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Recommended and Observed Statin Use among U.S. Adults – National Health and Nutrition Examination Survey, 2011–2018

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Abstract

Background: The American College of Cardiology/American Heart Association Blood Cholesterol Guideline was published in 2013 (2013 Cholesterol Guideline) and the Multi-society Guideline on the Management of Blood Cholesterol in 2018 (2018 Cholesterol Guideline).

Objective: To compare differences in population level estimates for statin recommendations and use between guidelines.

Methods: Using four 2-year cycles from the National Health and Nutrition Examination Survey (2011–2018), we analyzed data from 8,642 non-pregnant adults aged ≥20 years with complete information for blood cholesterol measurements and other cardiovascular risk factors used to define treatment recommendations in the 2013 or 2018 Cholesterol Guidelines. We compared the prevalence of statin recommendations and use between the guidelines, overall and among patient management groups.

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Author Contributions

All authors contributed to the conception, design, final revisions, and approval of this article (AMT, CG, HKW, FL, LS, YH). CG and AMT also contributed to the data analysis.

Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention, the National Heart, Lung, and Blood Institute, the National Institutes of Health, or the U.S. Department of Health and Human Services.

Declaration of Competing Interest

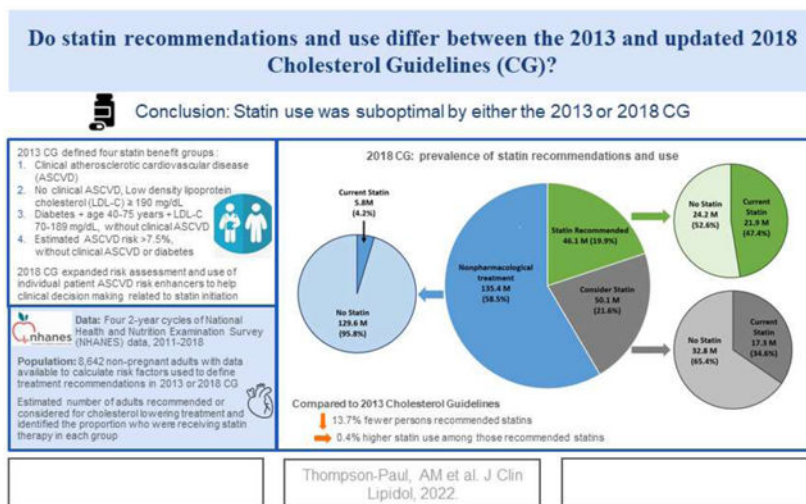
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Results: Under the 2013 Cholesterol Guideline, an estimated 77.8 million (33.6%) adults would be recommended statins, compared to 46.1 million (19.9%) recommended and 50.1 million (21.6%) considered for statins by the 2018 Cholesterol Guideline. Statin use among those recommended treatment was similar utilizing the 2018 Cholesterol Guideline (47.4%) compared to the 2013 Cholesterol Guideline (47.0%). Differences were observed across demographic and patient management groups.

Conclusion: Compared to the 2013 Cholesterol Guideline, the prevalence of statin recommendations decreased utilizing the 2018 Cholesterol Guideline algorithm, though additional persons would be considered for treatment after risk factor assessment and patient-clinician discussion under the 2018 Cholesterol Guideline. Statin use was suboptimal (<50%) for those recommended treatment under either guideline. Optimizing patient-clinician risk discussions and shared decision making may be needed to improve treatment rates.

Graphical Abstract



Keywords

cardiovascular disease; cholesterol management; statin; NHANES

Introduction

Heart disease and stroke are the first and fifth leading causes of death in the United States.(1) A leading risk factor for both conditions, high blood cholesterol levels are positively associated with atherosclerotic cardiovascular disease (ASCVD).(2-5) The 2013 American College of Cardiology/American Heart Association (ACC/AHA) *Guideline on the Treatment of Blood Cholesterol to Reduce Atherosclerotic Cardiovascular Risk in Adults* (2013 Cholesterol Guideline) eliminated specific LDL-c treatment targets, shifted treatment focus to use of HMG-CoA reductase inhibitors (statins), identified four patient groups most likely to benefit from statin use, and emphasized the importance of patient-clinician risk discussions for primary ASCVD prevention.(6) The four statin benefit groups included individuals with: 1) clinical ASCVD, 2) severe hypercholesterolemia (LDL-c 190 mg/dL),

3) diabetes aged 40 to 75 years with LDL-c 70 to 189 mg/dL and without clinical ASCVD, or 4) without clinical ASCVD or diabetes with LDL-c 70 to 189 mg/dL and estimated 10-year ASCVD risk >7.5%.⁽⁶⁾

In 2018, the *AHA/ACC Multi-society Guideline on the Management of Blood Cholesterol* (2018 Cholesterol Guideline) incorporated additional clinical trial evidence and allowed for more detailed interpretation of the evidence, including an expanded risk assessment and use of individual patient ASCVD risk enhancing factors to help clinical decision making related to statin initiation.⁽⁷⁾ The objective of this analysis was: 1) to identify elements included in these guidelines within national surveillance data; 2) to provide population level estimates of the numbers of U.S. adults eligible for cholesterol treatment by patient management groups according to the 2018 Guideline; 3) to compare differences in recommended and observed statin use between the 2013 and 2018 Cholesterol Guidelines to better understand the potential impact of the updated guidelines.

Methods

The National Health and Nutrition Examination Survey (NHANES) is a complex, multistage probability sample of the resident, civilian, noninstitutionalized U.S. population.^(8,9) Briefly, NHANES includes at-home interviews and physical exams including blood draw in mobile examination centers. To obtain statistically reliable estimates, we combined four 2-year NHANES cycles (2011–2018), which yielded 9,189 non-pregnant, fasting adults aged ≥ 20 years. From these eligible participants 8,642 individuals (94.0%) were included in the analytic sample after excluding those missing risk factors used to define treatment recommendations in the 2013 or 2018 Cholesterol Guidelines (n = 547). The data used are publicly available and further Institutional Review Board approval was not required for their use in secondary analyses.

