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Original Article

Underuse of Aspirin for Primary and Secondary Prevention of Cardiovascular Disease Events in Women

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Abstract

Background: Evidence-based guidelines for use of aspirin to decrease cardiovascular disease (CVD) events in women are well established. Despite this, aspirin is underused in women. We examined self-reported aspirin use in women for primary and secondary prevention of CVD events, correlates of use, and change in use over time from 2004 to 2009.

Methods: Data from volunteer respondents participating in a web-based CVD risk assessment tool at 127 US healthcare centers were analyzed. Survey questions included information on CVD risk factors, the presence or absence of any form of CVD, diabetes mellitus, and medication usage, including daily aspirin. Logistic regression analyses identified factors associated with aspirin intake.

Results: Of the 217,987 women respondents, 29,701 women were recommended to take aspirin based on the guidelines. We found, however, that only 41% of women who meet criteria for primary prevention and 48% of women who meet criteria for secondary prevention report that they take aspirin on a daily basis. The main factors that favored aspirin use were a family history of CVD or high cholesterol. Although aspirin use for secondary prevention did not change between the years 2004 and 2009, there was a significant increase in aspirin use for primary prevention.

Conclusions: These findings confirm that the majority of women for whom aspirin is recommended for primary and secondary prevention of CVD were not following national guidelines. Educational programs for clinicians and women aimed at promoting appropriate use of aspirin is one measure that should improve CVD outcomes in women.

Introduction

Cardiovascular disease (CVD) is the leading cause of death among women in the United States.[1] In 2007, the American Heart Association (AHA) published specific evidence-based guidelines for aspirin use in women.[2] These guidelines were based on evidence from multiple randomized controlled trials (RCTs) demonstrating a decreased risk of CVD events and deaths associated with the use of aspirin for both primary and secondary prevention of CVD.[3–9] Although these RCTs have demonstrated a benefit from aspirin use, multiple studies have found that the reported prevalence of aspirin use for both primary and secondary prevention of CVD is low.[10–14] Several studies have shown aspirin use to be lower among women compared with men. The largest study to date was a random-digit telephone survey of 58,548 women participating in the Behavioral Risk Factor Surveillance System (BRFSS) from 1997 to 1999. This study found that women in all CVD risk categories reported significantly less aspirin use than did men.[15] A recent prospective longitudinal study with >68,000 community-dwelling men and women participants from six continents selected for a history of atherothrombotic disease was done between the years 2003 and 2006. This study used the Reduction of Atherothrombosis for Continued Health (REACH) Registry and also found aspirin use to be greater among men (76%) vs. women (66%).[16]

Aspirin is an important, inexpensive, and easily accessible therapy for CVD prevention, yet accurate knowledge of aspirin use for CVD prevention is problematic because it is purchased over the counter (OTC) and not dispensed by a

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pharmacy. Prior low use has been documented for women by BRFSS and in the REACH Registry. BRFSS surveyed a representative sample in 1999 of noninstitutionalized persons aged ≥40 years.[15] The study, using the REACH Registry, examined data collected between the years 2003 and 2006 and focused on criteria for secondary prevention only.[16] Our objectives were to determine the prevalence of self-reported aspirin use in women for both primary and secondary prevention of CVD events, the predictors of aspirin use among women primarily >age 65, and changes in aspirin use over time from 2004 to 2009 after the AHA guidelines for women were released in 2007.[2]

Materials and Methods

Setting and study design

HeartAware™ is a web-based CVD risk assessment tool (Navigant, Healthcare, Chicago, IL). Raw data were cleaned and analyzed by researchers at Scott and White (Temple, TX). Data were extracted from 127 participating healthcare centers (academic, community, for-profit, and not-for-profit) in the United States that offered the HeartAware program between 2004 and 2009; HeartAware is not currenly available through any independent physician practice. Individuals participating in the survey access the HeartAware survey through the participating organization's website, and most sites increase survey participation by various media advertisements, including mail, television, and radio ads. The online risk assessment takes approximately 7–10 minutes to complete. The goal of the HeartAware program is to identify people with or at risk for CVD who may not be aware of their personal risk. The use of the risk assessment tool is voluntary, and results are confidential.

