

Lipids and Lipoproteins in Blood Plasma (Serum)

National Cholesterol Education Program Guidelines

The National Cholesterol Education Program (NCEP) of the National Heart, Lung, and Blood Institute established guidelines for detection, evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel III [ATP III]). The ATP III guidelines for desirable lipid concentrations and those concentrations associated with increased risk for cardiovascular disease in adults are not dependent on age or sex. The guidelines consist of the following points (JAMA 2001;285:2486-2497):

STEP 1: Determine lipoprotein levels-obtain complete lipoprotein profile after a 9- to 12-hour fast:

ATP III Classification of Low Density Lipoprotein (LDL), Total and High Density Lipoprotein (HDL) Cholesterol (mg/dL)	
LDL Cholesterol—Primary Target of Therapy	
<100	Optimal
100-129	Near optimal/above optimal
130-159	Borderline high
160-189	High
≥190	Very high
Total Cholesterol	
<200	Desirable
200-239	Borderline high
≥240	High
HDL Cholesterol	
<40	Low
≥60	High

STEP 2: Identify the presence of clinical atherosclerotic disease that confers high risk for coronary heart disease (CHD) events (CHD-risk equivalent):

- Clinical CHD
- Symptomatic carotid artery disease
- Peripheral arterial disease
- Abdominal aortic aneurysm
- Diabetes

STEP 3: Determine the presence of major risk factors (other than LDL):

Major Risk Factors (Exclusive of LDL Cholesterol) that Modify LDL Goals
• Cigarette smoking
• Hypertension (blood pressure ≥140/90 mm Hg or on antihypertensive medication)
• Low HDL cholesterol (<40 mg/dL)*
• Family history of premature CHD (CHD in male first degree relative <55 years; CHD in female first degree relative <65 years)
• Age (men ≥45 years; women ≥55 years)
* HDL cholesterol ≥60 mg/dL counts as a “negative” risk factor; its presence removes 1 risk factor from the total count.

Note: In ATP III, diabetes is regarded as a CHD-risk equivalent.

STEP 4: If 2 or more risk factors (other than LDL) are present without CHD or CHD-risk equivalent, assess 10-year (short-term) CHD risk (see Framingham tables):

Three levels of 10-year risk:

- >20%—CHD-risk equivalent
- 10-20%
- <10%

STEP 5: Determine risk category:

- Establish LDL goal of therapy
- Determine need for therapeutic lifestyle changes (TLC)
- Determine level for drug consideration

LDL Cholesterol Goals and Cutpoints for TLC and Drug Therapy in Different Risk Categories			
Risk Category	LDL Goal	LDL Level at Which to Initiate TLC	LDL Level at Which to Consider Drug Therapy
CHD or CHD-risk equivalents (10-year risk >20%)	<100 mg/dL	≥100 mg/dL	≥130 mg/dL (100-129 mg/dL: drug optional)*
2 Or more risk factors (10-year risk ≤20%)	<130 mg/dL	≥130 mg/dL	10-year risk 10-20% ≥130 mg/dL
			10-year risk <10% ≥160 mg/dL
0-1 Risk factor**	<160 mg/dL	≥160 mg/dL	≥190 mg/dL (160-189 mg/dL: LDL-lowering drug optional)
* Some authorities recommend use of LDL-lowering drugs in this category if an LDL cholesterol <100 mg/dL cannot be achieved by TLC. Others prefer use of drugs that primarily modify triglycerides and HDL, eg, nicotinic acid or fibrate. Clinical judgement also may call for deferring drug therapy in the subcategory.			
** Almost all people with 0-1 risk factor have a 10-year risk of <10%, thus 10-year risk assessment in people with 0-1 risk factor is not necessary.			