Definition

Venous blood samples were drawn at the Mobile Examination Centers using standardized protocols.⁽¹⁰⁾ During the 2011–2018 data collection cycles, serum LDL-c levels were derived on fasting study participants who were examined in the morning session only. LDL-c was calculated from measured values of total cholesterol, triglycerides, and HDL-cholesterol according to the Friedewald calculation (mg/dL): $[\text{LDL-c}] = [\text{total cholesterol}] - [\text{HDL-c}] - [\text{triglycerides}/5]$ and is valid for triglycerides < 400 mg/dL. Statin use was identified during the interview or using the NHANES prescription medication data files.

Following the 2018 Cholesterol Guideline, we categorized participants into the four patient management groups (referred to as ‘statin benefit groups’ in the 2013 Cholesterol Guideline): 1) secondary prevention for those with existing ASCVD, 2) hyperlipidemia (LDL-c levels ≥ 190 mg/dL), 3) diabetes, and 4) primary prevention among those without ACSVD or diabetes, and with LDL-c levels < 190 mg/dL (see Supplemental Table 1 for further definition).

We further classified individuals into the following three treatment recommendation subgroups: those who were (1) “recommended” for treatment, (2) “considered” for

treatment, or (3) neither recommended nor considered for treatment, referred to in this analysis as the non-pharmacologic therapy group. We considered individuals to be “recommended” for cholesterol treatment if a specific course of treatment was recommended in the 2018 Cholesterol Guideline and supported by a Class I Recommendation. For example, among those assessed to be at high (20% 10-year ASCVD risk), the 2018 Cholesterol Guideline recommended initiation of moderate intensity statin during a patient-clinician risk discussion. Further details regarding criteria used to define conditions in this analysis and data elements available in NHANES are described in Supplemental Table 1 and 2.

We classified statin use as “considered” for those at intermediate risk (7.5% to < 20% risk) because the guidelines stated that statin therapy were not required for this group but initiation of therapy may be favored after additional consideration of risk enhancing factors. Statin use was also classified as “considered” if the evidence was supported with a Class IIa or IIb Recommendation. For example, the 2018 Cholesterol Guideline defined statin continuation or initiation as reasonable but dependent upon clinical assessment and patient-clinician risk discussion among adults >75 years of age for secondary ASCVD prevention, among those with diabetes but not aged 40–75 years, and for adults with LDL-c levels between 70–189 mg/dL. We also estimated the number of adults older >75 years of age with severe hypercholesterolemia, however, there are no guideline recommendations for this group due to sparse clinical trial data.(7) To help categorize individuals, we identified variables available in NHANES which corresponded to the ASCVD risk-enhancing factors and very high-risk conditions specified in the guidelines.

Analysis

We estimated the number of adults recommended or considered for cholesterol lowering treatment according to the 2018 Cholesterol Guideline and identified the proportion who were receiving statin therapy in each group. To estimate population counts, we multiplied the estimated prevalence (as proportions) by the average 2-year national population counts, which are compiled by the National Center for Health Statistics (NCHS) from the US Census Bureau’s American Community Survey.(11) We estimated the prevalence of those recommended statins according to the 2013 and 2018 Cholesterol Guidelines and the difference between those estimates. To test for statistical significance for the difference, we used the Chi-square test based on McNemar, adapted for the complex sampling design, test of independence between discordant groups (i.e.: Statin recommended in the 2013 guidelines, but not in the 2018 updated guidelines versus Statin not recommended in the 2013 guidelines, but recommended in the 2018 updated guidelines). Subgroups assessed included sex, age groups (20–39, 40–64, and 65, with subgroups of 65–75 and >75 years), and race/Hispanic origin (non-Hispanic white, non-Hispanic black, non-Hispanic Asian, Hispanic, and other) as well as by the four patient management groups identified in the 2018 Cholesterol Guideline (secondary ASCVD prevention, severe hypercholesterolemia, adults aged 40–75y with diabetes, and primary ASCVD prevention). We examined prevalence of statin use among those recommended for treatment under each guideline. Finally, we examined concordance and discordance between statin recommendations in the 2013 and 2018 Cholesterol Guidelines. All analyses were conducted using fasting sampling weights

and statistical software (SAS version 9.4 and SUDAAN, Release 11; RTI International Research Triangle Park, NC) to adjust variance estimates for sampling design. Statistical stability was determined based on the NCHS Data Presentation Standards for Proportions. (12)

Results

The weighted analytic sample representative of the U.S. population comprised 51.4% women, 35.6% persons aged 20–39 years, 44.9% persons aged 40–64 years, 19.5% persons aged ≥ 65 years. The race/Hispanic origin of the analytic sample included 64.9% non-Hispanic white, 11.3% non-Hispanic black, 5.4% non-Hispanic Asian, 15.0% Hispanic, and 3.4% other race/ethnic origins.

Application of the 2018 Cholesterol Guideline to 2011–2018 NHANES data indicates that an estimated 46.1 million (M) US adults (19.9%) would be recommended statin use for cholesterol management representing a 13.7% decrease from the 2013 Cholesterol Guideline. Compared to the 2013 Cholesterol Guideline, the proportion of individuals recommended statin therapy under the 2018 Cholesterol Guideline was lower overall, across all demographic categories (p-value 0.003, Table 1).

Among demographic groups, the greatest differences in prevalence of statin recommendations between the 2013 and 2018 Cholesterol Guidelines were among men (–10.7%, p-value = 0.004), individuals ≥ 65 years of age (–11.2%, p-value = 0.002), and non-Hispanic whites (–12.1% p-value = 0.002). Among patient management groups (Table 2), application of the 2018 Cholesterol Guideline compared to the 2013 Cholesterol Guideline resulted in decreases in statin recommendations for primary and secondary ASCVD prevention (11.0% and 0.1% decreases, respectively), little change in statin recommendations among those with severe hypercholesterolemia, and a 1.5% increase in recommended statin use among persons with diabetes.

Prevalence of statin use among those for whom statin therapy is recommended was similar (0.4% lower) under the 2018 Cholesterol Guideline compared to the 2013 Cholesterol Guideline (Table 3). Decreases were seen across most patient demographic characteristics with the greatest decreases for females (–6.7%), persons ≥ 65 years of age and non-Hispanic whites (–10.3%). Compared to non-Hispanic White adults, prevalence of statin use was lower among non-Hispanic Black adults, non-Hispanic Asian adults, and Hispanic adults under both the 2013 and 2018 Cholesterol Guidelines.

