3	29, 35
CA 125 antigen (units/mL)	7.2 to 27.0	2/2 to 268	12 to 25.1	16.8 to 43.8	86, 87, 88
Calcium, ionized (mg/dL)	4.5 to 5.3	4.5 to 5.1	4.4 to 5.0	4.4 to 5.3	5, 31, 36, 37
Calcium, total (mg/dL)	8.7 to 10.2	8.8 to 10.6	8.2 to 9.0	8.2 to 9.7	4, 5, 30, 32, 36-38
Ceruloplasmin (mg/dL)	25 to 63	30 to 49	40 to 53	43 to 78	5, 39
Chloride (mEq/L)	102 to 109	101 to 105	97 to 109	97 to 109	4, 5, 40
Creatinine (mg/dL)	0.5 to 0.9[Δ]	0.4 to 0.7	0.4 to 0.8	0.4 to 0.9	4, 5, 46
Gamma-glutamyl transpeptidase (units/L)	9 to 58	2 to 23	4 to 22	3 to 26	4, 5, 8, 29
Lactate dehydrogenase (units/L)	115 to 221	78 to 433	80 to 447	82 to 524	4, 5, 32, 8
Lipase (units/L)	3 to 43	21 to 76	26 to 100	41 to 112	33
Magnesium (mg/dL)	1.5 to 2.3	1.6 to 2.2	1.5 to 2.2	1.1 to 2.2	4, 5, 30-32, 36, 38

Osmolality (mOsm/kg H20)	275 to 295	275 to 280	276 to 289	278 to 280	38, 41
Phosphate (mg/dL)	2.5 to 4.3	3.1 to 4.6	2.5 to 4.6	2.8 to 4.6	4, 5, 30, 31, 42
Potassium (mEq/L)	3.5 to 5.0	3.6 to 5.0	3.3 to 5.0	3.3 to 5.1	4, 5, 15, 31, 32, 38, 40
Prealbumin (mg/dL)	17 to 34	15 to 27	20 to 27	14 to 23	5
Protein, total (g/dL)	6.7 to 8.6	6.2 to 7.6	5.7 to 6.9	5.6 to 6.7	5, 31, 32
Sodium (mEq/L)	136 to 146	133 to 148	129 to 148	130 to 148	4, 5, 15, 31, 32, 38, 41
Urea nitrogen (mg/dL)	7 to 20	7 to 12	3 to 13	3 to 11	4, 5, 40
Uric acid (mg/dL)	2.5 to 5.6$^{\Delta}$	2.0 to 4.2	2.4 to 4.9	3.1 to 6.3	4, 5, 41
Metabolic and endocrine tests					
Aldosterone (ng/dL)	2 to 9	6 to 104	9 to 104	15 to 101	43, 44, 45
Angiotensin converting enzyme (units/L)	9 to 67	1 to 38	1 to 36	1 to 39	39, 46
Alpha-fetoprotein (ng/mL)	0 to 8.5	Not reported	50 to 425	50 to 590	82, 84
Cortisol (mcg/dL)	0 to 25	7 to 19	10 to 42	12 to 50	5, 45
Hemoglobin A_{1C} (%)	4 to 6	4 to 6	4 to 6	4 to 7	36, 47, 48
Parathyroid hormone (pg/mL)	8 to 51	10 to 15	18 to 25	9 to 26	30
Parathyroid hormone-related protein (pmol/L)	<1.3†	0.7 to 0.9	1.8 to 2.2	2.5 to 2.8	30
Renin, plasma activity (ng/mL/hour)	0.3 to 9.0†	Not reported	7.5 to 54.0	5.9 to 58.8	40, 44
Thyroid-stimulating hormone (milli-int. units/mL)	0.34 to 4.25	0.60 to 3.40	0.37 to 3.60	0.38 to 4.04	4, 5, 49
[American Thyroid Association recommendation]**		0.1 to 2.5	0.2 to 3.0	0.3 to 3.0	83
Thyroxine-binding globulin (mg/dL)	1.3 to 3.0	1.8 to 3.2	2.8 to 4.0	2.6 to 4.2	5
Thyroxine, free (ng/dL)	0.8 to 1.7	0.8 to 1.2	0.6 to 1.0	0.5 to 0.8	5, 49
Thyroxine, total (mcg/dL)	5.4 to 11.7	6.5 to 10.1	7.5 to 10.3	6.3 to 9.7	5, 32
Triiodothyronine, free (pg/mL)	2.4 to 4.2	4.1 to 4.4	4.0 to 4.2	Not reported	49
Triiodothyronine, total (ng/dL)	77 to 135	97 to 149	117 to 169	123 to 162	5
Vitamins and minerals					
Copper (mcg/dL)	70 to 140	112 to 199	165 to 221	130 to 240	50, 51, 5
Selenium (mcg/L)	63 to 160	116 to 146	75 to 145	71 to 133	5, 50
Vitamin A (retinol)	20 to 100	32 to 47	35 to 44	29 to 42	5

