Recent trends in the prevalence of low-dose aspirin use for primary and secondary prevention of cardiovascular disease in the United States, 2012–2015☆

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ABSTRACT

Aspirin therapy has been shown to be an effective prevention measure to reduce the risk of new or recurring cardiovascular events. The aim of this study was to provide an epidemiological analysis of low-dose aspirin use for primary and secondary CVD prevention from 2012 to 2015. Estimates of self-reported low-dose aspirin use for primary and secondary CVD prevention were obtained from the National Health Interview Survey for the years 2012–2015. Temporal changes in the prevalence of aspirin use for primary and secondary CVD prevention were assessed using logistic regression. During 2012–2015, 23.3% of respondents self-reported as taking aspirin for primary CVD prevention, decreasing from 23.7% in 2012 to 21.8% in 2015. Also during this period, 8.4% self-reported as taking aspirin for secondary CVD prevention, decreasing from 8.9% in 2012 to 8.2% in 2015. Overall, the prevalence of aspirin use for CVD prevention declined from 32.6% in 2012 to 30.0% in 2015. This study shows that over 30% of the adult population self-reports as taking low-dose aspirin for primary or secondary CVD prevention. Despite the decline in this prevalence over the previous four years, aspirin therapy remains a highly-utilized means of preventing CVD.

1. Introduction

Cardiovascular disease (CVD) produces immense health and economic burdens in the United States. CVD is the leading cause of death, accounting for 30.8% of all deaths in the United States in 2013 (Mozaffarian et al., 2016). For 2011 to 2012, the estimated annual direct costs for CVD were $193.1 billion. By comparison, cancer, the second leading cause of death, had an estimated direct cost of $88.7 billion. CVD also accounted for an additional $123.5 billion in indirect costs from lost future productivity, bringing the total attributable cost to $316.6 billion (Mozaffarian et al., 2016).

Aspirin is one of the oldest drugs in use, dating back to the times of the ancient Greeks when the bark of the willow tree became known for its anti-inflammatory properties. Acetylsalicylic acid, the modern version of aspirin, has been in constant use since being introduced to the public in 1904 (Ittaman et al., 2014; Fuster and Sweeny, 2011). Later studies demonstrated the anti-thrombotic effects of low-dose aspirin regimens (Miner and Hoffhines, 2007).

Aspirin has been shown to be effective as a preventive therapy among patients at risk of developing CVD (primary prevention) as well as among patients who suffer from one or more CVD events (secondary prevention) (Baigent et al., 2009). The United States Preventive Services Task Force (USPSTF) currently recommends low-dose aspirin use for primary CVD prevention (Bibbins-Domingo and US Preventive Services Task Force, 2016) and the American Heart Association and American College of Cardiology Foundation jointly recommend low-dose aspirin use for secondary CVD prevention (Smith et al., 2011).

Previous cross-sectional studies have examined the use of aspirin use for CVD prevention (Mainous et al., 2014; Fang et al., 2015), though to our knowledge there are no existing studies that have utilized multiple years of data to examine possible trends in the epidemiology of aspirin and CVD prevention. The aim of this study was to provide an accurate and up-to-date epidemiological analysis of the use of low-dose aspirin for both primary and secondary CVD prevention from 2012 to 2015.

2. Methods

This study utilized data from the 2012–2015 National Health Interview Survey (NHIS), one of the major data collection programs of the National Center for Health Statistics (NCHS) which is part of the Centers for Disease Control and Prevention (CDC). The NHIS is the principal source of information on a broad range of health topics for the civilian noninstitutionalized population and has been conducted continuously since 1957. The sampling plan follows a multistage area probability design that permits the representative sampling of households and

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noninstitutional group quarters (National Center for Health Statistics, 2016). The NHIS Core questions remain largely unchanged from year to year, allowing for trends analysis or for data from more than one year to be pooled to increase sample size for analytic purposes (National Center for Health Statistics, 2016). The current study focuses on adults aged 40 years and older, because no aspirin-use questions were asked to participants under the age of 40.