More than half of all U.S. adults (58.5%) are neither recommended nor considered for statin therapy according to the 2018 Cholesterol Guideline (Figure 1). Among these adults 4.2% reported statin use. Among the 96.2 M U.S. adults for whom statin therapy would be recommended (46.1 M) or considered (50.1 M) under the 2018 Cholesterol Guideline, less than half reported current statin therapy (Figure 1). Adults recommended or considered for statin use include 22.5 M for secondary ASCVD prevention, 4.8 M for severe hypercholesterolemia, 20.3 M adults aged 40–75y with diabetes, and 45.0 M for primary prevention (Figure 2). Prevalence of statin use was greatest among those recommended

or considered (60.3% and 74.5%, respectively) for treatment for secondary ASCVD prevention. Among persons with severe hypercholesterolemia 91.4% of persons who would be recommended for statins were not taking the treatment. Only 47.0% of persons aged 40–75 years with Diabetes reported statin use and 34.3% of persons recommended statins for primary prevention reported statin use.

There was high concordance between the 2013 and 2018 Cholesterol Guidelines (Supplemental Table 3). Neither guideline recommended therapy for 73.8% of adults, both guidelines recommended statin therapy for 26.2% of individuals, and the remaining 24.2% were discordant (Supplemental Figure).

Discussion

We used the 2018 Cholesterol Guideline to update our definition of patient management groups as well as statin recommendations and applied them to NHANES data from 2011–2018. While much of the definition for the patient management groups was consistent with the 2013 Cholesterol Guideline, we separately categorized and quantified persons who were “considered” versus those who were “recommended” for cholesterol management treatment. This distinction is important in our surveillance data to quantify those who may benefit from treatment while acknowledging the guideline language that increased focus on patient-clinician risk discussion, and clinical decisions that allow for individualization of treatment. Application of the 2018 Cholesterol Guideline resulted in 37.1 M fewer adults overall being recommended statin therapy for blood cholesterol management compared to the 2013 Cholesterol Guideline. Under 2013 Cholesterol Guideline, 33.6% (77.8 M) adults were recommended treatment compared to 19.9% of US adults (46.1 M) under the 2018 Cholesterol Guideline. This shift was driven in large part by the adults were reclassified from being recommended for statin therapy under the 2013 Cholesterol Guideline to being considered for statin therapy or receiving no statin recommendation under the 2018 Cholesterol Guideline.

We estimated that less than half of adults who would be recommended or considered for statin therapy under the 2018 Cholesterol Guideline were receiving treatment. Prior estimates from NHANES showed that 54.5% of adults recommended statins under the 2013 Cholesterol Guideline were receiving treatment.⁽¹³⁾ A cross-sectional study that included patients who were receiving care at 140 specialty clinics across the U.S. demonstrated higher statin utilization among patients eligible for primary (62.3%) or secondary prevention (82.2%) compared to the prior or current analyses using NHANES data. Almost half of those not on a statin reported that they were never offered statin therapy.⁽¹⁴⁾ Similarly, a recent study using electronic health record data from Manhattan-area patients with primary care or cardiology visits between October 2018 and January 2020, reported that among 7,550 patients eligible for primary prevention statin therapy only 52.9% were prescribed statins.⁽¹⁵⁾ Although we might expect higher statin utilization in clinic populations compared to the general U.S. population, which includes many people not engaged in routine medical care, even in these clinical populations statin use was less than optimal.

Importantly, we identified racial/Hispanic origin disparities in treatment. Among those for whom statins are recommended, statin use was higher for non-Hispanic White and non-Hispanic Asian adults (52.0% and 47.7%, respectively) and lower among non-Hispanic Black and Hispanic adults (38.5% and 32.0%, respectively). These findings align with prior reports. Metser and colleagues reported a higher prevalence of statin prescriptions among White and Asian patients than among Black patients.(15) Medical Expenditure Panel Study data showed that statin use was less than optimal across all patient groups, with lower odds of use in racial/ethnic minorities.(16,17) Of particular importance, although there are an estimated 4.6 M adults with LDL-c \geq 190 mg/dL who would be recommended treatment, fewer than one in 10 were receiving treatment. Early identification and treatment of individuals with severe hypercholesterolemia may reduce lifetime risk for ASCVD.(18,19)

While statin use is considered safe and has been proven to be effective for lowering ASCVD risk for persons for whom it is indicated, it may have minimal benefit among adults in this analysis who may be taking a statin with an unclear indication. Use of additional risk assessment tools and patient-clinician risk discussion may help to determine if treatment is warranted or if therapy is not needed among these individuals.(20) Cessation of statins not recommended in current guidelines could result in cost-savings and avoid potential side effects or drug interactions.

There is evidence that adoption of the 2013 Cholesterol Guideline and clinical implementation have been modest, but statin use may be increasing over time.(21–23) Awareness of high blood cholesterol among U.S. adults has increased modestly since 2005 but approximately one in three persons are currently unaware of having elevated cholesterol levels.(24) Awareness of ASCVD risk among U.S. adults is not currently assessed by national surveys so prevalence is unknown, but might be low as well. Additional efforts are needed in ASCVD risk assessment, communication, and cholesterol management between clinicians and patients (25) to optimize treatment plans and opportunities for ASCVD prevention.(26)

While treatments have evolved over time and guideline recommendations have adapted per the growing evidence-base, it is important to recognize that we continue to see progress in cholesterol management at the national level. Since 2005, cholesterol screening has increased and mean total blood cholesterol has decreased among U.S. adults.(27) A small but significant declining trend in mean levels of LDL-c has also been observed.(28) The 2018 Cholesterol Guideline further emphasizes the need for shared-decision making, highlighting the importance of understanding each patient's risk profile to help determine those with net clinical benefit from drug treatment for elevated blood cholesterol. For certain patient management groups such as adults 40 to 75 years without diabetes mellitus and with LDL-C levels \geq 70 mg/dL (\geq 1.8 mmol/L), at a 10-year ASCVD risk of \geq 7.5%, the guidelines emphasize starting statin therapy only if discussion (including consideration of risks-enhancing factors) favors statin therapy. This does not mandate therapy but does provide an opportunity for patients and providers to discuss risk-enhancing factors, and to consider using measures such as coronary artery calcification (CAC) to improve specificity in determining whether cholesterol lowering treatment would be beneficial.(6)