(mcg/dL)					
Vitamin B12 (pg/mL)	279 to 966	118 to 438	130 to 656	99 to 526	6, 10
Vitamin C (ascorbic acid) (mg/dL)	0.4 to 1.0	Not reported	Not reported	0.9 to 1.3	52
Vitamin D, 1,25-dihydroxy (pg/mL)	25 to 45	20 to 65	72 to 160	60 to 119	30, 36
Vitamin D, 24,25-dihydroxy (ng/mL)	0.5 to 5.0[†]	1.2 to 1.8	1.1 to 1.5	0.7 to 0.9	53
Vitamin D, 25-hydroxy (ng/mL)	14 to 80	18 to 27	10 to 22	10 to 18	30, 53
Vitamin E (α-tocopherol) (mcg/mL)	5 to 18	7 to 13	10 to 16	13 to 23	5
Zinc (mcg/dL)	75 to 120	57 to 88	51 to 80	50 to 77	5, 13, 50
Autoimmune and inflammatory mediators					
C3 complement (mg/dL)	83 to 177	62 to 98	73 to 103	77 to 111	5
C4 complement (mg/dL)	16 to 47	18 to 36	18 to 34	22 to 32	5
C-reactive protein (mg/L)	0.2 to 3.0	Not reported	0.4 to 20.3	0.4 to 8.1	54
Erythrocyte sedimentation rate (mm/hour)	0 to 20[Δ]	4 to 57	7 to 47	13 to 70	55
Immunoglobulin A (mg/dL)	70 to 350	95 to 243	99 to 237	112 to 250	5
Immunoglobulin G (mg/dL)	700 to 1700	981 to 1267	813 to 1131	678 to 990	5
Immunoglobulin M (mg/dL)	50 to 300	78 to 232	74 to 218	85 to 269	5
Sex hormones					
Dehydroepiandrosterone sulfate (mmol/L)	1.3 to 6.8[†]	2.0 to 16.5	0.9 to 7.8	0.8 to 6.5	56
Estradiol (pg/mL)	<20 to 443[Δ,¶¶]	188 to 2497	1278 to 7192	614 to 3460	56, 57
Progesterone (ng/mL)	<1 to 20[Δ]	8 to 48		99 to 342	56, 57
Prolactin (ng/mL)	0 to 20	36 to 213	110 to 330	137 to 372	30, 47, 57, 58
Sex hormone binding globulin (nmol/L)	18 to 114[Δ]	39 to 131	214 to 717	216 to 724	56, 59
Testosterone (ng/dL)	6 to 86[Δ]	25.7 to 211.4	34.3 to 242.9	62.9 to 308.6	56
17-hydroxyprogesterone (nmol/L)	0.6 to 10.6[Δ,†]	5.2 to 28.5	5.2 to 28.5	15.5 to 84	56
Lipids					
Cholesterol, total (mg/dL)	<200	141 to 210	176 to 299	219 to 349	5, 60-62
High-density lipoprotein cholesterol (mg/dL)	40 to 60	40 to 78	52 to 87	48 to 87	5, 60-63