All adults over 40 were asked if a doctor or other health professional had ever recommended that they take low-dose aspirin to prevent or control heart disease. Those who answered "yes" were asked if they were currently following this advice. Participants who did not confirm that a doctor had recommended they take aspirin were asked if they were taking aspirin on their own to prevent or control heart disease.

Adults with CVD were defined as those who self-reported as having ever been told that they had at least one of: coronary heart disease, angina pectoris, myocardial infarction, or stroke. Individuals who self-reported as currently taking aspirin but did not self-report as having any of the four CVDs were classified as taking aspirin for primary CVD prevention. Those who self-reported as currently taking aspirin as well as having had at least one of the CVDs were classified as taking aspirin for secondary CVD prevention.

For trend analyses, age was classified as three groups: 40–49 years, 50–64 years, and 65 years and older. Race/ethnicity was self-reported and categorized as non-Hispanic whites, non-Hispanic blacks, Hispanics, and other. Body mass index (BMI) was calculated according to the World Health Organization's definitions: underweight (BMI <18.50 kg/m²), normal weight (BMI 18.50–24.99 kg/m²), overweight (BMI 25–29.99 kg/m²), and obese (BMI ≥30 kg/m²) (World Health Organization, 2016). Modifiable CVD risk factors among primary CVD prevention patients were current smoking, diabetes, high cholesterol within the past year, hypertension within the past year, obesity, and physical inactivity (defined as patients who responded "never" or "unable" to three questions asking the frequency of their exercise habits).

All analyses were performed with SPSS Complex Samples module version 23.0 (IBM Corp., Armonk, NY). Complex sample data analysis adjusts for weights, cluster, and stratification of the sampling design to produce unbiased national estimates of population means and frequencies from the sample after taking into account weights for over- or undersampling of specific groups (Saylor et al., 2012). The survey design-based variance estimation method is Taylor linearization (Bieler et al., 2010). In the case of the NHIS, complex sample analysis can be used to produce national estimates that are representative of the adult civilian noninstitutionalized US population (Parsons et al., 2014).

Annual trends in the prevalence of aspirin use for primary and secondary CVD prevention were examined by age (age-specific prevalence), sex, race/ethnicity, geographic region, household income, health insurance status, BMI, and education (age-adjusted prevalences). Age-adjusted prevalences were calculated using the year 2000 US population as the standard (direct method) (Klein and Schoenborn, 2001). Age-specific and age-adjusted prevalences were estimated with corresponding 95% confidence intervals (CIs). The CSLOGISTIC procedure was used to estimate the average rates of change over time, and trends were tested by evaluating the parameter for years as a continuous variable. Trend significance was assessed via a Wald F test with $\alpha = 0.05$.

This study was approved by the Deerfield Institute Research Review Committee and deemed to be in full compliance of HIPAA (Health Insurance Portability and Accountability Act) guidelines, as it did not collect protected private health information that could be used to identify participants. Survey participation in the NHIS is voluntary and the confidentiality of responses is assured under Section 308(d) of the Public Health Service Act (National Center for Health Statistics, 2016).

3. Results

The 2012–2015 NHIS included a total of 90,558 adults over the age of 40. Demographic characteristics of the sample are presented in Table 1. During 2012–2015, 12.3% (95% CI: 12.0%–12.6%) of adults self-reported as having at least one CVD. Coronary heart disease was the most common CVD, prevalent among 7.1% (95% CI: 6.9%–7.3%) of adults, followed by myocardial infarction (5.0%; 95% CI: 4.8%–5.2%), stroke (4.1%; 95% CI: 4.0%–4.3%), and angina pectoris (3.0%; 95% CI: 2.8%–3.1%).

Table 2 describes the prevalence of aspirin use for primary CVD prevention by select demographic characteristics. Aspirin use prevalence was highest among adults aged 65 years and older; males; non-Hispanic whites; those living in the Midwest region; those with annual household income of $100,000 and over; those with health insurance; obese; those with at least some college education; and those with four or more modifiable CVD risk factors.