The variables collected in the survey include age, gender, ethnicity, height, weight, body mass index (BMI), aerobic activity level, information on CVD risk factors (tobacco use, diabetes mellitus, hypertension, hyperlipidemia) , forms of CVD (i.e., coronary, cerebral, and peripheral arterial disease), related procedures (i.e., angioplasty, coronary artery bypass surgery [CABG]), medication use including daily aspirin, family history, and whether the subject is under the care of a physician. The question ascertaining aspirin use was stated as follows: Are you taking any of the following medications? Arthritis medications, cholesterol medications, aspirin on a regular basis, blood pressure medications, diabetes medication, none. Respondents were able to check all responses that applied to them. De-identified data were provided to the authors, omitting dates of assessment and personal identifiers. All study procedures and ethics were approved by the Institutional Review Board of Scott and White.

Measures

The dependent measure was aspirin use status. This measure was assessed by a single survey question. Responses for aspirin use were coded as yes or no. Additionally, the following self-reported variables were used in this report: ethnicity, certain forms of CVD (acute myocardial infarction [MI], stroke, bypass surgery, cardiac stent, cardiac angioplasty, carotid surgery, abdominal aortic aneurysm, angina, claudication, renal artery stenosis, cardiac arrest, and diabetes mellitus), certain risk factors for CVD (hypertension, high cholesterol, smoking status, family history of CVD, family history of stroke, and physical activity), and type of healthcare provider seen by the respondent. Having hypertension was defined as either a systolic blood pressure (SBP) ≥140 mm Hg or a diastolic blood pressure (DBP) ≥90 mm Hg or the use of antihypertensive medications.[17] All prescription antihypertensives and diabetes medications were recoded into indicators of hypertensive medication (yes/no) and diabetes medication (yes/no). High cholesterol was defined as a total cholesterol >200 mg/dL.[18] Smoking status was defined as never smoked, currently smoking, or past smoking. Physical activity was defined as no exercise, 1–2 times per week, 3–4 times per week, or ≥5 times per week. Healthcare provider was defined as having a primary care provider (PCP) or a cardiologist, both, or none.

Study sample

Between the years 2004 and 2009, responses were collected from the participating centers for 320,010 men and women who elected to take the survey (Fig. 1). There was a total of 217,987 women respondents. Using the 2007 AHA guidelines summarized in Table 1, women were considered eligible for aspirin use for primary prevention of CVD (primary prevention group) if they were ≥65 years of age at the time of the survey and did not meet criteria for secondary prevention. Meeting criteria for secondary prevention of CVD through daily aspirin use (secondary prevention group) was defined by a history of any of the following conditions: acute MI, stroke, abdominal aortic aneurysm, coronary artery stenting, bypass surgery, balloon angioplasty, or carotid endarterectomy. Individuals with diabetes mellitus or those taking diabetes medications were included in the secondary prevention category following the National Cholesterol Education Program-Adult Treatment Panel III (NCEP-ATP III) guidelines and the 2007 AHA guidelines.[2,18]

Affirmative responses for angina, claudication, renal artery stenosis, and cardiac arrest were collected as part of the survey but were excluded as criteria for secondary prevention because of the potential for misreporting or faulty responses. When these variables were included (all together and separately), there was no significant difference in the percentage of women using aspirin for secondary prevention.

Statistical analysis

All variables were summarized for the two groups (those taking aspirin and those not taking aspirin) using frequency (percent). There were two subgroup analyses. Women in the primary prevention group were analyzed separately from those in the secondary prevention group. Multivariable logistic regression models estimated odds ratios (OR) of complying with guidelines on the use of aspirin and 95% confidence intervals (CI) for the primary prevention group and the secondary prevention group. A stepwise selection method was used to establish the final reduced logistic regression model. The variables remained in the final model only if their p value was <0.05. Possible interactions were also considered in the model. The OR, 95% CI, and parameter estimates were reported. Goodness of fit was checked with the Hosmer-Lemeshow test. Aspirin use rate over each year of the study by prevention group was calculated, and annual aspirin trend was tested for each prevention group using the

