

Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.

eTable 1. Maximal Sample Sizes^a, by Survey Cycle: National Health and Nutrition Examination Survey, 1999-2016

	Sample Sizes (N, [% ^b]) for Total Cholesterol, HDL Cholesterol, and Non-HDL Cholesterol Analyses ^c								
	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008	2009-2010	2011-2012	2013-2014	2015-2016
All youth	2930	3139	2821	2826	2055	2150	2076	2282	2099
Females	1417 (48)	1556 (50)	1367 (48)	1390 (49)	988 (48)	1021 (47)	1014 (49)	1115 (49)	1032 (49)
Age, years									
6-8	415 (14)	495 (16)	397 (14)	415 (15)	481 (23)	464 (22)	486 (23)	513 (22)	495 (24)
9-11	439 (15)	507 (16)	439 (16)	486 (17)	506 (25)	507 (24)	493 (24)	536 (23)	497 (24)
12-15	1078 (37)	1097 (35)	991 (35)	954 (34)	536 (26)	573 (27)	553 (27)	629 (28)	573 (27)
16-19	998 (34)	1040 (33)	994 (35)	971 (34)	532 (26)	606 (28)	544 (26)	604 (26)	534 (25)
Race/ethnicity									
NH white	595 (20)	938 (30)	730 (26)	735 (26)	627 (31)	672 (31)	475 (23)	605 (27)	547 (26)
NH black	819 (28)	982 (31)	1021 (36)	911 (32)	519 (25)	436 (20)	619 (30)	556 (24)	447 (21)
Mexican	1264 (43)	960 (31)	873 (31)	939 (33)	527 (26)	644 (30)	404 (19)	550 (24)	499 (24)
Other Hispanic	141 (5)	134 (4)	87 (3)	84 (3)	322 (16)	255 (12)	233 (11)	232 (10)	291 (14)
NH Asian^d	-	-	-	-	-	-	234 (11)	201 (9)	186 (9)
Other race^d	111 (4)	125 (4)	110 (4)	157 (6)	114 (6)	143 (7)	111 (5)	138 (6)	129 (6)
BMI category^e									
Normal weight	1748 (62)	1942 (65)	1682 (62)	1679 (61)	1183 (60)	1277 (62)	1217 (61)	1296 (60)	1189 (59)
Overweight	477 (17)	485 (16)	485 (18)	452 (17)	337 (17)	351 (17)	324 (16)	407 (19)	376 (19)
Obese	599 (21)	561 (19)	541 (20)	602 (22)	439 (22)	445 (21)	441 (22)	475 (22)	462 (23)
	Sample Sizes (N, [% ^b]) for Triglycerides, LDL Cholesterol, and Apolipoprotein B Analyses ^f								
	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008	2009-2010	2011-2012	2013-2014	
All youth	904	929	903	851	439	558	517	532	
Females	430 (48)	457 (49)	405 (45)	413 (49)	191 (44)	258 (46)	254 (49)	276 (52)	
Age, years									
12-15	475 (53)	456 (49)	443 (49)	428 (50)	209 (48)	274 (49)	266 (51)	269 (51)	
16-19	429 (47)	473 (51)	460 (51)	423 (50)	230 (52)	284 (51)	251 (49)	263 (49)	
Race/ethnicity									
NH white	199 (22)	289 (31)	237 (26)	214 (25)	143 (33)	184 (33)	129 (25)	138 (26)	
NH black	234 (26)	268 (29)	336 (37)	278 (33)	107 (24)	109 (20)	165 (32)	125 (23)	
Mexican	398 (44)	290 (31)	264 (29)	297 (35)	102 (23)	166 (30)	85 (16)	138 (26)	
Other Hispanic	40 (4)	34 (4)	29 (3)	24 (3)	68 (15)	62 (11)	48 (9)	49 (9)	
NH Asian^d	-	-	-	-	-	-	70 (14)	57 (11)	
Other race^d	33 (4)	48 (5)	37 (4)	38 (4)	19 (4)	37 (7)	20 (4)	25 (5)	
BMI category^e									
Normal weight	530 (61)	588 (67)	550 (64)	506 (62)	262 (63)	330 (61)	301 (63)	301 (60)	
Overweight	158 (18)	129 (15)	141 (16)	143 (17)	67 (16)	108 (20)	77 (16)	81 (16)	
Obese	185 (21)	163 (19)	172 (20)	171 (21)	86 (21)	100 (19)	103 (21)	121 (24)	

^aSample sizes shown are maximal sample sizes, for any of the listed variables. For example, sample size for triglycerides, LDL cholesterol and apolipoprotein B analyses would include a participant with triglycerides and apolipoprotein B values included in the analysis but LDL cholesterol value excluded from the analysis due to triglycerides > 400 mg/dL. See text (Results) for a description of missing data.

^bProportion of the category total sample for the indicated survey cycle, calculated without survey weights. Proportions may not sum to 100% due to rounding and because for BMI category, "underweight" is not shown.

^cData are not reported for HDL and non-HDL cholesterol prior to the 2007-2008 survey cycle, due to possible biased laboratory methods prior to that time. Sample sizes shown prior to 2007 apply to total cholesterol only. See text (Methods) for more details.

^dAsian race specified in National Health and Nutrition Examination Survey data starting in 2011; prior to 2011, Asian race was included in "other race" category.

^eBody mass index categories defined as per 2000 Centers for Disease Control age- and sex-specific percentiles: normal weight, $\geq 5^{\text{th}}$ - $< 85^{\text{th}}$, overweight, $\geq 85^{\text{th}}$ - $< 95^{\text{th}}$, and obese, $\geq 95^{\text{th}}$ percentile.