STEP 6: Initiate TLC if LDL is above goal:

TLC features:

- TLC diet:
 - Saturated fat, <7% of calories, cholesterol <200 mg/day
 - Consider increased viscous (soluble) fiber (10-25 g/day) and plant stanols/sterols (2 g/day) as therapeutic options to enhance LDL lowering
- Weight management
- Increased physical activity

STEP 7: Consider adding drug therapy if LDL exceeds levels shown in STEP 5:

- Consider drug simultaneously with TLC for CHD and CHD equivalents
- Consider adding drug to TLC after 3 months for other risk categories

Drugs Affecting Lipoprotein Metabolism				
Drug Class	Agents and Daily Doses	Lipid/Lipoprotein Effects	Side Effects	Contraindications
HMG CoA reductase inhibitors (statins)	Lovastatin (20-80 mg) Pravastatin (20-40 mg) Simvastatin (20-80 mg) Fluvastatin (20-80 mg) Atorvastatin (10-80 mg) Rosuvastatin (5-40 mg)	LDL-C: ↓18-55% HDL-C: ↑5-15% TG: ↓7-30%	Myopathy Increased liver enzymes	Absolute: active or chronic liver disease Relative: concomitant use of certain drugs*
Bile acid sequestrants	Cholestyramine (4-16 g) Colestipol (5-20 g) Colesevelan (2.6-3.8 g)	LDL-C: ↓15-30% HDL-C: ↑3-5% TG: No change or increase	Gastrointestinal (GI) distress Constipation Decreased absorption of other drugs	Absolute: dysbeta-lipoproteinemia: TG >400 mg/dL Relative: TG >200 mg/dL
Nicotinic acid	Immediate release (crystalline) nicotinic acid (1.5-3 g) Extended release nicotinic acid (Niaspam®) (1-2 g) Sustained release nicotinic acid (1-2 g)	LDL-C: ↓5-25% HDL-C: ↑15-35% TG: ↓20-50%	Flushing Hyperglycemia Hyperuricemia (or gout) Upper GI distress Hepatotoxicity	Absolute: chronic liver disease and severe gout Relative: diabetes, hyperuricemia, and peptic ulcer disease
Fibric acids	Gemfibrozil (600 mg b.i.d.) Fenofibrate (200 mg) Clofibrate (1,000 mg b.i.d.)	LDL-C: ↓5-20% may be increased in patients with high TG HDL-C: ↑10-20% TG: ↓20-50%	Dyspepsia Gallstones Myopathy	Absolute: severe renal disease and severe hepatic disease

* Cyclosporine, macrolide antibiotics, various anti-fungal agents, and cytochrome P450 inhibitors (fibrates and niacins) should be used with appropriate caution.

STEP 8: Identify metabolic syndrome and, if present after 3 months of TLC, treat:

Clinical Identification of the Metabolic Syndrome-Any 3 of the Following:	
Risk Factor	Defining Level
Abdominal obesity	Waist circumference*
Men	>102 cm (>40 in)
Women	>88 cm (>35 in)
Triglycerides	≥150 mg/dL
HDL cholesterol	
Men	<40 mg/dL
Women	<50 mg/dL
Blood pressure	≥130/≥85 mm Hg
Fasting glucose	≥110 mg/dL

* Some male patients can develop multiple metabolic risk factors when the waist circumference is only marginally increased, eg, 94-102 cm (37-39 in). Some patients may have a strong genetic contribution to insulin resistance. They should benefit from change in life habits, similarly to men with categorical increases in waist circumference.