Clinically the 2018 Cholesterol Guideline allows for more personalized health care. As many who may benefit from statin use remain untreated, increased identification and treatment of persons recommended for statin-based pharmacotherapy should remain a priority. This aligns with the Department of Health and Human Services Million Hearts[®] initiative's target of achieving 80% performance for statin therapy among individuals considered at high risk of ASCVD events.(13)

Recently, Mortensen and Nordestgaard examined five major guidelines on the use of statins for primary ASCVD prevention using data from the Copenhagen General Population Study, and actual ASCVD events observed during 10 years.(29,30) They compared the potential effectiveness of guidelines from the National Institute for Health and Care Excellence (NICE, 2014) in the United Kingdom(31), the Canadian Cardiovascular Society (CCS, 2016)(32), European Society of Cardiology/European Atherosclerosis Society (ESC/EAS, 2016)(33), USPSTF (34) and the 2018 Cholesterol Guideline (7). They concluded that guidelines recommending broader statin use for primary prevention could prevent more events than guidelines recommending use by fewer individuals.(30) The authors also found that NICE, CCS, and the 2018 Cholesterol Guidelines correctly assigned statin therapy to many more of the individuals who later develop ASCVD compared to the other two guidelines examined.(29) These three guidelines had similar number-needed-to-treat values, ranging from approximately 20 persons treated with high-intensity statins to 30 persons treated with moderate-intensity statins to prevent one ASCVD event during 10 years. The ESC/EAS Guideline published in 2019 recommended lower and more aggressive targets than their 2016 guideline, with an LDL-c goal of <55 mg/dL for very high-risk patients with greater emphasis on consideration for proprotein convertase subtilisin/kexin type 9 serine protease (PCSK9)-inhibitors if treatment with a statin and ezetimibe does not produce adequate LDL-c reduction.(35)

There are several limitations that should be acknowledged. The NHANES protocol during the 2011–2018 data collection cycles required that laboratory values were measured only for fasting participants during the morning session. As a result, a large proportion of participants were excluded from this analysis due to missing laboratory measurements; however, the application of fasting weights account for differential selection and non-response. Self-reported and prescription medication data available did not include intensity or reason for use. Statins comprised 94% of all cholesterol-lowering medications reported during the 2011–2018 data collection cycles. Non-statin medications such as fibric acid derivatives, bile acid sequestrants, and ezetimibe were used by 15.0% of persons included in the analytic sample, including by 9.6% of those who used statins. Antihyperlipidemic medication combinations were not examined in this analysis. Additionally, misclassification of some individuals to a lower risk category may have occurred for several reasons. NHANES has information for only three out of the four major ASCVD categories (symptomatic peripheral arterial disease is not available) and seven out of nine high-risk conditions (heterozygous familial hypercholesterolemia, or history of prior coronary artery bypass surgery or percutaneous coronary intervention outside of the major ASCVD categories are not available), therefore some high-risk individuals may have been inadvertently misclassified to a lower risk category. Similarly, NHANES includes information on many, but not all of the ASCVD risk-enhancing factors listed by the 2018 Cholesterol Guideline

(see Supplemental Table 2 for additional details), and does not capture cardiac computerized tomography CAC data which the 2018 Cholesterol Guideline recommends to consider in appropriate patients as a tool for risk reclassification and decision-making.(20) Finally, the 2018 Cholesterol Guideline was retrospectively applied to data collected from 2011–2018, which does not represent true guideline implementation.

Conclusions

Slightly under one in five U.S. adults are recommended statins by the 2018 Cholesterol Guideline, which is substantially lower than the estimate of one in three adults by the 2013 Cholesterol Guideline. The difference in these estimates can be largely explained by the evolution of the guidelines to include those who would be considered rather than recommended for treatment, a group comprising approximately 26.0% of U.S. adults under the 2018 Cholesterol Guideline. Although the number recommended for treatment decreased, the proportion taking statins (<50%) did not improve. The prevalence of statin use was suboptimal by either guideline. Statin use was lowest for adults with severe hypercholesterolemia and highest for secondary ASCVD prevention. Racial/ethnic disparities in statin use also exist, with lower prevalence of use among non-Hispanic black and Hispanic adults. Optimizing patient-clinician discussions and shared decision making to address patient concerns related to statin therapy may be needed to improve treatment rates.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations:

ASCVD	atherosclerotic cardiovascular disease
LDL-c	low density lipoprotein cholesterol
HDL-c	high density lipoprotein cholesterol
CHD	coronary heart disease
NHANES	National Health and Nutrition Examination Survey
USPSTF	U.S. Preventive Services Task Force
NCHS	National Center for Health Statistics
NICE	National Institute for Health and Care Excellence
CCS	Canadian Cardiovascular Society

ESC/EAS European Society of Cardiology/European Atherosclerosis Society

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Highlights

- Statin use was suboptimal (<50%) by the 2013 or 2018 cholesterol guidelines (CG)
- Proportion of adults recommended statins was lower (2013 CG: 33.6%; 2018 CG: 19.9%)
- An additional 21.6% of adults were considered for statin use according to 2018 CG
- Only 47.0% of persons aged 40–75 years with diabetes reported statin use
- <10% of persons with hypercholesterolemia reported statin use