^fData are not available for apolipoprotein B prior to the 2005-2006 survey cycle. Sample sizes shown prior to 2005 apply to triglycerides and LDL cholesterol. See text (Methods) for more details.
BMI, body mass index; HDL, high-density lipoprotein; LDL, low-density lipoprotein, NH, non-Hispanic.

eTable 2. Characteristics of Examined^a Youth with Complete Versus Any Missing Data for Lipids and Apolipoprotein B, by Survey Cycle: National Health and Nutrition Examination Survey, 1999-2016

	Missingness of Data for Total Cholesterol in Surveyed Youth Ages 6 to 11 years									
	1999-2000		2001-2002		2003-2004		2005-2006			
	Complete Data	Missing Data	Complete Data	Missing Data	Complete Data	Missing Data	Complete Data	Missing Data		
N (%)	853 (79)	208 (21)	1002 (83)	200 (17)	836 (80)	156 (20)	901 (82)	205 (18)		
Females, N (%)^b	411 (48)	103 (50)	500 (50)	103 (52)	434 (52)	92 (59)	454 (50)	106 (52)		
Mean age, yrs (SD)	8.6 (1.7)	8.2 (1.7) ^c	8.6 (1.7)	8.0 (1.6) ^c	8.6 (1.7)	8.1 (1.7) ^c	8.6 (1.7)	7.9 (1.7) ^c		
Race/ethnicity, N (%)^b										
NH white	187 (22)	48 (23)	298 (30)	58 (29)	203 (24)	57 (37) ^c	243 (27)	53 (26) ^c		
NH black	249 (29)	68 (33)	335 (33)	78 (39)	304 (36)	43 (28) ^c	251 (28)	78 (38) ^c		
Mexican	347 (41)	78 (38)	288 (29)	41 (21)	264 (32)	37 (24) ^c	311 (35)	61 (30) ^c		
Other Hispanic	43 (5)	9 (4)	38 (4)	12 (6)	25 (3)	6 (4) ^c	29 (3)	2 (1) ^c		
Other race	27 (3)	5 (2)	43 (4)	11 (6)	40 (5)	13 (8) ^c	67 (7)	11 (5) ^c		
Mean BMI %ile (SD)	64 (30)	61 (31)	63 (30)	62 (31)	67 (30)	62 (31)	65 (29)	61 (31)		
	Missingness of Data for Either Total or HDL Cholesterol in Surveyed Youth Ages 6 to 11 years									
	2007-2008		2009-2010		2011-2012		2013-2014		2015-2016	
	Complete Data	Missing Data	Complete Data	Missing Data	Complete Data	Missing Data	Complete Data	Missing Data	Complete Data	Missing Data
N (%)	987 (80)	228 (20)	971 (77)	251 (23)	978 (77)	294 (23)	1049 (80)	263 (20)	992 (75)	285 (25)
Females, N (%)^b	493 (50)	116 (51)	471 (49)	128 (51)	482 (49)	139 (47)	500 (48)	134 (51)	499 (50)	145 (51)
Mean age, yrs (SD)	8.6 (1.7)	8.2 (1.6) ^c	8.6 (1.7)	8.2 (1.7) ^c	8.5 (1.7)	8.1 (1.7) ^c	8.5 (1.7)	8.0 (1.7) ^c	8.5 (1.7)	8.3 (1.7) ^c
Race/ethnicity, N (%)^b										
NH white	292 (30)	68 (30)	292 (30)	101 (40) ^c	229 (23)	71 (24) ^c	283 (27)	63 (24) ^c	249 (25)	103 (36) ^c
NH black	249 (25)	68 (30)	187 (19)	54 (22) ^c	287 (29)	81 (28) ^c	274 (26)	85 (32) ^c	206 (21)	67 (24) ^c
Mexican	269 (27)	57 (25)	308 (32)	50 (20) ^c	210 (21)	44 (15) ^c	249 (24)	35 (13) ^c	242 (24)	43 (15) ^c
Other Hispanic	130 (13)	22 (10)	121 (12)	25 (10) ^c	109 (11)	35 (12) ^c	101 (10)	27 (10) ^c	151 (15)	27 (9) ^c
NH Asian^d	-	-	-	-	83 (8)	50 (17) ^c	75 (7)	30 (11) ^c	80 (8)	20 (7) ^c
Other race^d	47 (5)	13 (6)	63 (6)	21 (8) ^c	60 (6)	13 (4) ^c	67 (6)	23 (9) ^c	64 (6)	25 (9) ^c
Mean BMI %ile (SD)	64 (31)	66 (28)	65 (31)	63 (31)	66 (30)	61 (30) ^c	66 (30)	60 (31) ^c	67 (29)	61 (32) ^c
	Missingness of Data for Total Cholesterol in Surveyed Youth Ages 12 to 19 years									
	1999-2000		2001-2002		2003-2004		2005-2006			
	Complete Data	Missing Data	Complete Data	Missing Data	Complete Data	Missing Data	Complete Data	Missing Data		
N (%)	2075 (89)	203 (11)	2137 (90)	225 (10)	1985 (89)	199 (11)	1925 (89)	228 (11)		
Females, N (%)^b	1006 (48)	105 (52)	1056 (49)	112 (50)	933 (47)	100 (50)	936 (49)	118 (52)		
Mean age, yrs (SD)	15.3 (2.3)	14.8 (2.2) ^c	15.4 (2.3)	15.1 (2.3)	15.5 (2.3)	15.2 (2.4)	15.5 (2.3)	15.2 (2.2)		
Race/ethnicity, N (%)^b										
NH white	408 (20)	52 (26)	640 (30)	58 (26)	527 (27)	72 (36) ^c	492 (26)	59 (26)		
NH black	570 (27)	53 (26)	647 (30)	76 (34)	717 (36)	69 (35) ^c	660 (34)	82 (36)		
Mexican	915 (44)	75 (37)	672 (31)	64 (28)	609 (31)	49 (25) ^c	628 (33)	66 (29)		
Other Hispanic	98 (5)	9 (4)	96 (4)	15 (7)	62 (3)	2 (1) ^c	55 (3)	6 (3)		
Other race	84 (4)	14 (7)	82 (4)	12 (5)	70 (4)	7 (4) ^c	90 (5)	15 (7)		