- Overweight and obesity are associated with insulin resistance and the metabolic syndrome. However, the presence of abdominal obesity is more highly correlated with the metabolic risk factors than is an elevated body mass index (BMI). Therefore, the simple measure of waist circumference is recommended to identify the body weight component of the metabolic syndrome.
- Treatment of the metabolic syndrome:
 - Treat underlying causes (overweight/obesity and physical inactivity):
 - Intensify weight management
 - Increase physical activity

- Treat lipid and non-lipid risk factors if they persist despite these lifestyle therapies:
 - Treat hypertension:
 - Use aspirin for CHD patients to reduce prothrombotic state
 - Treat elevated triglycerides and/or low HDL (as shown in STEP 9)

STEP 9: Treat elevated triglycerides:

ATP III Classification of Serum Triglycerides (mg/dL)	
LDL Cholesterol—Primary Target of Therapy	
<150	Normal
150-199	Borderline high
200-499	High
≥500	Very high

- Treatment of elevated triglycerides (≥150 mg/dL):
 - Primary aim of therapy is to reach LDL goal
 - Intensify weight management
 - Increase physical activity
 - If triglycerides are ≥200 mg/dL **after** LDL goal is reached, set secondary goal for non-HDL cholesterol (total HDL) 30 mg/dL higher than LDL goal

Comparison of LDL Cholesterol and Non-HDL Cholesterol Goals for 3 Risk Categories		
Risk Category	LDL Goal (mg/dL)	Non-HDL Goal (mg/dL)
CHD or CHD-risk equivalent (10-year risk for CHD >20%)	<100	<130
Multiple (2 or more) risk factors and 10-year ≤20%	<130	<160
0-1 Risk factor(s)	<160	<190

- If triglycerides are 200 mg/dL to 499 mg/dL after LDL goal is reached, consider adding drug if needed to reach non-HDL goal:
 - Intensify therapy with LDL-lowering drug, or
 - Add nicotinic acid or fibrate to further lower very low density lipoprotein (VLDL)
- If triglycerides are ≥500 mg/dL, first lower triglycerides to prevent pancreatitis:
 - Very low-fat diet (≤15% of calories from fat)
 - Weight management and physical activity
 - Fibrate or nicotinic acid
 - When triglycerides are <500 mg/dL, turn to LDL-lowering therapy
- Treatment of low HDL cholesterol (<40 mg/dL):
 - First reach LDL goal, then:
 - Intensify weight management and increase physical activity
 - If triglycerides are 200 mg/dL to 499 mg/dL, achieve non-HDL goal
 - If triglycerides are <200 mg/dL (isolated low HDL) in CHD or CHD equivalent, consider nicotinic acid or fibrate

Lipoprotein Profile Information

Lipoprotein analysis can provide practical information about a patient's health. A definitive analysis must include preparative ultracentrifugation and quantitation of 1 or more components of each of the various individual lipoprotein fractions. Electrophoresis of the whole serum, of the isolated VLDLs, and of the LDLs and HDLs separate from the VLDLs provides an overview analysis to guide subsequent quantitative analyses; by electrophoresis of the serum and the fractions, the quantitatively significant components are revealed, and quantitative fractionation can be tailored accordingly. The testing of lipoprotein profiles in Mayo Medical Laboratories includes ultracentrifugation, selective precipitation, electrophoresis, quantitation of cholesterol and triglycerides in isolated lipoprotein fractions, and, in some cases, analysis of apolipoproteins. Lipoprotein profile considerations include:

1. An increased level of LDL is a risk factor for atherosclerotic disease.
2. A high level of HDL may or may not reflect a healthy status. For a person who has no liver disease or chronic intoxication of any form, a high level of HDL probably is an indication of a healthy metabolic system and a relatively low risk for atherosclerotic disease. Otherwise, a high level (or increased concentration) of HDL may reflect the existence of an early stage of primary biliary cirrhosis or the existence of chronic hepatitis or of alcoholism or some other form of chronic intoxication.