The overall age-adjusted prevalence of aspirin use for primary CVD prevention was 22.1% (95% CI: 21.9%–22.3%), decreasing from 22.8% in 2012 to 20.4% in 2015. Based on the complex samples logistic regression model, this corresponds to an average annual rate of change of −2.7% ($p = 0.003$). All age groups saw significant decreases in prevalence, though the 40–49 years age group saw the greatest decline (−7.9% average annual rate of change; $p = 0.001$). While the majority of the select demographics saw a decline in aspirin use for primary CVD prevention,

Table 1
Characteristics and demographics of adults 40 years of age and older by year of NHIS data.

	2012 % (95% CI)	2013 % (95% CI)	2014 % (95% CI)	2015 % (95% CI)	2012–2015 total % (95% CI)
Sample size	22,091	22,167	23,972	22,328	90,558
Age group					
40–49	29.1% (28.4–29.8)	28.5% (27.7–29.3)	27.9% (27.0–28.7)	27.2% (26.3–28.2)	28.2% (27.7–28.6)
50–64	41.9% (41.1–42.8)	41.9% (41.0–42.7)	41.9% (40.9–42.8)	41.8% (40.8–42.7)	41.8% (41.4–42.4)
≥65	29.0% (28.2–29.8)	29.6% (28.9–30.4)	30.3% (29.4–31.2)	31.0% (30.1–32.0)	30.0% (29.5–30.5)
Sex					
Male	47.3% (46.4–48.1)	47.6% (46.7–48.5)	47.3% (46.4–48.3)	47.3% (46.4–48.2)	47.4% (46.9–47.8)
Female	52.7% (51.9–53.6)	52.4% (51.5–53.3)	52.7% (51.7–53.6)	52.7% (51.8–53.6)	52.6% (52.2–53.1)
Race					
Non-Hispanic white	71.9% (71.1–72.8)	71.4% (70.6–72.3)	70.8% (69.9–71.7)	70.0% (69.0–70.9)	71.0% (70.4–71.7)
Non-Hispanic black	10.6% (10.0–11.2)	10.6% (10.0–11.2)	10.7% (10.1–11.3)	10.9% (10.3–11.5)	10.7% (10.3–11.1)
Hispanic	11.2% (10.6–11.8)	11.6% (10.9–12.2)	11.8% (11.2–12.4)	12.1% (11.5–12.7)	11.7% (11.2–12.1)
Other	6.2% (5.8–6.7)	6.4% (6.0–6.9)	6.7% (6.3–7.2)	7.0% (6.5–7.5)	6.6% (6.3–6.9)
CVD prevalence					
Coronary heart disease	7.4% (7.0–7.8)	7.5% (7.1–7.9)	6.5% (6.1–6.9)	7.1% (6.7–7.6)	7.1% (6.9–7.3)
Angina pectoris	3.0% (2.7–3.3)	3.1% (2.8–3.4)	2.8% (2.5–3.1)	3.0% (2.7–3.3)	3.0% (2.8–3.1)
Myocardial infarction	5.1% (4.8–5.5)	5.0% (4.7–5.3)	4.9% (4.5–5.3)	4.9% (4.5–5.3)	5.0% (4.8–5.2)
Stroke	4.1% (3.8–4.5)	4.3% (3.9–4.6)	4.0% (3.7–4.3)	4.1% (3.8–4.4)	4.1% (4.0–4.3)
≥1 CVD	12.7% (12.2–13.3)	12.7% (12.2–13.2)	11.7% (11.1–12.3)	12.1% (11.5–12.7)	12.3% (12.0–12.6)

Table 2
Prevalence of aspirin use for primary CVD prevention by select demographic characteristics, 2012–2015.