	Missingness of Data for Total Cholesterol in Surveyed Youth Ages 12 to 19 years									
	1999-2000		2001-2002		2003-2004		2005-2006			
	Complete Data	Missing Data	Complete Data	Missing Data	Complete Data	Missing Data	Complete Data	Missing Data		
Mean BMI %ile (SD)	66 (29)	63 (32)	63 (30)	63 (32)	66 (29)	63 (30)	66 (30)	62 (32) ^c		
	Missingness of Data for Either Total or HDL Cholesterol in Surveyed Youth Ages 12 to 19 years									
	2007-2008		2009-2010		2011-2012		2013-2014		2015-2016	
	Complete Data	Missing Data	Complete Data	Missing Data	Complete Data	Missing Data	Complete Data	Missing Data	Complete Data	Missing Data
N (%)	1068 (88)	142 (12)	1179 (89)	131 (11)	1097 (90)	133 (10)	1233 (90)	158 (10)	1107 (88)	163 (12)
Females, N (%) ^b	495 (46)	79 (56) ^c	550 (47)	65 (50)	531 (48)	68 (51)	615 (50)	84 (53)	533 (48)	88 (54)
Mean age, yrs (SD)	15.5 (2.2)	15.3 (2.5)	15.5 (2.3)	15.0 (2.3) ^c	15.5 (2.3)	15.0 (2.2) ^c	15.4 (2.3)	15.3 (2.3)	15.4 (2.2)	14.7 (2.2) ^c
Race/ethnicity, N (%) ^b										
NH white	335 (31)	44 (31) ^c	380 (32)	60 (46) ^c	246 (22)	25 (19)	322 (26)	29 (18) ^c	298 (27)	39 (24) ^c
NH black	270 (25)	56 (39) ^c	249 (21)	38 (29) ^c	331 (30)	43 (32)	282 (23)	60 (28) ^c	241 (22)	51 (31) ^c
Mexican	258 (24)	23 (16) ^c	336 (29)	17 (13) ^c	194 (18)	20 (15)	301 (24)	28 (18) ^c	257 (23)	20 (12) ^c
Other Hispanic	156 (15)	14 (10) ^c	134 (11)	10 (8) ^c	124 (11)	15 (11)	131 (11)	11 (7) ^c	140 (13)	12 (7) ^c
NH Asian ^d	-	-	-	-	151 (14)	21 (16)	126 (10)	26 (16) ^c	106 (10)	30 (18) ^c
Other race ^d	49 (5)	5 (4) ^c	80 (7)	6 (5) ^c	51 (5)	9 (7)	71 (6)	4 (3) ^c	65 (6)	11 (7) ^c
Mean BMI %ile (SD)	65 (31)	63 (31)	68 (29)	62 (31) ^c	66 (30)	59 (29) ^c	67 (30)	64 (29)	68 (29)	63 (31) ^c
	Missingness of Data for Triglycerides, LDL cholesterol, or Apolipoprotein B ^e in the Subset of Surveyed Youth Ages 12 to 19 years with Morning Examinations									
	1999-2000		2001-2002		2003-2004		2005-2006			
	Complete Data	Missing Data	Complete Data	Missing Data	Complete Data	Missing Data	Complete Data	Missing Data		
Total, N (%)	892 (83)	168 (17)	923 (82)	213 (18)	900 (83)	176 (17)	849 (82)	186 (18)		
Not fasting 8.5-24h ^b	-	116 (69)	-	142 (67)	-	103 (59)	-	131 (70)		
TG>400 mg/dL ^b	-	4 (2)	-	3 (1)	-	3 (2)	-	2 (1)		
Females, N (%) ^b	425 (48)	74 (44)	454 (49)	106 (50)	404 (45)	85 (48)	411 (48)	83 (45)		
Mean age, yrs (SD)	15.3 (2.3)	15.2 (2.2)	15.5 (2.3)	15.1 (2.2) ^c	15.5 (2.3)	15.5 (2.4)	15.4 (2.4)	15.6 (2.1)		
Race/ethnicity, N (%) ^b										
NH white	197 (22)	37 (22)	288 (31)	49 (23) ^c	235 (26)	51 (29)	213 (25)	45 (24)		
NH black	231 (26)	47 (28)	267 (29)	96 (45) ^c	336 (37)	77 (44)	278 (33)	77 (41)		
Mexican	392 (44)	70 (42)	287 (31)	47 (22) ^c	263 (29)	38 (22)	297 (35)	49 (26)		
Other Hispanic	39 (4)	9 (5)	34 (4)	8 (4) ^c	29 (3)	7 (4)	23 (3)	7 (4)		
Other race	33 (4)	5 (3)	47 (5)	13 (6) ^c	37 (4)	3 (2)	38 (4)	8 (4)		
Mean BMI %ile (SD)	67 (29)	64 (31)	62 (31)	61 (32)	66 (29)	65 (30)	64 (30)	63 (32)		
	Missingness of Data for Triglycerides, LDL cholesterol, or Apolipoprotein B ^e in the Subset of Surveyed Youth Ages 12 to 19 years with Morning Examinations									
	2007-2008		2009-2010		2011-2012		2013-2014			
	Complete Data	Missing Data	Complete Data	Missing Data	Complete Data	Missing Data	Complete Data	Missing Data		
Total, N (%)	439 (81)	100 (19)	557 (85)	98 (15)	515 (85)	97 (15)	531 (82)	130 (18)		
Not fasting 8.5-24h ^b	-	76 (76)	-	62 (63)	-	60 (62)	-	84 (65)		
TG>400 mg/dL ^b	-	0 (0)	-	1 (1)	-	1 (1)	-	1 (1)		

	Missingness of Data for Triglycerides, LDL cholesterol, or Apolipoprotein B ^e in the Subset of Surveyed Youth Ages 12 to 19 years with Morning Examinations									
	2007-2008		2009-2010		2011-2012		2013-2014			
	Complete Data	Missing Data	Complete Data	Missing Data	Complete Data	Missing Data	Complete Data	Missing Data		
Females, N (%)^b	191 (44)	43 (43)	258 (46)	47 (48)	252 (49)	45 (46)	276 (52)	59 (45)		
Mean age, yrs (SD)	15.7 (2.2)	15.3 (2.5)	15.6 (2.3)	15.2 (2.4)	15.4 (2.3)	15.0 (2.4)	15.4 (2.3)	15.3 (2.5)		
Race/ethnicity, N (%)^b										
NH white	143 (33)	32 (32)	183 (33)	42 (43)	129 (25)	20 (21)	137 (26)	26 (20) ^c		
NH black	107 (24)	37 (37)	109 (20)	24 (24)	164 (32)	32 (33)	125 (24)	51 (39) ^c		
Mexican	102 (23)	17 (17)	166 (30)	16 (16)	85 (17)	11 (11)	138 (26)	24 (18) ^c		
Other Hispanic	68 (15)	11 (11)	62 (11)	10 (10)	48 (9)	13 (13)	49 (9)	9 (7) ^c		
NH Asian^d	-	-	-	-	69 (13)	17 (18)	57 (11)	18 (14) ^c		
Other race^d	19 (4)	3 (3)	37 (7)	6 (6)	20 (4)	4 (4)	25 (5)	2 (2) ^c		
Mean BMI %ile (SD)	64 (31)	61 (32)	68 (28)	66 (32)	65 (30)	61 (31)	66 (30)	64 (28)		

^aOnly surveyed youth who attended examinations were included in the study (and shown here). The response rates for National Health and Nutrition Examination Surveys across cycles 1999-2000 to 2015-2016 were 65% to 86 percent.¹

^bProportion of column total; all values were calculated for the sample, i.e., without survey weights.