3. Hypercholesterolemia apparently has been considered by many persons to be an expression of an increased concentration of LDL or type IIa hyperlipoproteinemia. In some patients, however, an increased or relatively high level of serum cholesterol reflects increased levels of other lipoproteins (HDL, LDL, VLDL, or chylomicrons). This interpretational problem is readily resolvable through simple quantitative testing involving ultracentrifugation or selective precipitation or a combination of these methods. In addition, hypercholesterolemia can be a reflection of the presence of "LP-X," the abnormal lipoprotein complex associated with cholestasis, or of anomalous conditions. The basis of hypercholesterolemia in any single case can best be identified through the combination of electrophoretic screening and quantitative testing, with the method of quantitative testing being selected according to the forms of the lipoproteins that are prominent in the electrophoregrams.
4. Identification of patients who have type III hyperlipoproteinemia may be helpful for their optimal management. A definitive analysis must include establishing the presence of an increased population of cholesterol-rich, VLDL particles of sizes much smaller than the primary VLDL particles. Evaluation of the cholesterol/triglyceride ratio in the isolated total VLDL is a necessary step.
5. Abnormalities in the serum lipoprotein profile can suggest various problems in metabolism, liver function, and renal function in addition to being reflections of problems primarily inherent in lipid transport.
6. For many patients, quantitative analysis of a single lipoprotein fraction is inadequate for evaluation of the status of the lipoprotein profile. Although the serum total cholesterol value and the HDL cholesterol value together can be adequate primary information for the evaluation of some specimens, in many cases, an adequate evaluation can be accomplished only with examination of the entire lipoprotein profile.
7. Analysis of the serum lipoproteins may be of use if the patient's lipid values (cholesterol, triglycerides, HDL, LDL) are abnormal (outside the guidelines established by the NCEP's ATP III). Once a lipoprotein analysis has been obtained, routine repetition of lipoprotein analysis is not necessary; however, reevaluation of the lipoproteins would be appropriate after a clinically significant change in either the serum cholesterol or triglyceride concentration.

Lipoprotein (a) Cholesterol

Lipoprotein (a) [Lp(a)], first reported in 1963 by the Norwegian physician-investigator, Kare Berg, consists of an ordinary LDL particle combined with an additional protein. Like in LDL, the Lp(a) particle contains apolipoprotein B100 (molecular weight=approximately 512,000 D), but additionally contains apolipoprotein (a) (molecular weight=275,000-800,000 D), which is covalently linked to apolipoprotein B100. Apolipoprotein (a) has a high sequence homology with plasminogen.

The Lp(a) particle has been referred to as "the most atherogenic lipoprotein." Observations over the last 3 decades have indicated that Lp(a) increases cardiovascular risk 2- to 3-fold when its level in the blood plasma is above 30 mg/dL; correspondingly, Lp(a) cholesterol would be above 5 mg/dL. Lp(a) concentrations of ≤ 15 mg/dL [Lp(a) cholesterol ≤ 5 mg/dL] appear not to confer an increased risk. Some recent observations have indicated that Lp(a)-associated cardiovascular risk is significant only when the concentration of the companion risk factor, LDL, is also increased.

Concentrations of Lp(a) particles in the blood can be expressed readily either as concentrations of Lp(a)-specific protein or as Lp(a) cholesterol. Accurate immunochemical measurement of Lp(a)-specific protein, however, is complicated by a number of factors. A significant problem is the issue of how to express the result of a quantitative test for Lp(a)-specific protein in meaningful terms. Because the molecular size of Lp(a)-specific protein varies over a broad range in the population (240,000-800,000 D), a test result primarily related to the number of molecules of Lp(a)-specific protein in a specimen cannot be expressed accurately or meaningfully in terms of mg protein/dL unless the molecular weight of the Lp(a)-specific protein in that specimen has been determined. An additional related concern is that the degree of atherogenicity of the Lp(a) particle in any specific case might depend on the molecular size of the Lp(a)-specific protein.