	Prevalence[a]	95% CI	Prevalence trend, 2012–2015	
			Average annual rate of change, %	p[b]
All adults 40 +	22.1%	21.9–22.3	−2.7%	0.003
Age group				
40–49	9.8%	9.4–10.3	−7.9%	0.001
50–64	24.0%	23.4–24.6	−3.4%	0.023
≥ 65	35.0%	34.2–35.7	−2.8%	0.050
Sex				
Male	23.5%	23.2–23.8	−3.3%	0.013
Female	20.8%	20.6–21.1	−2.1%	0.099
Race				
Non–Hispanic white	23.0%	22.8–23.3	−4.3%	<0.001
Non–Hispanic black	21.9%	21.5–22.4	5.1%	0.035
Hispanic	18.8%	18.3–19.3	4.0%	0.141
Other	18.3%	17.7–18.9	−2.5%	0.497
Geographic region				
Northeast	21.2%	20.7–21.7	−2.1%	0.309
Midwest	23.4%	23.0–23.8	−4.2%	0.015
South	22.6%	22.3–22.9	−1.5%	0.323
West	21.0%	20.6–21.4	−3.9%	0.067
Household income				
$0–$34,999	20.7%	20.4–21.0	1.8%	0.235
$35,000–$74,999	22.8%	22.5–23.2	0.6%	0.760
$75,000–$99,999	23.5%	22.9–24.1	−6.5%	0.028
$100,000 and over	24.1%	23.6–24.5	−5.6%	0.009
Health insurance				
Not covered	17.2%	16.0–18.4	−4.8%	0.234
Covered	22.4%	22.2–22.6	−3.4%	<0.001
BMI				
Underweight	13.9%	12.8–15.0	4.1%	0.633
Normal	18.5%	18.2–18.8	−2.0%	0.272
Overweight	22.4%	22.1–22.7	−2.8%	0.078
Obese	25.1%	24.8–25.4	−3.7%	0.015
Education				
<High school	17.4%	16.8–18.0	12.0%	0.002
High school	22.1%	21.8–22.4	−0.4%	0.820
≥College	22.9%	22.6–23.1	−5.2%	<0.001
Modifiable CVD risk factors[c]				
0	17.5%	17.2–17.9	−5.0%	0.037
1	20.6%	20.3–20.9	−5.6%	0.002
2	24.0%	23.6–24.4	−2.7%	0.153
3	27.6%	27.1–28.2	0.4%	0.847
≥4	30.9%	30.1–31.6	0.4%	0.877

[a] Age-adjusted to the 2000 standard US population.
[b] p-Values are for trend significance via Wald F test, adjusted for age.
[c] Modifiable CVD risk factors include current smoking, diabetes, high cholesterol within the past year, hypertension within the past year, obesity, and physical inactivity.

Table 3
Prevalence of aspirin use for secondary CVD prevention by select demographic characteristics, 2012–2015.

	Prevalence[a]	95% CI	Prevalence trend, 2012–2015	
			Average annual rate of change, %	p[b]
All adults 40 +	8.0%	7.9–8.1	−3.6%	0.015
Age group				
40–49	1.9%	1.7–2.1	−12.0%	0.032
50–64	6.8%	6.5–7.1	−6.5%	0.009
≥65	16.9%	16.4–17.5	−3.3%	0.081
Sex				
Male	10.3%	10.1–10.5	−2.0%	0.312
Female	6.1%	5.9–6.2	−5.8%	0.006
Race				
Non-Hispanic white	8.2%	8.1–8.3	−2.5%	0.152
Non-Hispanic black	8.8%	8.5–9.1	−3.4%	0.360
Hispanic	6.4%	6.2–6.7	−5.4%	0.199
Other	6.3%	5.9–6.7	−12.6%	0.060
Geographic region				
Northeast	7.1%	6.8–7.3	−3.2%	0.369
Midwest	9.2%	8.9–9.4	3.3%	0.287
South	8.8%	8.6–9.1	−7.3%	0.001
West	6.2%	6.0–6.3	−5.8%	0.083
Household income				
$0–$34,999	10.9%	10.7–11.1	−4.3%	0.034
$35,000–$74,999	8.1%	7.8–8.3	−0.3%	0.921
$75,000–$99,999	6.2%	5.8–6.5	2.8%	0.581
$100,000 and over	5.8%	5.6–6.1	−0.7%	0.874
Health insurance				
Not covered	5.0%	4.4–5.6	−17.2%	0.006
Covered	8.1%	8.0–8.2	−4.1%	0.006
BMI				
Underweight	7.8%	6.8–8.8	−4.3%	0.680
Normal	6.0%	5.9–6.2	−6.1%	0.025
Overweight	8.1%	7.9–8.3	−5.4%	0.014
Obese	9.6%	9.4–9.8	−0.7%	0.767
Education				
<High school	9.9%	9.4–10.4	−0.6%	0.901
High school	9.2%	9.0–9.4	−2.8%	0.172
≥College	7.0%	6.9–7.2	−4.0%	0.043

[a] Age-adjusted to the 2000 standard US population.
[b] p-Values are for trend significance via Wald F test, adjusted for age.

there was a significant increasing trend in prevalence among non-Hispanic blacks (5.1% average annual rate of change; $p = 0.035$) and those with less than high school education (12.0% average annual rate of change; $p = 0.002$).