^cSignificantly different between youth with complete data and youth with missing data, at the P<.05 level. For race/ethnicity, P is for comparison of overall distributions.

^dAsian race specified in National Health and Nutrition Examination Survey data starting in 2011; prior to 2011, Asian race was included in "other race" category.

^eApolipoprotein B data available (and included in assessment of missing data) beginning in 2005-2006 survey cycle.

BMI, body mass index; h, hours; HDL, high-density lipoprotein; LDL, low-density lipoprotein; NH, non-Hispanic; SD, standard deviation; TG, triglycerides; yrs, years.

eTable 3. Age- and Race/Ethnicity-Adjusted Changes in the Prevalence of Apolipoprotein B Concordance and Discordance^a with Non-HDL Cholesterol and LDL Cholesterol Over Time in US Youth Ages 12 to 19 Years, 2007-2014

Apolipoprotein B versus Non-HDL Cholesterol									
	Proportion Discordant, Low Apolipoprotein B (95% CI), %			Proportion Concordant (95% CI), %			Proportion Discordant, High Apolipoprotein B (95% CI), %		
	2007-2010	2011-2014	P Value	2007-2010	2011-2014	P Value	2007-2010	2011-2014	P Value
All adolescents	17.4 (12.4-22.5)	19.9 (15.3-24.5)	.48	64.5 (60.0-69.0)	62.7 (57.2-68.3)	.67	18.1 (13.8-22.3)	17.4 (13.7-21.0)	.79
Age, years									
12-15	19.4 (13.4-25.3)	20.8 (14.7-26.9)	.72	69.4 (63.4-75.5)	62.6 (56.1-69.2)	.14	11.2 (7.2-15.1)	16.6 (12.3-20.9)	.08
16-19	15.4 (9.6-21.3)	18.8 (13.3-24.4)	.44	59.2 (53.3-65.0)	63.3 (56.4-70.1)	.43	25.4 (19.2-31.6)	17.9 (13.3-22.6)	.04
Males	19.3 (13.5-25.2)	18.3 (13.9-22.7)	.77	65.3 (59.7-70.8)	65.0 (59.5-70.5)	.95	15.4 (10.7-20.1)	16.7 (12.3-21.1)	.66
Females	15.4 (9.7-21.0)	21.4 (15.2-27.7)	.17	63.4 (56.7-70.0)	60.3 (52.6-68.1)	.61	21.3 (15.8-26.8)	18.3 (13.0-23.5)	.43
Race/ethnicity^b									
NH white	17.6 (10.3-24.9)	21.1 (13.3-28.9)	.51	69.0 (62.0-76.0)	62.8 (51.9-73.7)	.35	13.4 (10.1-16.8)	16.1 (10.5-21.7)	.42
NH black	17.7 (10.5-25.0)	20.5 (14.0-27.0)	.57	54.8 (49.0-60.6)	62.0 (53.9-70.1)	.15	27.5 (21.1-33.9)	17.5 (11.9-23.1)	.02
Mexican	12.3 (7.7-17.0)	11.8 (6.8-16.8)	.88	70.6 (63.6-77.5)	68.3 (62.2-74.4)	.62	17.1 (10.0-24.3)	20.0 (14.2-25.7)	.54
BMI category									
Normal	18.9 (13.4-24.3)	20.9 (14.8-27.0)	.62	63.5 (57.5-69.5)	60.0 (52.9-67.1)	.48	17.7 (12.6-22.8)	19.1 (14.5-23.7)	.66
Overweight	13.5 (4.7-22.4) ^c	22.8 (14.1-31.5)	.17	67.5 (57.5-77.6)	68.3 (58.9-77.7)	.92	18.9 (11.4-26.4)	8.9 (3.0-14.8) ^c	.04
Obese	20.9 (10.9-31.0)	16.9 (9.6-24.2)	.52	63.8 (53.8-73.9)	66.2 (57.7-74.7)	.73	15.3 (8.9-21.7)	16.9 (11.3-22.5)	.72
Apolipoprotein B versus LDL Cholesterol									
	Proportion Discordant, Low Apolipoprotein B (95% CI), %			Proportion Concordant (95% CI), %			Proportion Discordant, High Apolipoprotein B (95% CI), %		
	2007-2010	2011-2014	P Value	2007-2010	2011-2014	P Value	2007-2010	2011-2014	P Value
All adolescents	22.0 (17.0-27.0)	26.5 (22.0-31.0)	.19	55.6 (51.5-59.7)	54.3 (50.0-58.5)	.69	22.4 (18.2-26.5)	19.2 (15.6-22.8)	.24
Age, years									
12-15	27.4 (21.6-33.3)	27.2 (22.1-32.2)	.95	56.9 (51.1-62.6)	54.4 (48.2-60.7)	.59	15.7 (11.5-20.0)	18.4 (13.4-23.4)	.39
16-19	16.5 (10.9-22.2)	25.4 (19.2-31.5)	.05	53.7 (47.9-59.5)	54.7 (49.0-60.5)	.81	29.8 (23.5-36.1)	19.9 (15.2-24.7)	.01
Males	23.6 (17.5-29.7)	25.6 (20.7-30.5)	.59	54.7 (49.9-59.4)	53.9 (49.5-58.2)	.81	21.8 (17.4-26.2)	20.5 (16.2-24.9)	.65