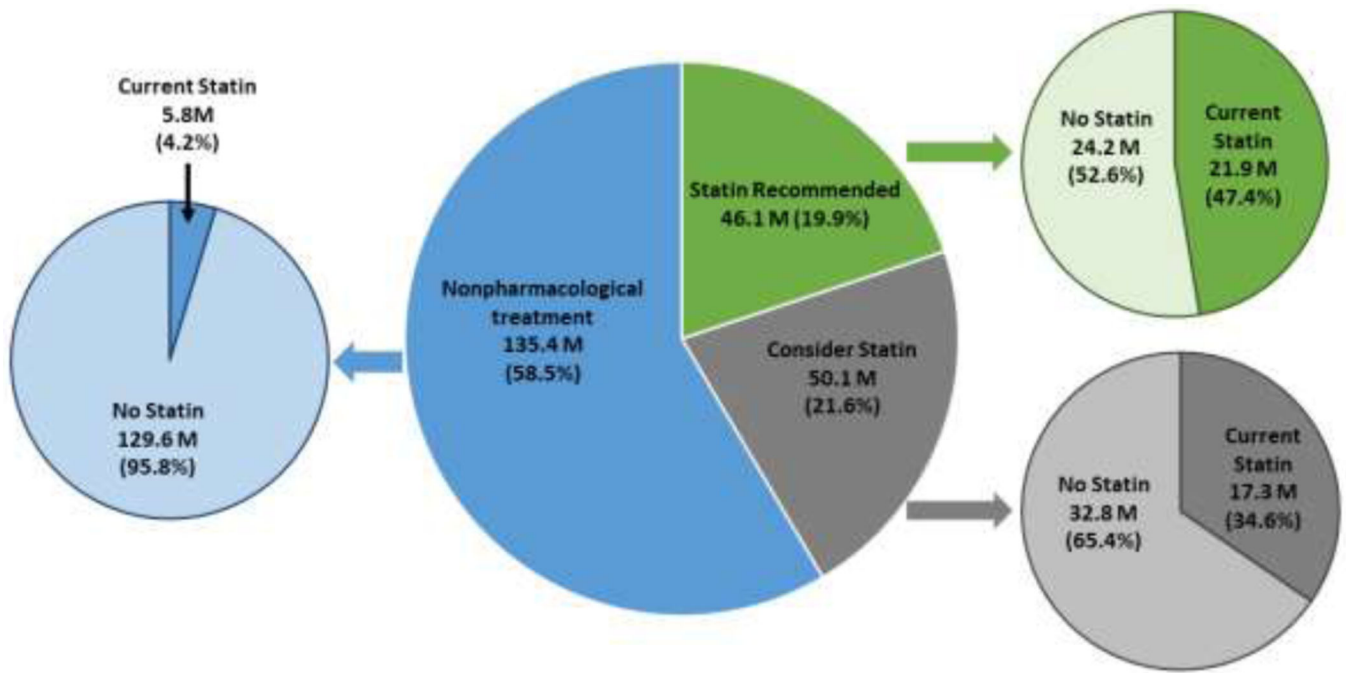
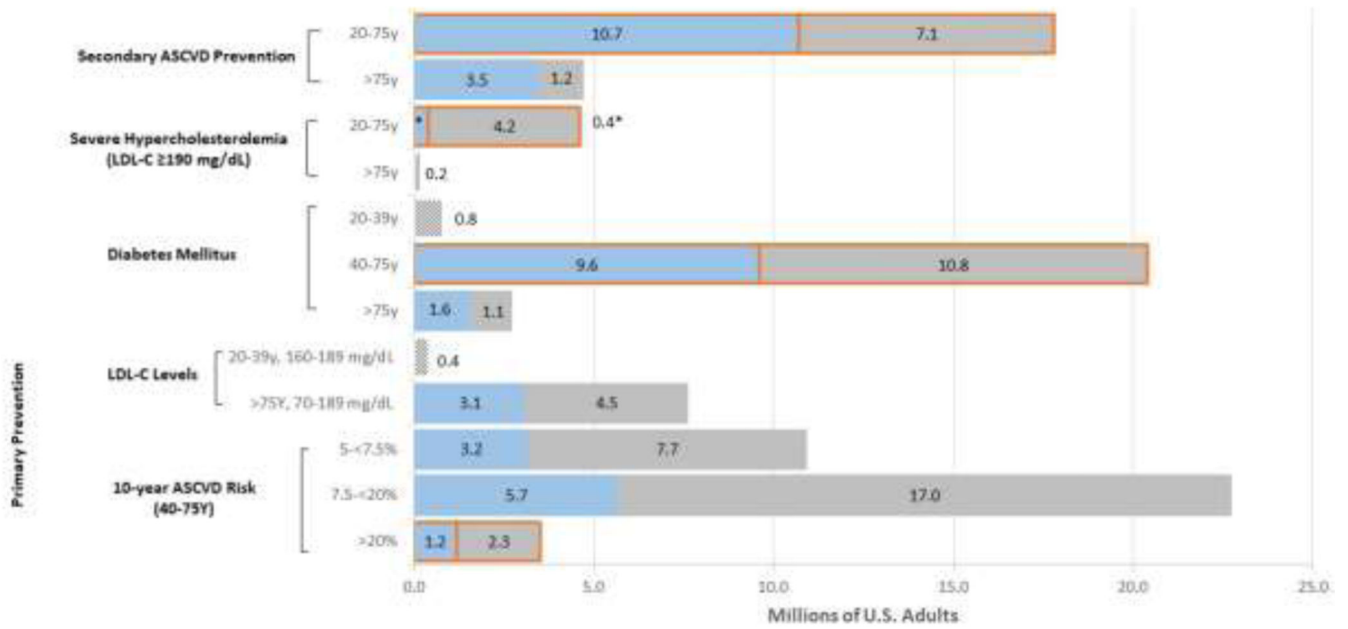


Figure 1. Cholesterol lowering recommendations and statin use among U.S. adults according to the 2018 Cholesterol Guideline, NHANES 2011–2018.



The prevalence of individuals in each patient management group who are receiving current statin treatment is indicated by a blue bar (■), the prevalence of those who are receiving no statin treatment is indicated by the gray bar (■), and prevalence of treatment groups were not calculated. The groups for whom statin treatment is recommended are indicated by the orange outline (▭). Groups for whom statin treatment could be considered have no outline.

Figure 2. Estimated number of U.S. adults recommended or considered for statin use according to the 2018 Cholesterol Guideline: NHANES 2011–2018

Table 1.