Table 3 shows the prevalence of aspirin use for secondary CVD prevention. Aspirin use prevalence was highest among adults aged 65 years and older; males; non-Hispanic blacks; those living in the Midwest region; those with household annual income <$35,000; those with health insurance; obese; and those with less than high school education.

The overall age-adjusted prevalence of aspirin use for secondary CVD prevention was 8.0% (95% CI: 7.9%–8.1%), declining from 8.6% in 2012 to 7.6% in 2015. This corresponds to an average annual rate of change of −3.6% ($p = 0.015$). Similar to the primary CVD prevention population, the prevalence of aspirin use for secondary CVD prevention declined across the majority of the select demographics. Adults without health insurance saw the greatest decline in aspirin use prevalence for secondary CVD prevention (−17.2% average annual rate of change;

$p = 0.006$). Trends among all demographics with positive average annual rates of change were not statistically significant.

4. Discussion

Low-dose aspirin use for primary CVD prevention is currently recommended by the USPSTF (Bibbins-Domingo and US Preventive Services Task Force, 2016), while the American Heart Association and American College of Cardiology Foundation (AHA/ACCF) jointly recommend low-dose aspirin use for secondary CVD prevention (Smith et al., 2011). This study shows that >30% of adults over the age of 40 self-report as taking low-dose aspirin for primary or secondary CVD prevention. Extrapolating to the US Census Bureau's 2016 population estimates (United States Census Bureau, 2016), this results in approximately 35.8 million primary CVD prevention patients and 12.9 million secondary CVD prevention patients. However, we found that the prevalences of aspirin use for both primary and secondary CVD prevention have declined over the previous four years, despite the USPSTF and AHA/ACCF recommendations. The only selected demographics that saw statistically significant increases in aspirin use were non-Hispanic Blacks and those with less than high school education, both for primary CVD prevention.

The aim of this study was to provide an epidemiological analysis of the use of low-dose aspirin for primary and secondary CVD prevention based on the most recently available data. However, there are some

important limitations. The NHIS is designed to be as representative as possible, yet there are inherent difficulties in extrapolating to national estimates from relatively small sample sizes. Also, this study was based on self-report data, which can be subject to inaccuracies due to re-call bias, social desirability bias, and errors in self-observation (Hawkshead and Krousel-Wood, 2007; Gagné and Godin, 2005; Turner, 2002; Farmer, 1999; La Fleur, 2004) especially regarding behaviors and risk factors relating to CVD and cancer (Mainous et al., 2014; Newell et al., 1999). To combat this, the NCHS conducts question evaluation studies in order to test and develop survey questions through the Questionnaire Design Research Laboratory (QDRL). The QDRL leads studies to isolate and define patterns of question interpretation, types of response error, and potential for bias in cross-national or cross-cultural population data (Centers for Disease Control and Prevention, 2016). Other potential limitations include being restricted only to adults over 40 years of age and not including data on other types of cardiovascular disease such as aortic aneurysms or peripheral arterial disease.

Despite these potential limitations, the results of this study provide greater detail on the use of aspirin in the general population for both primary and secondary CVD prevention. Of particular note is the fact that this study used the most current four years of available data to provide insight into recent changes in the primary and secondary CVD prevention populations, rather than a cross-sectional snapshot. To our knowledge this is the first epidemiological study to investigate trends in aspirin usage. Based on our results, although the prevalence of aspirin usage remains high, with over 30% of adults over 40 years of age taking aspirin for primary or secondary CVD prevention, this proportion has decreased in recent years.

Conflict of interest

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