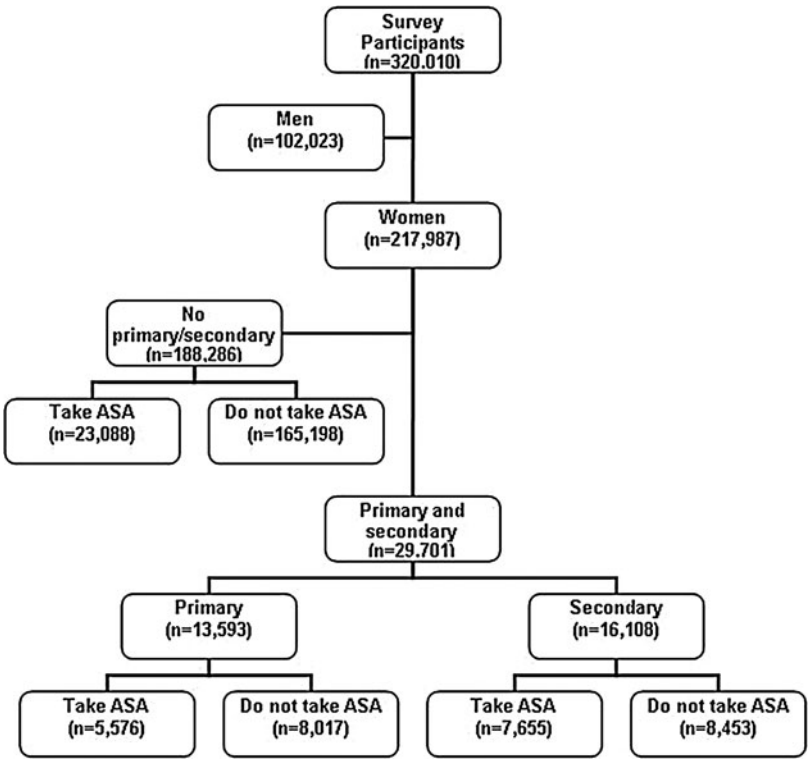

FIG. 1. Flow chart of study participants. ASA, acetylsalicylic acid (aspirin).

Cochran-Armitage test. All tests of significance were conducted at an alpha level of 0.05. SAS version 9.2 (SAS Institute, Cary, NC) was used for data analysis.

Results

Prevalence of aspirin use

From the participating centers, 29,701 women met eligibility criteria for aspirin use; 13,593 women met criteria for aspirin use for primary prevention of CVD events, and 16,108 met criteria for aspirin use for secondary prevention of CVD events. Characteristics of the women in the primary and secondary prevention groups are summarized in Table 2. Only 41% of women who met criteria for primary prevention and 48% of women who met criteria for secondary prevention reported taking aspirin. Among the women in the latter group, 44% of those <65 years of age and 63% of those ≥ 65 years of age reported they were taking aspirin. Additionally, 66% of those in the secondary prevention group were taking aspirin when diabetes was excluded from criteria for the secondary prevention group. Table 2 also summarizes aspirin use by the type of CVD, risk factors for CVD, type of healthcare provider, and self-reported physical activity.

Table 1. American Heart Association 2007 Guidelines for Aspirin Use for Cardiovascular Disease Prevention in Women

Primary prevention (other at-risk or healthy women)
Consider aspirin therapy in women ≥ 65 years if blood pressure is well controlled and benefit for ischemic stroke and myocardial infarction prevention is likely to outweigh the risk of gastrointestinal bleeding and hemorrhagic stroke.
Secondary prevention (high risk)
Aspirin therapy should be used in high-risk women (established coronary heart disease, cerebrovascular disease, peripheral arterial disease, abdominal aortic aneurysm, end-stage or chronic renal disease, diabetes mellitus, and 10-year Framingham risk $>20\%$) unless contraindicated.

Predictors of aspirin use: primary prevention

The final reduced multivariable logistic regression model for the primary prevention group is summarized in Table 3. Variables that were associated with aspirin use were ethnicity, ($p<0.0001$), a smoking status ($p=0.0275$), having a PCP or a cardiologist or both ($p<0.0001$), use of antihypertensive medications ($p<0.0001$), a family history of CVD ($p=0.0001$), and a family history of hypercholesterolemia ($p<0.0001$). African Americans ($p<0.0001$) were less likely than Caucasians to take aspirin. Current smokers ($p=0.0216$) were less likely to take aspirin than those who reported they never smoked. Those with a family history of CVD ($p=0.0001$) were more likely to take aspirin than those with no family history of CVD. Those with a family history of hypercholesterolemia ($p<0.0001$) were more likely to take aspirin than those with no family history of hypercholesterolemia.