Low-density lipoprotein cholesterol (mg/dL)	<100	60 to 153	77 to 184	101 to 224	5, 60-63
Very-low-density lipoprotein cholesterol (mg/dL)	6 to 40[†]	10 to 18	13 to 23	21 to 36	62
Triglycerides (mg/dL)	<150	40 to 159	75 to 382	131 to 453	4, 5, 60-63
Apolipoprotein A-I (mg/dL)	119 to 240	111 to 150	142 to 253	145 to 262	4, 47, 61
Apolipoprotein B (mg/dL)	52 to 163	58 to 81	66 to 188	85 to 238	4, 47, 61
Cardiac function					
Cardiac output (L/minute)	4.8 to 6.8	5.6 to 9.7	5.5 to 9.9	4.8 to 8.7	64, 65, 66, 67, 68
Cardiac index (L/min/m^2)	2.6 to 4.2	3.2 to 4.6	3.1 to 4.7	2.5 to 4.4	65, 68
Stroke volume (mL)	79 to 90	77.5 to 107.6	70.3 to 107.6	54 to 99	65, 68, 69
Stroke index (mL/m^2)		46 to 62	39 to 62	30 to 42	65
Systemic vascular resistance (dyns/cm^5)	700 to 1600	747 to 1485	692 to 1201	1034 to 1201	65, 67, 70
Echocardiography					
Intraventricular septal dimension (cm)	0.7 to 0.9	0.63 to 0.83	0.65 to 0.85	0.66 to 0.9	68, 69, 70, 89, 90
Posterior ventricular wall dimension (cm)	0.75 to 0.9	0.56 to 0.8	0.59 to 0.9	0.59 to 0.9	68, 69, 70, 89, 90
Left ventricular mass (g)	116 to 143	108 to 167	115 to 150	128 to 162	68, 70, 89, 90
Left ventricular mass index	40 to 78	53 to 79	58 to 82	60 to 88	68, 70, 89, 90
E/A ratio	1.4 to 1.75	1.6	1.4	1.3	68, 70
Left ventricular diastolic diameter (cm)	4.3 to 4.8	4.3 to 4.6	4.4 to 4.9	5.1	69, 70
Left ventricular systolic diameter (cm)	2.8 to 3.1	2.8 to 2.9	2.8 to 3.4	2.8 to 3.3	69, 70
Left vent, fractional shortening (%)	35 to 36	35 to 37	3.5	35 to 36	69, 70
Left vent ejection fraction (%)	60 to 73	61 to 75	61 to 63	60 to 73	69, 70
Diastolic function					
Mitral E wave (m/second)	0.77±0.11	0.85±0.13	0.84±0.16	0.77±0.15	89, 90
Mitral A wave (m/second)	0.46±0.1	0.5±0.09	0.5±0.1	0.55±0.1	89, 90
Isovolumic relaxation time (m/second)	69±10	50±10	79±18	72±16	89, 90
Cardiac function (blood tests)					
Atrial natriuretic peptide (pg/mL)	Not reported	Not reported	28.1 to 70.1	Not reported	73
B-type natriuretic	<167 (age- and	18.4	13.5 to 29.5	15.5 to 46	71, 72, 73, 95