Prevalence of statin recommendations among adults by demographic characteristics: 2013 & 2018 Cholesterol Guidelines -- NHANES 2011–2018

Characteristic	Unweighted	Population	2013 GL			2018 GL			Difference		Chi-square p-value †
	n (sample size)	N (millions)	%	(se)	N	%	(se)	N	%	N	
Total - overall	8,642	231.6	33.6	(0.9)	77.8	19.9	(0.6)	46.1	-13.7	-31.7	0.003
Male	4,207	112.6	39.0	(1.2)	43.9	21.9	(0.9)	24.7	-17.1	-19.2	0.004
Female	4,435	119.0	28.5	(1.0)	33.9	18.0	(0.8)	21.5	-10.5	-12.5	
Age group											
20–39	2,767	82.4	3.2	(0.4)	2.7	2.2	(0.3)	1.8	-1.0	-0.8	0.002
40–64	3,799	104.0	45.8	(1.4)	47.6	26.8	(1.0)	27.9	-18.9	-19.7	
65	2,076	45.2	61.0	(1.6)	27.6	36.3	(1.5)	16.4	-24.7	-11.2	0.002
65–75	1,286	29.9	92.2	(1.3)	27.6	54.8	(2.2)	16.4	-37.3	-11.2	
>75	790	15.3	0.0	(0.0)	0.0	0.0	(0.0)	0.0	0.0	0.0	
Race-Hispanic Origin											
Non-Hispanic White	3,276	150.3	35.0	(1.1)	52.5	19.2	(0.8)	28.9	-15.7	-23.6	0.002
Non-Hispanic Black	1,817	26.2	38.1	(1.2)	10.0	24.0	(0.9)	6.3	-14.1	-3.7	
Non-Hispanic Asian	1,124	12.5	28.3	(1.6)	3.5	17.9	(1.3)	2.2	-10.4	-1.3	
Hispanic	2,121	34.7	25.7	(1.1)	8.9	19.0	(0.9)	6.6	-6.7	-2.3	
Other	304	7.9	36.2	(4.5)	2.9	26.4	(3.6)	2.1	-9.8	-0.8	

Includes non-pregnant fasting participants adults ≥20y, with complete data on risk factors and statin use.

N: Population N in millions; Total population calculated from the American Community Survey data released by NCHS, averaged across the 4 cycles. Subgroup population Ns calculated based on the weighted distribution of the NHANES analytic sample. For additional information, see: <https://www.cdc.gov/nchs/nhanes/ResponseRates.aspx#population-totals>.

The 2013 GLs apply to adults ≥21 years. The 2018 GLs apply to adults ages ≥20y.

The 2013 ACC-AHA Guidelines recommended statin therapy for adults ≥21 years who fall into any of the following 5 groups:

- 1) Clinical ASCVD: Criteria used to define ASCVD are found in Supplemental Table 1.
- 2) Severe hypercholesterolemia: fasting LDL-c ≥190 mg/dL, no clinical ASCVD (as defined above), and age 40–75 y
- 3) Diabetes, no clinical ASCVD or Hypercholesterolemia, age 40–75 y; Criteria used to define Diabetes are found in Supplemental Table 1.
- 4) ASCVD risk ≥7.5%, no clinical ASCVD, Hypercholesterolemia, or Diabetes, age 40–75 y ASCVD risk score is calculated based on the equations published in: Goff DC Jr, Lloyd-Jones DM, Bennett G, Coady S, D'Agostino RB Sr, Gibbons R, Greenland P, Lackland DT, Levy D, O'Donnell CJ, Robinson JG, Schwartz JS, Shero ST, Smith SC Jr, Sorlie P, Stone NJ, Wilson PWF. 2013 ACC/AHA guideline on the assessment of cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2014;129(suppl 2): S49-S73.
- 5) Current statin use, age 21–75y: identified using the NHANES prescription medication data files.

The 2018 ACC-AHA Guidelines recommend statin therapy for adults ≥20 years who fall into any of the following 4 groups:

- 1) Clinical ASCVD (as defined above) and age 20–75 years
- 2) Severe hypercholesterolemia: fasting LDL-c ≥190 mg/dL, no clinical ASCVD, and age 20–75 y
- 3) Diabetes, no clinical ASCVD or severe hypercholesterolemia, and age 40–75 y

4) Primary prevention (no clinical ASCVD, severe hypercholesterolemia, or Diabetes, age 40–75y): ASCVD Risk 20%

Standard errors not calculated for prevalence defined as zero based on guidelines.

[†]Chi-square p-values was based on McNemar’s test, adapted for the complex sampling design; test of independence between discordant groups (i.e.: Statin recommended in the 2013 guidelines, but not in the 2018 updated guidelines versus Statin not recommended in the 2013 guidelines, but recommended in the 2018 updated guidelines).

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Table 2.

Prevalence of Statin Recommendation Patient Management Groups identified by the 2013 and 2018 Cholesterol Guidelines, by demographic characteristics -- NHANES 2011–2018