In the multivariable model, an interaction between healthcare provider and antihypertensive medication was found to be significant ($p<0.0001$). Goodness of fit test (Hosmer-Lemeshow test statistic $=4.38$, $p=0.8209$) showed adequate model calibration. Women who had both a PCP and a cardiologist or at least one (a PCP or cardiologist) were more likely to take aspirin than those who did not have a PCP or cardiologist. Women who had hypertension or who were taking antihypertensive medications were more likely to take aspirin than those who did not take antihypertensives. Because of the interaction between healthcare provider and

Table 2. Characteristics of Women Respondents Who Did or Did Not Take Aspirin

	Overall n *(column %)*	*Aspirin*	
		No n *(row %)*	*Yes* n *(row %)*
Prevention with age group			
Primary (without secondary prevention)	13,593 (45.8%)	8,017 (59.0%)	5,576 (41.0%)
Secondary, <65	12,930 (43.5%)	7,288 (56.4%)	5,642 (43.6%)
Secondary, ≥65	3,178 (10.7%)	1,165 (36.7%)	2,013 (63.3%)
Ethnicity			
Caucasian	25,319 (86.2%)	13,720 (54.2%)	11,599 (45.8%)
African American	2,375 (8.1%)	1,492 (62.8%)	883 (37.2%)
Hispanic	722 (2.5%)	467 (64.7%)	255 (35.3%)
Other	942 (3.2%)	577 (61.3%)	365 (38.7%)
Eligible for secondary prevention			
Acute MI	1,434 (4.8%)	358 (25.0%)	1,076 (75.0%)
Stroke	1,981 (6.7%)	890 (44.9%)	1,091 (55.1%)
Bypass surgery	924 (3.1%)	200 (21.6%)	724 (78.4%)
Stent	2,037 (6.9%)	331 (16.2%)	1,706 (83.8%)
Angioplasty	1,113 (3.7%)	271 (24.3%)	842 (75.7%)
Carotid surgery	153 (1.4%)	62 (40.5%)	91 (59.5%)
Abdominal aortic aneurysm	366 (1.2%)	175 (47.8%)	191 (52.2%)
Diabetes or diabetes medication	11,900 (40.3%)	7,011 (58.9%)	4,889 (41.1%)
Risk factors for CVD (excluding diabetes)			
Hypertension	17,986 (65.4%)	8,723 (48.5%)	9,263 (51.5%)
High cholesterol	8,303 (38.5%)	4,728 (56.9%)	3,575 (43.1%)
Smoking			
Never	19,321 (65.7%)	10,840 (56.1%)	8,481 (43.9%)
Currently	2,785 (9.5%)	1,608 (57.7%)	1,177 (42.3%)
Past	7,291 (24.8%)	3,732 (51.2%)	3,559 (48.8%)
Family history of CVD	11,842 (39.9%)	5,914 (49.9%)	5,928 (50.1%)
Family history of stroke	1,684 (14.9%)	873 (51.8%)	811 (48.2%)
Physical activity			
No exercise	12,091 (41.0%)	6,951 (57.5%)	5,140 (42.5%)
1–2 times per week	7,781 (26.4%)	4,273 (54.9%)	3,508 (45.1%)
3–4 times per week	6,490 (22.0%)	3,481 (53.6%)	3,009 (46.4%)
5+ times per week	3,119 (10.6%)	1,545 (49.5%)	1,574 (50.5%)
Physician			
Both PCP and cardiologist	6,950 (23.4%)	2,571 (37.0%)	4,379 (63.0%)
Cardiologist only or PCP only	18,425 (62.0%)	11,084 (60.2%)	7,341 (39.8%)
No PCP and no cardiologist	4,326 (14.6%)	2,815 (65.1%)	1,511 (34.9%)

CVD, cardiovascular disease; MI, myocardial infarction; PCP, primary care physician.

antihypertensive medications, the OR of healthcare provider and the OR of antihypertensive medications cannot be estimated separately.