Cardiovascular Laboratory Medicine measures and reports Lp(a) cholesterol as part of the lipoprotein profile. It is also available as a stand alone test (#89005 "Lipoprotein (a) Cholesterol, Serum"). The cholesterol content of Lp(a) particles varies little, and Lp(a) cholesterol can be readily quantified. In many cases, we have observed Lp(a) cholesterol to be at levels of 25 mg/dL to 50 mg/dL and in rare cases as high as 100 mg/dL. Thus, Lp(a) can contain significant proportions of the serum cholesterol. In such cases, knowledge of the concentration of Lp(a) and of the contribution of Lp(a) cholesterol to the serum total cholesterol should be helpful to physicians in their evaluation of cardiovascular risk levels.

Lipid Reference Values for Lipoprotein Profile*

The following set of values by percentiles has been determined at Mayo Clinic for a defined population of healthy persons. These age-related, sex-related reference data are based on approximately 4,000 ostensibly healthy persons who have favorable family histories in relation to metabolic diseases and atherosclerotic disease. Specimens were collected and analyses performed in the early 1970s using analytic systems that were standardized with the Lipid Standardization Laboratory of the Centers for Disease Control and Prevention (CDC) at that time. We recommend use of NCEP ATP III guidelines for upper limits of total cholesterol, LDL cholesterol, triglycerides, and HDL cholesterol.

5th-95th Percentile Ranges by Age and Sex						
Cholesterol						
Age (Years)		Females			Males	
	VLDL	LDL	HDL	VLDL	LDL	HDL
6-11	3-20	60-150 (114)	34-65	3-20	60-140 (114)	30-70
12-14	3-25	60-150 (114)	30-65	3-25	60-140 (111)	30-65
15-19	3-25	60-150 (118)	33-65	3-30	60-140 (113)	30-60
20-29	3-35	60-160 (128)	34-75	5-45	60-175 (131)	30-65
30-39	3-35	70-170 (140)	35-80	5-60	70-190 (147)	30-70
40-49	3-35	80-190 (150)	35-80	5-60	70-205 (160)	30-70
≥50	3-35	80-200 (164)	35-80	10-60	80-220 (170)	30-70

() Values in parentheses approximate the 75th percentile values for LDL cholesterol.
 *The values are in mg/dL of serum and represent healthy persons at the mean ages of the age ranges shown.

5th-95th Percentile Ranges by Age and Sex						
Triglycerides						
Age (Years)		Females			Males	
	VLDL	LDL	HDL	VLDL	LDL	HDL
6-7	10-60	10-25	5-15	5-60	10-25	5-15
8-11	5-85	10-25	5-15	5-60	10-25	5-15
12-14	5-85	10-25	5-15	5-90	10-25	5-15
15-19	5-85	10-25	5-15	5-105	10-25	5-15
20-29	5-90	10-30	5-15	5-155	10-30	5-20
30-39	5-90	10-40	5-15	5-155	10-40	5-20
40-49	5-90	10-40	5-15	5-155	10-50	5-20
≥50	10-90	10-40	5-15	15-155	10-50	5-20

*The values are in mg/dL of serum and represent healthy persons at the mean ages of the age ranges shown.

Cholesterol, HDL-Percentile Ranking

Females												
Age (Years)	N	Percentiles										
		5	10	20	30	40	50	60	70	80	90	95
6-11	330	34	38	41	44	47	48	50	55	56	61	66
12-14	470	30	33	36	39	42	44	47	50	53	57	63
15-19	428	33	35	39	43	45	47	50	53	56	60	64
20-29	39	34	37	42	45	48	50	52	55	59	65	75
30-39	42	35	38	44	48	51	54	57	60	64	70	79
40-49	38	35	40	47	51	54	57	60	63	68	74	80
50-59	39	35	43	49	53	56	59	62	65	70	76	80
60-69	32	35	43	49	53	56	59	62	65	70	76	80

*The values are in mg/dL of serum and represent healthy persons at the mean ages of the age ranges shown.