peptide (pg/mL)	gender-specific)				
Creatine kinase (units/L)	39 to 238[Δ]	27 to 83	25 to 75	13 to 101	5, 74
Creatine kinase-MB (units/L)	<6[ΔΔ]	—	—	1.8 to 2.4	74
N-terminal pro-brain natriuretic peptide (pg/mL)	50±26	60±45	60±40	43±34	94
Troponin I (hs-TnI)	0 to 1.0	0 to 1.0	0 to 1.0	0 to 1.0	102
Blood gas					
pH	7.38 to 7.42 (arterial)	7.36 to 7.52 (venous)	7.40 to 7.52 (venous)	7.41 to 7.53 (venous) 7.39 to 7.45 (arterial)	31, 75
PO_2 (mmHg)	90 to 100	93 to 100	90 to 98	92 to 107	75, 76
PCO_2 (mmHg)	38 to 42	Not reported	Not reported	25 to 33	75
Bicarbonate (HCO_3^-) (mEq/L)	22 to 26	Not reported	Not reported	16 to 22	75
Renal function tests					
Effective renal plasma flow (mL/minute)	492 to 696[Δ,†]	696 to 985	612 to 1170	595 to 945	77, 78
Glomerular filtration rate (GFR) (mL/minute)	106 to 132[Δ]	131 to 166	135 to 170	117 to 182	77, 78, 79
Filtration fraction (%)	16.9 to 24.7[◊◊]	14.7 to 21.6	14.3 to 21.9	17.1 to 25.1	77, 78, 79
Osmolarity, urine (mOsm/kg)	500 to 800	326 to 975	278 to 1066	238 to 1034	80
24-h albumin excretion (mg/24 hours)	<30	5 to 15	4 to 18	3 to 22	80, 81
24-h calcium excretion (mmol/24 hours)	<7.5[†]	1.6 to 5.2	0.3 to 6.9	0.8 to 4.2	15
24-h creatinine clearance (mL/minute)	91 to 130	69 to 140	55 to 136	50 to 166	15, 78
24-h creatinine excretion (mmol/24 hours)	8.8 to 14[†]	10.6 to 11.6	10.3 to 11.5	10.2 to 11.4	80
24-h potassium excretion (mmol/24 hours)	25 to 100[†]	17 to 33	10 to 38	11 to 35	15
24-h protein excretion (mg/24 hours)	<150	19 to 141	47 to 186	46 to 185	81
24-h sodium excretion (mmol/24 hours)	100 to 260[†]	53 to 215	34 to 213	37 to 149	15, 41
Pulmonary function tests					
Forced vital capacity (FVC) (L)	4.00±0.51	3.89±0.48	3.92±0.48	4.00±0.53	96
Forced expiratory	3.20±0.41	3.18±0.44	3.16±0.39	3.20±0.43	96

volume in one second (FEV1) (L)					
Peak expiratory flow (PEF) (L/second)	7.18±1.05	6.71±1.19	6.92±1.13	7.19±1.10	96
Tidal volume (L)	0.21 to 0.48	0.52±0.15	0.54±0.15	0.57±0.14	101
Minute ventilation (L)	2.27 to 10.35	12.63±3.89	13.05±3.55	14.08±4.07	101

* Unless otherwise specified, all normal reference values are from the seventeenth edition of *Harrison's Principles of Internal Medicine*[82].

¶ Range includes references with and without iron supplementation.

Δ Normal reference range is specific range for females.

◊ Reference values are from Cerneca et al: Coagulation and fibrinolysis changes in normal pregnancy increased levels of procoagulants and reduced levels of inhibitors during pregnancy induce a hypercoagulable state, combined with a reactive fibrinolysis[19].

§ References values are from Cerneca et al and Choi et al: Tissue plasminogen activator levels change with plasma fibrinogen concentrations during pregnancy[17,19].

¥ Reference values are from Mannuci et al: Changes in health and disease of the metalloprotease that cleaves von Willebrand factor[28].

‡ Reference values are from Bacq Y et al: Liver function tests in normal pregnancy: a prospective study of 102 pregnant women and 102 matched controls[29].

† Reference values are from the fifteenth edition of *Harrison's Principles of Internal Medicine*[83].

** The American Thyroid Association recommends these TSH ranges if individual laboratories do not determine their own trimester-specific reference ranges.

¶¶ Range is for premenopausal females and varies by menstrual cycle phase.

ΔΔ Reference values are from Leiserowitz GS et al: Creatine kinase and its MB isoenzyme in the third trimester and the peripartum period[74].

◊◊ Reference values are from Dunlop W: Serial changes in renal haemodynamics during normal human pregnancy[77].

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