Secondary Prevention	2013 GL			2018 GL			Difference	
	%	(se)	N	%	(se)	N	%	N
Total	7.8	(0.5)	18.0	7.7	(0.5)	17.8	-0.1	-0.2
Male	8.9	(0.8)	10.0	8.8	(0.8)	9.9	-0.1	-0.1
Female	6.8	(0.5)	8.1	6.7	(0.5)	7.9	-0.1	-0.1
Age group								
20–39*	1.0	(0.2)	0.8	1.0	(0.2)	0.8	0.0	0.0
40–64	9.7	(0.7)	10.1	9.6	(0.7)	10.0	-0.1	-0.1
65	15.8	(1.3)	7.1	15.5	(1.3)	7.0	-0.3	-0.1
65–75	23.8	(2.0)	7.1	23.4	(2.0)	7.0	-0.4	-0.1
>75	0.0		0.0	0.0		0.0	0.0	0.0
Race-Hispanic Origin								
Non-Hispanic White	8.1	(0.7)	12.2	8.0	(0.7)	12.1	-0.1	-0.2
Non-Hispanic Black	8.6	(0.6)	2.3	8.6	(0.6)	2.2	-0.1	0.0
Non-Hispanic Asian	3.5	(0.6)	0.4	3.5	(0.6)	0.4	0.0	0.0
Hispanic	5.6	(0.6)	2.0	5.6	(0.6)	1.9	-0.1	0.0
Other	14.5	(3.2)	1.1	14.4	(3.2)	1.1	-0.1	0.0
	2013 GL			2018 GL			Difference	
Hyperlipidemia	%	(se)	N	%	(se)	N	%	N
Total	2.0	(0.2)	4.6	2.0	(0.2)	4.6	0.0	0.0
Male	2.0	(0.3)	2.3	2.0	(0.3)	2.3	0.0	0.0
Female	1.9	(0.2)	2.3	1.9	(0.2)	2.3	0.0	0.0
Age group								
20–39*	1.2	(0.2)	1.0	1.2	(0.2)	1.0	0.0	0.0
40–64	2.9	(0.4)	3.0	2.9	(0.4)	3.0	0.0	0.0
65	1.2	(0.3)	0.5	1.2	(0.3)	0.5	0.0	0.0
65–75	1.8	(0.4)	0.5	1.8	(0.4)	0.5	0.0	0.0
>75	0.0		0.0	0.0		0.0	0.0	0.0
Race-Hispanic Origin								
Non-Hispanic White	2.0	(0.3)	3.0	2.0	(0.3)	3.0	0.0	0.0
Non-Hispanic Black	2.1	(0.4)	0.6	2.1	(0.4)	0.6	0.0	0.0
Non-Hispanic Asian	1.8	(0.4)	0.2	1.8	(0.4)	0.2	0.0	0.0
Hispanic	1.9	(0.3)	0.6	1.9	(0.3)	0.6	0.0	0.0
Other	~			~				
	2013 GL			2018 GL			Difference	
Diabetes	%	(se)	N	%	(se)	N	%	N
Total	7.3	(0.4)	16.9	8.8	(0.4)	20.3	1.5	3.4

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	2013 GL			2018 GL			Difference	
Secondary Prevention	%	(se)	N	%	(se)	N	%	N
Male	7.2	(0.5)	8.1	8.9	(0.6)	10.0	1.7	1.9
Female	7.4	(0.5)	8.8	8.7	(0.6)	10.3	1.2	1.5
Age group								
20–39*	0.0		0.0	0.0		0.0	0.0	0.0
40–64	11.9	(0.8)	12.4	13.7	(0.8)	14.3	1.8	1.9
65	9.9	(0.9)	4.5	13.4	(1.1)	6.0	3.5	1.6
65–75	15.0	(1.3)	4.5	20.2	(1.6)	6.0	5.2	1.6
>75	0.0		0.0	0.0		0.0	0.0	0.0
Race-Hispanic Origin								
Non-Hispanic White	6.3	(0.5)	9.5	7.8	(0.5)	11.7	1.4	2.2
Non-Hispanic Black	10.1	(0.6)	2.7	11.3	(0.6)	3.0	1.2	0.3
Non-Hispanic Asian	8.4	(0.9)	1.1	11.0	(1.1)	1.4	2.5	0.3
Hispanic	9.3	(0.6)	3.2	10.7	(0.6)	3.7	1.4	0.5
Other	5.9	(1.4)	0.5	7.6	(1.6)	0.6	1.7	0.1
	2013 GL			2018 GL			Difference	
Primary Prevention	%	(se)	N	%	(se)	N	%	N
Total	12.5	(0.6)	28.9	1.5	(0.2)	3.4	-11.0	-25.5
Male	17.4	(0.9)	19.6	2.2	(0.3)	2.5	-15.2	-17.1
Female	7.8	(0.5)	9.3	0.8	(0.2)	0.9	-7.0	-8.4
Age group								
20–39*	0.0		0.0	0.0		0.0	0.0	0.0
40–64	14.0	(0.8)	14.6	0.6	(0.1)	0.6	-13.4	-13.9
65	31.8	(1.7)	14.4	6.2	(0.8)	2.8	-25.5	-11.5
65–75	48.0	(2.2)	14.4	9.4	(1.2)	2.8	-38.6	-11.5
>75	0.0		0.0	0.0		0.0	0.0	0.0
Race-Hispanic Origin								
Non-Hispanic White	13.6	(0.8)	20.4	1.5	(0.2)	2.2	-12.1	-18.2
Non-Hispanic Black	15.1	(0.8)	3.9	2.0	(0.2)	0.5	-13.0	-3.4
Non-Hispanic Asian	11.4	(1.1)	1.4	1.7	(0.4)	0.2	-9.8	-1.2
Hispanic	7.1	(0.6)	2.5	0.9	(0.2)	0.3	-6.2	-2.2
Other	8.1	(2.2)	0.6	2.0	(0.9)	0.2	-6.1	-0.5

Includes non-pregnant fasting adults age ≥20y, with complete data on risk factors and statin use.

The 2013 GLs apply to adults ≥21 years. The 2018 GLs apply to adults ≥20y. Includes non-pregnant fasting participants adults ≥20y, with complete data on risk factors and statin use.

The 2013 ACC-AHA Guidelines recommended statin therapy for adults ≥21 years who fall into any of the following 5 groups:

- 1) Clinical ASCVD: Criteria used to define ASCVD are found in Supplemental Table 1.
- 2) Severe hypercholesterolemia: fasting LDL-c ≥190 mg/dL, no clinical ASCVD

(as defined above), and age 40–75 y

- 3) Diabetes, no clinical ASCVD or severe hypercholesterolemia, age 40–75 y; Criteria used to define Diabetes are found in Supplemental Table 1.
- 4) ASCVD risk $\geq 7.5\%$, no clinical ASCVD, severe hypercholesterolemia, or Diabetes, age 40–75 y

ASCVD risk score is calculated based on the equations published in: Goff DC Jr, Lloyd-Jones DM, Bennett G, Coady S, D'Agostino RB Sr, Gibbons R, Greenland P, Lackland DT, Levy D, O'Donnell CJ, Robinson JG, Schwartz JS, Shero ST, Smith SC Jr, Sorlie P, Stone NJ, Wilson PWF. 2013 ACC/AHA guideline on the assessment of cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2014;129(suppl 2): S49-S73.