Males												
Age	N	Percentiles		20	30	40	50	60	70	80	90	95
(Years)		5	10									
6-11	312	30	35	39	48	51	53	54	59	63	67	69
12-14	491	30	33	37	39	43	44	46	49	53	58	63
15-19	392	29	31	34	36	39	40	44	47	49	53	57
20-29	37	30	34	37	39	41	43	45	47	50	57	65
30-39	40	30	34	37	39	41	43	45	47	50	59	68
40-49	39	30	33	37	39	41	44	45	47	50	59	69
50-59	37	30	34	37	39	41	44	45	47	50	60	70
60-69	31	30	34	37	39	41	43	45	47	50	60	70

*The values are in mg/dL of serum and represent healthy persons at the mean ages of the age ranges shown.

Cholesterol, LDL-Percentile Ranking

Females													
Age	N	Percentiles		20	30	40	50	60	70	75	80	90	95
(Years)		5	10										
6-11	330	63	72	81	89	94	99	105	110	114	120	130	150
12-14	470	64	72	81	89	94	99	105	110	114	120	130	150
15-19	428	66	73	83	90	96	101	107	114	118	122	133	152
20-29	39	72	79	89	97	103	109	115	123	128	132	143	160
30-39	42	78	87	97	105	112	119	126	135	140	145	155	173
40-49	38	83	92	104	113	121	128	137	146	150	157	170	188
50-59	39	90	99	112	122	131	139	148	158	164	170	180	200
60-69	32	95	106	120	131	140	150	159	170	175	180	190	208

*The values are in mg/dL of serum and represent healthy persons at the mean ages of the age ranges shown.

Males													
Age	N	Percentiles		20	30	40	50	60	70	75	80	90	95
(Years)		5	10										
6-11	312	68	74	83	88	94	99	105	111	114	120	129	140
12-14	491	64	70	79	84	90	95	100	107	111	116	130	140
15-19	392	62	68	75	84	90	96	102	109	113	117	135	148
20-29	37	69	78	88	96	104	110	118	126	131	136	155	171
30-39	40	77	87	99	108	116	125	132	141	147	154	170	191
40-49	39	85	95	107	118	127	134	144	154	160	166	180	206
50-59	37	93	103	115	127	136	145	154	164	170	176	196	214
60-69	31	96	107	120	131	140	149	159	169	175	182	200	217

*The values are in mg/dL of serum and represent healthy persons at the mean ages of the age ranges shown.

Total Cholesterol-Percentile Ranking

Females												
Age (Years)	Percentiles		20	30	40	50	60	70	75	80	90	95
	5	10										
0-5	Not established											
6-9	122	129	141	150	154	158	162	167	173	180	189	209
10-14	124	134	142	149	155	161	168	178	174	190	203	217
15-19	125	133	142	148	154	159	165	171	175	180	199	212
20-24	128	134	144	152	158	163	169	177	181	185	197	209
25-29	134	142	152	159	165	171	178	186	190	194	207	218
30-34	141	149	159	166	173	180	186	194	199	204	217	229
35-39	147	156	167	175	182	188	196	204	209	214	228	240
40-44	155	164	175	183	191	198	206	215	219	224	239	253
45-49	162	171	184	192	200	208	216	224	229	235	251	265
50-54	171	180	192	202	210	218	227	236	241	246	263	278
55-59	179	190	202	212	220	228	237	247	253	259	276	291
60-64	188	198	212	222	231	240	249	259	265	271	290	306
65-69	197	208	222	233	242	252	261	271	278	285	304	320
70-74	207	218	232	244	254	264	274	285	291	298	319	336
>74	217	229	244	256	266	277	287	299	306	313	334	352

*The values are in mg/dL of serum and represent healthy persons at the mean ages of the age ranges shown.