Apolipoprotein B versus LDL Cholesterol									
	Proportion Discordant, Low Apolipoprotein B (95% CI), %			Proportion Concordant (95% CI), %			Proportion Discordant, High Apolipoprotein B (95% CI), %		
	2007-2010	2011-2014	P Value	2007-2010	2011-2014	P Value	2007-2010	2011-2014	P Value
Females	20.3 (14.2-26.5)	27.2 (21.1-33.4)	.14	56.4 (49.7-63.0)	54.7 (48.3-61.1)	.76	23.3 (17.2-29.5)	18.1 (13.7-22.5)	.19
Race/ethnicity^b									
NH white	21.7 (16.4-27.1)	28.8 (20.7-36.8)	.15	57.8 (52.6-62.9)	53.7 (44.1-63.3)	.47	20.5 (16.5-24.5)	17.5 (11.7-23.3)	.40
NH black	30.9 (21.0-40.8)	34.4 (27.6-41.1)	.57	49.6 (40.9-58.3)	50.7 (43.6-57.8)	.85	19.5 (14.0-25.0)	15.0 (10.3-19.6)	.21
Mexican	17.5 (11.0-24.0)	15.5 (10.1-20.9)	.65	53.2 (46.8-59.5)	60.1 (53.5-66.7)	.14	29.3 (22.6-36.0)	24.4 (18.7-30.1)	.27
BMI category									
Normal	25.4 (19.9-30.9)	31.4 (25.6-37.1)	.11	56.5 (51.0-61.9)	54.1 (48.5-59.7)	.54	18.1 (13.4-22.9)	14.6 (10.4-18.8)	.27
Overweight	17.3 (9.7-24.8)	27.3 (15.4-39.2)	.18	56.6 (47.4-65.7)	56.2 (44.1-68.3)	.97	26.2 (18.7-33.6)	16.5 (10.0-23.0)	.05
Obese	21.1 (13.1-29.2)	11.4 (5.5-17.3)	.08	49.9 (39.9-59.9)	55.3 (47.1-63.4)	.40	28.9 (18.6-39.3)	33.4 (25.9-40.8)	.49

All estimates are based on population-weighted data from the National Health and Nutrition Examination Survey. The ranges (minimum to maximum) of unweighted sample sizes (denominators) for each apolipoprotein B analysis and period are as follows: for apolipoprotein B versus non-HDL cholesterol 2007-2010, 175 (overweight) to 997 (all adolescents) and 2011-2014, 158 (overweight) to 1049 (all adolescents); for apolipoprotein B versus LDL cholesterol 2007-2010, 174 (overweight) to 996 (all adolescents) and 2011-2014, 158 (overweight) to 1046 (all adolescents).

^aDiscordance is defined as apolipoprotein B level more than 5 mg/dL lower or higher than predicted by non-HDL cholesterol (or LDL cholesterol) level, based on regression of apolipoprotein B on non-HDL cholesterol (or LDL cholesterol) among the entire sample from 2007-2014. See text for details.

^bAdjusted for age only.

^cEstimates may be unstable due to large relative CI width (>130% of proportion) in the setting of absolute CI width >5.0 percent.²
 BMI, body mass index; CI, confidence interval; HDL, high-density lipoprotein; LDL, low-density lipoprotein; NH, non-Hispanic.

eTable 4. Age-Adjusted Trends in Mean Levels of Lipids and Apolipoprotein B Over Time by Race/Ethnicity and Body Mass Index Category in US Youth Ages 6 to 19 Years, 1999-2016^a

	Mean Level (95% CI), mg/dL								
	Total Cholesterol			HDL Cholesterol			Non-HDL Cholesterol		
	1999-2000	2015-2016	β (95% CI) per year	2007-2008	2015-2016	β (95% CI) per year	2007-2008	2015-2016	β (95% CI) per year
Race/ethnicity									
NH white	164 (162-166)	155 (152-158)	-0.6 (-0.8, -0.4)	51.2 (50.2-52.1)	54.6 (52.7-56.5)	0.3 (0.1, 0.5)	109 (106-112)	100 (97-103)	-1.0 (-1.5, -0.6)
NH black	168 (165-171)	153 (150-156)	-0.9 (-1.0, -0.7)	56.8 (55.7-57.8)	58.7 (57.1-60.3)	0.3 (0.03, 0.5)	104 (101-106)	95 (91-98)	-0.9 (-1.5, -0.4)
Mexican	162 (161-163)	154 (151-157)	-0.5 (-0.6, -0.3)	50.7 (49.3-52.1)	52.2 (50.6-53.8)	0.2 (-0.1, 0.4)	108 (104-113)	102 (99-105)	-0.8 (-1.4, -0.3)
NH Asian^b	-	160 (155-165)	-0.6 (-2.3, 1.1)	-	55.0 (53.3-56.7)	0.3 (-0.3, 0.9)	-	105 (99-110)	-0.9 (-2.5, 0.7)
Race/ethnicity, by age, years									
6-11									
NH white	168 (163-173)	158 (155-160)	-0.7 (-1.0, -0.4)	51.3 (49.8-52.7)	57.0 (55.1-58.9)	0.6 (0.3, 0.9)	112 (108-116)	101 (98-103)	-1.2 (-1.7, -0.6)
NH black	174 (169-179)	155 (152-158)	-1.0 (-1.3, -0.7)	58.9 (57.4-60.4)	61.1 (59.2-63.1)	0.4 (0.1, 0.7)	103 (99-107)	94 (90-98)	-1.0 (-1.7, -0.4)
Mexican	163 (160-165)	155 (152-158)	-0.5 (-0.7, -0.2)	51.5 (48.9-54.1)	53.2 (50.8-55.7)	0.2 (-0.2, 0.6)	109 (103-115)	102 (100-104)	-0.9 (-1.6, -0.2)
12-19									
NH white	162 (159-165)	153 (150-157)	-0.6 (-0.8, -0.4)	50.3 (49.3-51.4)	52.6 (50.0-55.1)	0.2 (-0.2, 0.5)	108 (104-111)	101 (97-104)	-0.9 (-1.5, -0.3)
NH black	163 (161-166)	152 (149-155)	-0.8 (-1.0, -0.6)	54.9 (53.5-56.3)	56.4 (54.4-58.4)	0.2 (-0.1, 0.5)	104 (100-108)	95 (91-100)	-0.9 (-1.6, -0.2)
Mexican	161 (159-162)	153 (149-157)	-0.5 (-0.7, -0.3)	49.9 (48.2-51.6)	51.3 (49.4-53.1)	0.1 (-0.1, 0.4)	108 (104-112)	102 (98-105)	-0.8 (-1.4, -0.2)
Race/ethnicity, by sex									
Male									
NH white	161 (157-165)	154 (151-157)	-0.6 (-0.8, -0.3)	50.4 (49.2-51.6)	53.7 (51.5-55.9)	0.3 (0.03, 0.6)	109 (105-113)	101 (97-104)	-1.1 (-1.7, -0.5)
NH black	165 (163-167)	152 (149-156)	-0.9 (-1.1, -0.7)	57.2 (55.3-59.2)	58.9 (56.9-60.8)	0.2 (-0.1, 0.5)	101 (97-105)	94 (90-98)	-0.9 (-1.5, -0.3)
Mexican	160 (158-163)	154 (151-157)	-0.4 (-0.6, -0.3)	49.6 (47.7-51.5)	52.1 (50.6-53.6)	0.3 (0.1, 0.6)	108 (104-111)	102 (99-105)	-0.9 (-1.4, -0.4)
Female									
NH white	168 (166-170)	155 (152-159)	-0.7 (-0.9, -0.5)	51.9 (50.6-53.3)	55.5 (53.5-57.5)	0.3 (0.04, 0.6)	109 (105-114)	100 (97-103)	-1.0 (-1.6, -0.3)
NH black	171 (165-176)	154 (151-158)	-0.8 (-1.1, -0.6)	56.5 (54.7-58.3)	58.3 (56.0-60.7)	0.3 (-0.02, 0.6)	106 (102-110)	96 (91-100)	-1.0 (-1.7, -0.3)
Mexican	163 (161-165)	154 (149-159)	-0.5 (-0.8, -0.2)	51.8 (50.3-53.4)	52.5 (50.5-54.6)	-0.02 (-0.3, 0.2)	109 (102-115)	101 (97-106)	-0.8 (-1.6, 0.01)