- 5) Current statin use: identified using the NHANES prescription medication data files.

The 2018 ACC-AHA Guidelines recommend statin therapy for adults ≥ 20 years who fall into any of the following 4 groups:

- 1) Clinical ASCVD (as defined above) and age 20–75 years
- 2) Severe hypercholesterolemia: fasting LDL-c ≥ 190 mg/dL, no clinical ASCVD, and age 20–75 y
- 3) Diabetes, no clinical ASCVD or severe hypercholesterolemia, and age 40–75 y
- 4) Primary prevention (no clinical ASCVD, severe hypercholesterolemia, or Diabetes, age 40–75y): ASCVD risk $\geq 20\%$

Not shown is the category for current statin use among adults who do not fall within any of the management groups. The 2013 GLs recommended continued therapy for all adults currently treated; the 2018 GLs recommend considering continued therapy only within the management groups.

Does not include those for whom statin therapy should be considered according to the 2018 GLs.

For those aged 20–39y the 2013 GLs applied to adults age ≥ 21 years, while the 2018 GLs apply to adults age ≥ 20 years.

N: Population N in millions, calculated from the 2011–2012, 2013–2014, 2015–2016, 2017–2018 American Community Survey data released by NCHS, averaged across the 4 cycles. For additional information, see: http://www.cdc.gov/nchs/nhanes/response_rates_cps.htm.

~ Statistically unstable estimates are suppressed, based on the NCHS Data Presentation Standards for Proportions: Parker JD, Talih M, Malec DJ, et al. National Center for Health Statistics Data Presentation Standards for Proportions. National Center for Health Statistics. *Vital Health Stat* 2(175). 2017. https://www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf

Standard errors not calculated for prevalences defined as zero based on the guidelines.

Table 3.

Prevalence of Statin Use among U.S. adults (≥ 20y) for whom statin therapy is recommended by demographic characteristics: 2013 & 2018 Cholesterol Guidelines -- NHANES 2011–2018

Characteristic	2013 GL			2018 GL			Difference	
	%	(se)	N	%	(se)	N	%	N
Total	47.0	(1.3)	36.6	47.4	(1.7)	21.9	0.4	-14.7
Male	45.8	(1.7)	20.1	52.2	(2.2)	12.9	6.4	-7.2
Female	48.6	(2.2)	16.5	41.8	(2.3)	9.0	-6.7	-7.5
Age group								
20–39*	37.6	(6.3)	1.0	~				
40–64	45.5	(1.7)	21.7	43.9	(1.9)	12.2	-1.6	-9.4
65	50.4	(2.0)	13.9	57.5	(2.3)	9.4	7.1	-4.5
65–75	50.4	(2.0)	13.9	57.5	(2.3)	9.4	7.1	-4.5
>75	NA			NA				
Race-Hispanic Origin								
Non-Hispanic White	50.4	(1.7)	26.5	52.0	(2.4)	15.0	1.5	-11.5
Non-Hispanic Black	37.0	(1.9)	3.7	38.5	(2.2)	2.4	1.5	-1.3
Non-Hispanic Asian	46.7	(3.4)	1.7	47.7	(4.2)	1.1	1.0	-0.6
Hispanic	34.1	(2.2)	3.0	32.0	(2.6)	2.1	-2.1	-0.9
Other	58.9	(7.5)	1.7	58.5	(8.3)	1.2	-0.4	-0.5

Includes non-pregnant fasting adults age ≥ 20y, with complete data on risk factors and statin use

The 2013 ACC-AHA Guidelines recommended statin therapy for adults ≥ 21 years who fall into any of the following 5 groups:

- 1) Clinical ASCVD: Criteria used to define ASCVD are found in Supplemental Table 1.
- 2) Severe hypercholesterolemia: fasting LDL-c ≥ 190 mg/dL, no clinical ASCVD (as defined above), and age 40–75 y
- 3) Diabetes, no clinical ASCVD or severe hypercholesterolemia, age 40–75 y; Criteria used to define Diabetes are found in Supplemental Table 1.
- 4) ASCVD risk ≥ 7.5%, no clinical ASCVD, severe hypercholesterolemia, or Diabetes, age 40–75 y

ASCVD risk score is calculated based on the equations published in: Goff DC Jr, Lloyd-Jones DM, Bennett G, Coady S, D'Agostino RB Sr, Gibbons R, Greenland P, Lackland DT, Levy D, O'Donnell CJ, Robinson JG, Schwartz JS, Shero ST, Smith SC Jr, Sorlie P, Stone NJ, Wilson PWF. 2013 ACC/AHA guideline on the assessment of cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2014;129(suppl 2): S49-S73.

5) Current statin use: identified using the NHANES prescription medication data files The 2018 ACC-AHA Guidelines recommend statin therapy for adults ≥ 20 years who fall into any of the following 4 groups:

- 1) Clinical ASCVD (as defined above) and age 20–75 years
- 2) Severe hypercholesterolemia: fasting LDL-c ≥ 190 mg/dL, no clinical ASCVD, and age 20–75 y
- 3) Diabetes, no clinical ASCVD or severe hypercholesterolemia, and age 40–75 y
- 4) Primary prevention (no clinical ASCVD, severe hypercholesterolemia, or Diabetes, age 40–75y): ASCVD risk ≥ 20%

Not shown is the category for current statin use among adults who do not fall within any of the management groups. The 2013 GLs recommended continued therapy for all adults currently treated; the 2018 GLs recommend considering continued therapy only within the management groups.

Does not include those for whom statin therapy should be considered according to the 2018 GLs.

N: Population N in millions, calculated from the 2011–2012, 2013–2014, 2015–2016, 2017–2018 American Community Survey data released by NCHS, averaged across the 4 cycles. For additional information, see: http://www.cdc.gov/nchs/nhanes/response_rates_cps.htm.

~ Statistically unstable estimates are suppressed, based on the NCHS Data Presentation Standards for Proportions: Parker JD, Talih M, Malec DJ, et al. National Center for Health Statistics Data Presentation Standards for Proportions. National Center for Health Statistics. Vital Health Stat 2(175). 2017. https://www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf

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