Males												
Age (Years)	Percentiles		20	30	40	50	60	70	75	80	90	95
	5	10										
0-5	Not established											
6-9	126	133	141	146	151	156	162	168	172	176	187	191
10-14	130	135	145	152	157	162	167	174	179	185	196	204
15-19	114	117	130	139	145	151	156	162	167	173	190	198
20-24	128	135	145	153	160	166	173	181	185	190	204	216
25-29	140	148	159	168	175	182	189	197	202	208	222	236
30-34	150	160	170	178	187	194	202	211	216	222	238	250
35-39	156	166	179	187	196	203	212	221	226	232	250	264
40-44	162	172	185	195	203	211	220	229	235	241	258	274
45-49	166	176	190	200	208	217	226	236	242	248	264	280
50-54	170	180	193	204	213	221	230	240	246	252	270	286
55-59	173	183	196	207	216	225	234	244	250	256	275	291
60-64	175	185	198	209	218	228	237	247	253	259	278	295
65-69	176	186	200	211	220	229	239	249	255	262	280	298
70-74	177	188	202	212	221	230	240	250	256	263	282	299
>74	178	190	202	213	223	231	241	251	257	264	282	300

*The values are in mg/dL of serum and represent healthy persons at the mean ages of the age ranges shown.

Triglycerides-Percentile Ranking

Females											
Age (Years)	Percentiles		20	30	40	50	60	70	80	90	95
	5	10									
0-5	Not established										
6-9	34	39	45	50	53	56	59	62	66	70	76
10-14	33	37	44	51	56	63	68	77	90	100	121
15-19	33	36	42	47	52	57	62	67	77	88	122
20-24	32	36	43	47	52	56	61	67	75	86	97
25-29	33	38	44	49	54	59	64	70	78	89	100
30-34	35	41	46	52	57	62	67	74	81	94	106
35-39	38	42	49	55	60	65	71	77	86	99	110
40-44	40	44	52	57	63	68	74	81	89	104	117
45-49	41	46	54	60	66	71	78	85	94	108	122
50-54	43	49	56	63	69	75	81	89	98	113	128
55-59	45	52	59	66	72	78	85	93	103	119	134
60-64	47	54	62	69	76	82	89	97	106	125	140
65-69	50	56	65	72	79	86	93	102	113	130	147
70-74	52	59	68	76	83	90	98	107	118	137	154
>74	54	62	72	79	87	95	103	112	124	143	162

*The values are in mg/dL of serum and represent healthy persons at the mean ages of the age ranges shown.

Males											
Age (Years)	Percentiles		20	30	40	50	60	70	80	90	95
	5	10									
0-5	Not established										
6-9	27	32	37	42	46	50	55	60	68	87	102
10-14	30	33	40	46	51	56	61	66	74	92	103
15-19	31	33	39	46	53	62	69	78	90	107	124
20-24	34	41	48	56	62	69	77	86	98	118	137
25-29	40	46	56	64	72	80	88	98	113	136	157
30-34	43	51	62	70	78	87	97	109	124	148	171
35-39	45	54	65	74	83	92	102	114	130	157	182
40-44	48	56	67	77	86	96	106	119	135	162	189
45-49	50	57	69	79	88	98	109	121	138	166	193
50-54	50	58	70	80	89	99	110	123	140	169	195
55-59	51	59	71	81	90	100	111	124	142	170	197
60-64	51	59	71	81	91	101	111	125	142	170	198
65-69	51	59	71	81	91	101	112	126	143	171	199
70-74	51	59	71	82	91	101	112	126	143	172	199
>74	51	60	71	82	91	101	112	126	144	172	199

*The values are in mg/dL of serum and represent healthy persons at the mean ages of the age ranges shown.

The 75th percentile values are proposed as guidelines for significant hypercholesterolemia and the 95th percentile for significant triglyceridemia. This should not be construed to imply that values below these percentiles are without risk in the development of atherosclerosis, particularly coronary artery disease. The risk of coronary artery disease apparently is present at lower lipid levels and increases stepwise with increments in serum lipid values. The predictive value of blood lipid concentrations diminishes with increasing age. Hypertension and cigarette smoking augment the cardiac risk attendant on hyperlipidemia.