	Mean Level (95% CI), mg/dL								
	Total Cholesterol			HDL Cholesterol			Non-HDL Cholesterol		
	1999-2000	2015-2016	β (95% CI) per year	2007-2008	2015-2016	β (95% CI) per year	2007-2008	2015-2016	β (95% CI) per year
BMI category^c									
Normal	161 (158-164)	153 (151-155)	-0.5 (-0.7, -0.3)	55.4 (54.3-56.5)	58.3 (56.9-59.6)	0.3 (0.1, 0.5)	104 (101-106)	95 (93-96)	-1.1 (-1.4, -0.8)
Overwt.	164 (158-170)	155 (152-157)	-0.8 (-1.0, -0.5)	49.8 (48.0-51.5)	53.6 (51.6-55.5)	0.4 (0.1, 0.7)	112 (107-116)	102 (100-105)	-1.0 (-1.5, -0.4)
Obese	175 (170-181)	162 (158-166)	-0.9 (-1.2, -0.7)	45.5 (44.3-46.7)	47.7 (46.4-49.0)	0.2 (-0.04, 0.4)	118 (115-122)	114 (110-117)	-0.6 (-1.2, -0.03)
	Triglycerides^d			LDL Cholesterol			Apolipoprotein B		
	1999-2000	2013-2014	β (95% CI) ^d per year	1999-2000	2013-2014	β (95% CI) per year	2005-2006	2013-2014	β (95% CI) per year
Race/ethnicity									
NH white	84 (80-89)	63 (56-71)	-0.019 (-0.026, -0.013)	92 (89-96)	87 (81-93)	-0.4 (-0.7, -0.06)	70 (67-73)	67 (64-71)	-0.5 (-0.9, 0.02)
NH black	69 (63-74)	48 (44-53)	-0.020 (-0.027, -0.013)	97 (93-101)	87 (82-92)	-0.7 (-1.0, -0.3)	70 (67-72)	65 (61-69)	-0.6 (-1.1, -0.07)
Mexican	85 (81-89)	73 (66-81)	-0.011 (-0.018, -0.004)	93 (88-97)	84 (79-88)	-0.5 (-0.9, -0.2)	72 (70-73)	68 (64-72)	-0.4 (-0.9, 0.1)
NH Asian^b	-	69 (62-78)	-0.031 (-0.139, 0.077)	-	91 (83-100)	0.8 (-4.5, 6.0)	-	71 (66-76)	1.0 (-2.7, 4.8)
BMI category^c									
Normal	70 (66-73)	56 (52-59)	-0.015 (-0.019, -0.010)	88 (84-93)	84 (82-86)	-0.3 (-0.6, -0.1)	66 (64-68)	64 (62-66)	-0.3 (-0.6, 0.05)
Overwt.	83 (75-92)	70 (62-80)	-0.017 (-0.027, -0.007)	94 (84-104)	93 (86-100)	-0.5 (-1.2, 0.2)	71 (67-76)	71 (66-76)	-0.01 (-0.7, 0.6)
Obese	114 (103-127)	84 (72-97)	-0.021 (-0.030, -0.012)	108 (101-115)	90 (81-100)	-1.2 (-1.8, -0.5)	84 (79-89)	73 (67-79)	-1.1 (-2.0, -0.2)

All estimates are based on population-weighted data from the National Health and Nutrition Examination Survey. The ranges (minimum to maximum) of unweighted sample sizes for each lipid and survey cycle are as follows: total cholesterol 1999-2000, 187 (NH white 6-11 years) to 1748 (normal BMI); HDL and non-HDL cholesterol 2007-2008, 249 (NH black 6-11 years) to 1183 (normal BMI); total, HDL, and non-HDL cholesterol 2015-2016, 186 (NH Asian) to 1189 (normal BMI); triglycerides 1999-2000, 158 (overweight) to 530 (normal BMI); triglycerides and apolipoprotein B 2013-2014, 57 (NH Asian) to 301 (normal BMI); LDL cholesterol 1999-2000, 154 (overweight) to 526 (normal BMI) and 2013-2014, 57 (NH Asian) to 300 (normal BMI); and apolipoprotein B 2005-2006, 143 (overweight) to 506 (normal BMI).

Levels are presented as mg/dL; to convert to mmol/L, divide by 38.6 for total cholesterol, HDL cholesterol, non-HDL cholesterol, and LDL cholesterol, and divide by 88.6 for triglycerides.

^aTrend analyses are for the years shown in the table: for total cholesterol, 1999-2000 to 2015-2016, for HDL cholesterol and non-HDL cholesterol, 2007-2008 to 2015-2016, for triglycerides and LDL cholesterol, 1999-2000 to 2013-2014, for apolipoprotein B, 2005-2006 to 2013-2014. Data for triglycerides, LDL cholesterol, and apolipoprotein B are for youth ages 12-19 years only.

^bAsian race specified in NHANES data starting in 2011.

^cAdjusted for race/ethnicity in addition to age.

^dDue to the skewed distribution of triglycerides, the geometric mean is shown, and the regression coefficient was tested and is shown in log-transformed units.

BMI, body mass index; CI, confidence interval; HDL, high-density lipoprotein; LDL, low-density lipoprotein; NH, Non-Hispanic, overwt, overweight.

eTable 5. Age-Adjusted Changes in the Prevalence of Ideal Levels of Lipids and Apolipoprotein B Over Time by Race/Ethnicity and Body Mass Index Category in US Youth Ages 6 to 19 Years, 1999-2016^a

	Proportion with Ideal Levels (95% CI), %								
	Total Cholesterol			HDL Cholesterol			Non-HDL Cholesterol		
	1999-2006	2009-2016	P Value	2007-2010	2013-2016	P Value	2007-2010	2013-2016	P Value
Race/ethnicity									
NH white	61.7 (59.8-63.6)	71.3 (68.9-73.7)	<.001	69.1 (66.4-71.9)	72.7 (69.5-75.9)	.10	71.1 (67.4-74.7)	77.8 (75.1-80.5)	.004
NH black	57.8 (56.4-59.3)	69.5 (67.4-71.6)	<.001	77.6 (73.9-81.3)	81.6 (79.6-83.7)	.06	75.7 (73.2-78.2)	81.1 (78.0-84.1)	.008
Mexican	66.1 (64.8-67.3)	70.3 (68.1-72.6)	.002	65.0 (62.2-67.7)	69.3 (65.6-73.0)	.06	70.0 (66.2-73.7)	75.8 (72.8-78.8)	.02
NH Asian ^b	-	63.4 (60.1-66.6)	-	-	77.9 (73.6-82.3)	-	-	69.9 (63.7-76.2)	-
BMI category^c									
Normal	65.0 (63.1-66.9)	72.4 (70.6-74.2)	<.001	78.9 (76.5-81.2)	84.6 (82.4-86.7)	<.001	78.1 (76.0-80.2)	85.4 (83.5-87.3)	<.001
Overweight	60.0 (56.2-63.9)	70.0 (67.3-72.7)	<.001	64.8 (58.6-71.0)	68.1 (63.3-72.9)	.42	65.2 (60.0-70.3)	69.4 (65.1-73.8)	.24
Obese	49.1 (45.3-53.0)	62.0 (59.0-65.1)	<.001	48.4 (43.8-53.1)	49.1 (45.4-52.7)	.83	55.8 (51.3-60.2)	59.8 (56.0-63.7)	.16
	Triglycerides^d			LDL Cholesterol^d			Apolipoprotein B^d		
	1999-2006	2007-2014	P Value	1999-2006	2007-2014	P Value	2005-2008	2011-2014	P Value
Race/ethnicity									
NH white	58.1 (54.4-61.9)	69.4 (65.5-73.2)	<.001	77.3 (74.1-80.5)	80.9 (78.2-83.6)	.09	85.3 (80.0-90.6)	88.4 (84.5-92.3)	.36
NH black	80.7 (77.5-84.0)	87.3 (84.5-90.2)	.003	75.7 (72.9-78.5)	79.1 (75.0-83.1)	.18	86.5 (83.2-89.9)	87.6 (84.6-90.5)	.64
Mexican	59.9 (56.8-63.1)	62.8 (58.4-67.2)	.29	80.3 (78.1-82.5)	83.5 (80.4-86.6)	.10	86.1 (82.8-89.4)	85.0 (80.3-89.7)	.71
NH Asian ^b	-	68.6 (58.5-78.6)	-	-	76.3 (68.9-83.7)	-	-	84.2 (78.2-90.1)	-
BMI category^c									
Normal	73.5 (70.3-76.6)	80.2 (77.2-83.2)	.003	81.6 (78.8-84.5)	84.6 (82.3-86.9)	.08	89.0 (85.9-92.2)	91.8 (89.3-94.2)	.22
Overweight	53.7 (45.5-62.0)	67.0 (60.4-73.5)	.004	74.3 (67.3-81.4)	78.4 (73.6-83.2)	.35	85.0 (78.6-91.4)	83.9 (77.1-90.7)	.80
Obese	35.4 (30.6-40.2)	52.6 (46.7-58.4)	<.001	63.6 (56.7-70.4)	74.4 (69.0-79.8)	.006	76.9 (70.4-83.4)	78.4 (72.2-84.6)	.74

All estimates are based on population-weighted data from the National Health and Nutrition Examination Survey. The ranges (minimum to maximum) of unweighted sample sizes (denominators) for each lipid and period are as follows: total cholesterol 1999-2006, 1899 (overweight) to 7051 (normal BMI) and 2009-2016, 621 (NH Asian) to 4978 (normal BMI); HDL and non-HDL cholesterol 2007-2010, 688 (overweight) to 2460 (normal BMI); HDL and non-HDL cholesterol 2013-2016, 387 (NH Asian) to 2485 (normal BMI); triglycerides 1999-2006, 571 (overweight) to 2174 (normal BMI) and 2007-2014, 127 (NH Asian) to 1193 (normal BMI); LDL cholesterol 1999-2006, 566 (overweight) to 2167 (normal BMI) and 2007-2014, 126 (NH Asian) to 1191 (normal BMI); apolipoprotein B 2005-2008, 210 (overweight) to 768 (normal BMI) and 2011-2014, 127 (NH Asian) to 602 (normal BMI).

^aP values compare proportions between the time periods shown in the table: for total cholesterol, 1999-2006 vs. 2009-2016, for HDL cholesterol and non-HDL cholesterol, 2007-2010 vs. 2013-2016, for triglycerides and LDL cholesterol, 1999-2006 vs. 2007-2014, for apolipoprotein B, 2005-2008 vs. 2011-2014. Data for triglycerides, LDL cholesterol, and apolipoprotein B are for youth ages 12-19 years only.

^bAsian race specified in NHANES data starting in 2011; therefore estimate presented for 2011-2016 only, with no test of change.

^cAdjusted for race/ethnicity in addition to age.

^dTriglycerides, LDL cholesterol, and apolipoprotein B data are restricted to adolescents ages 12 to 19 years.

BMI, body mass index; CI, confidence interval; HDL, high-density lipoprotein; LDL, low-density lipoprotein; NH, non-Hispanic.

eTable 6. Age-Adjusted Changes in the Prevalence of Adverse Levels of Lipids and Apolipoprotein B Over Time by Race/Ethnicity and Body Mass Index Category in US Youth Ages 6 to 19 Years, 1999-2016^a

	Proportion with Adverse Levels (95% CI), %								
	Total Cholesterol			HDL Cholesterol			Non-HDL Cholesterol		
	1999-2006	2009-2016	P Value	2007-2010	2013-2016	P Value	2007-2010	2013-2016	P Value
Race/ethnicity									
NH white	10.5 (9.2-11.8)	7.5 (6.3-8.7)	.001	14.1 (12.4-15.8)	12.5 (9.9-15.0)	.30	10.4 (8.0-12.8)	7.1 (5.7-8.5)	.02
NH black	12.0 (10.9-13.1)	8.3 (7.2-9.3)	<.001	8.5 (6.2-10.7)	6.5 (4.9-8.0)	.17	7.2 (5.8-8.6)	5.6 (3.7-7.4)	.17
Mexican	8.9 (8.1-9.7)	6.9 (5.7-8.1)	.008	17.5 (15.5-19.5)	14.8 (12.3-17.3)	.10	9.3 (7.3-11.3)	7.4 (6.4-8.3)	.08
BMI category^b									
Normal	8.1 (7.0-9.2)	5.5 (4.8-6.3)	<.001	8.1 (6.8-9.3)	5.7 (4.0-7.3)	.02	5.4 (4.2-6.7)	2.8 (2.0-3.6)	.002
Overweight	11.0 (8.7-13.3)	7.0 (5.5-8.5)	.006	18.8 (14.3-23.2)	11.5 (8.2-14.9)	.01	11.6 (7.9-15.2)	8.9 (6.7-11.1)	.19
Obese	17.7 (15.1-20.4)	10.7 (9.0-12.4)	<.001	28.7 (24.8-32.5)	29.3 (26.3-32.4)	.79	18.7 (15.4-21.9)	14.1 (11.7-16.5)	.04
	Triglycerides			LDL Cholesterol			Apolipoprotein B		
	1999-2006	2007-2014	P Value	1999-2006	2007-2014	P Value	2005-2008	2011-2014	P Value
Race/ethnicity									
NH white	18.1 (14.8-21.5)	11.9 (9.6-14.3)	.003	7.6 (5.8-9.3)	7.8 (5.6-10.1)	.85	3.8 (1.1-6.5) ^c	1.8 (0.2-3.3) ^d	.21
NH black	6.4 (4.9-7.9)	4.8 (3.2-6.4)	.15	8.8 (7.2-10.4)	8.2 (5.9-10.6)	.67	3.8 (1.8-5.7)	3.2 (1.1-5.3) ^d	.71
Mexican	16.0 (14.0-18.0)	15.8 (12.2-19.3)	.93	7.4 (5.7-9.0)	4.3 (2.2-6.4)	.03	3.5 (1.3-5.7)	2.8 (0.9-4.7) ^d	.64
BMI category^b									
Normal	7.9 (5.8-10.0)	5.9 (4.1-7.8)	.18	5.2 (3.3-7.2)	5.1 (3.5-6.6)	.90	2.4 (0.9-3.9)	1.6 (0.1-3.0) ^d	.45
Overweight	20.2 (14.5-25.9)	14.5 (9.8-19.2)	.11	7.2 (4.0-10.3)	6.8 (3.6-10.0)	.88	2.4 (0.3-4.5) ^d	1.4 (0.01-2.8) ^d	.36
Obese	34.1 (28.6-39.6)	22.3 (17.1-27.5)	.001	15.4 (9.6-21.2)	10.0 (6.4-13.6)	.08	9.7 (4.1-15.2)	3.3 (0-6.8) ^{c,d}	.04

All estimates are based on population-weighted data from the National Health and Nutrition Examination Survey. The ranges (minimum to maximum) of unweighted sample sizes (denominators) for each lipid and period are as follows: total cholesterol 1999-2006, 1899 to 7051 and 2009-2016, 1458 to 4978; HDL and non-HDL cholesterol 2007-2010, 688 to 2460 and 2013-2016, 783 to 2485; triglycerides 1999-2006, 571 to 2174 and 2007-2014, 333 to 1193; LDL cholesterol 1999-2006, 566 to 2167 and 2007-2014, 332 to 1191; apolipoprotein B 2005-2008, 210 to 768 and 2011-2014, 158 to 602; for all lipids and periods, the minimum sample size was for overweight and the maximum was for normal BMI.

^aP values compare proportions between the time periods shown in the table: for total cholesterol, 1999-2006 vs. 2009-2016, for HDL cholesterol and non-HDL cholesterol, 2007-2010 vs. 2013-2016, for triglycerides and LDL cholesterol, 1999-2006 vs. 2007-2014, for apolipoprotein B, 2005-2008 vs. 2011-2014. Data for triglycerides, LDL cholesterol, and apolipoprotein B are for youth ages 12-19 years only.

^bAdjusted for race/ethnicity in addition to age.

^cEstimates may be unstable due to large relative CI width (>130% of proportion) in the setting of absolute CI width >5.0 percent.²

^dEstimates may be unreliable due to small effective sample sizes and extreme proportions (numerator sample sizes <12 for these cells).³

BMI, body mass index; CI, confidence interval; HDL, high-density lipoprotein; LDL, low-density lipoprotein; NH, non-Hispanic.

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