Predictors of aspirin use: secondary prevention

The final reduced multivariable logistic regression analysis for the secondary prevention group is presented in Table 4. Variables that showed a significant association with aspirin use were similar to those identified in the primary prevention group and included ethnicity ($p<0.0001$), smoking status ($p<0.0001$), having both a PCP and a cardiologist or having a PCP or a cardiologist ($p<0.0001$), the use of antihypertensive medication ($p<0.0001$), and family history of CVD ($p<0.0001$). Caucasians were more likely than other ethnic groups to take aspirin. Prior smokers were more likely to take aspirin compared with those who have never smoked ($p<0.0001$). Women with a family history of CVD ($p<0.0001$) were more likely to take aspirin than were women with no family history of CVD.

In the secondary prevention multivariable model, similar to the primary prevention multivariable model, an interaction between healthcare provider and antihypertensive medication was found to be significant ($p<0.0001$). Goodness of fit test (Hosmer-Lemeshow test statistic=10.3639, $p=0.2404$) showed adequate model calibration. Because of the interaction between healthcare provider and antihypertensive medications, OR of healthcare provider and OR of antihypertensive medications cannot be estimated separately.

Aspirin use over time

Figure 2 illustrates yearly aspirin use by prevention group. The number of respondents in each year and the number by each group are presented in Table 5. There was a gradual increase in aspirin use for the primary prevention group, and a statistically significant positive trend of linear increase in aspirin use rate was observed over the years between 2004 and 2009 ($p=0.0326$). No significant trend was observed in the aspirin use rate for the secondary prevention group over

Table 3. Multivariate Logistic Regression Analysis of Factors of Self-Reported Use of Aspirin for Primary Prevention Group of Cardiovascular Disease Events (N=13,242)

Variable	*Aspirin*	*No aspirin*	*Parameter estimate*	*Odds ratio (95% CI)*	p *value*
Ethnicity					<0.0001
Caucasian[a]	5,216 (41.83)	7,255 (58.17)			
Other	101 (35.31)	185 (64.69)	−0.2914	0.747 (0.581-0.961)	0.0230
Hispanic	62 (35.63)	112 (64.37)	−0.2849	0.752 (0.546-1.036)	0.0817
African American	141 (29.50)	337 (70.50)	−0.5458	0.579 (0.471-0.712)	<0.0001
Smoking status					0.0275
Never[a]	3,909 (41.26)	5,564 (58.74)			
Current	162 (33.54)	321 (66.46)	−0.2321	0.793 (0.650-0.967)	0.0216
Prior	1,500 (43.29)	1,965 (56.71)	0.0468	1.048 (0.966-1.136)	0.2582
Healthcare provider					<0.0001
None[a]	573 (30.29)	1,319 (69.71)			
Both PCP and cardiologist	1,271 (52.13)	1,167 (47.87)	0.8484		<0.0001
Only one of PCP or cardiologist	3,732 (40.29)	5,531 (59.71)	0.5254		<0.0001
Antihypertensive medication					
No[a]	2,515 (34.07)	4,866 (65.93)			
Yes	3,061 (49.28)	3,151 (50.72)	1.0799		<0.0001
Family history of CVD					
No[a]	3,571 (38.80)	5,632 (61.20)			
Yes	2,005 (45.67)	2,385 (54.33)	0.1544	1.167 (1.080-1.262)	0.0001
Family history of high cholesterol					
No[a]	4,325 (39.64)	6,587 (60.36)			
Yes	1,251 (46.66)	1,430 (53.34)	0.1853	1.204 (1.099-1.318)	<0.0001
Interaction[b]					<0.0001
None and BP medications[a]	297 (49.58)	302 (50.42)			
Both PCP and cardiologist and BP medications	843 (57.82)	615 (42.18)	−0.5049		0.0002
One PCP or cardiologist and BP medications	1,921 (46.23)	2,234 (53.77)	−0.6396		<0.0001
None and no BP medications	276 (21.35)	1,017 (78.65)			
Both PCP and cardiologist and no BP medications	428 (43.67)	552 (56.33)			
One PCP or cardiologist and no BP medications	1,811 (35.45)	3,297 (64.55)			

[a]Reference group used for comparison.
[b]Interaction between healthcare provider and antihypertensive medications. Because of the interaction between healthcare provider and antihypertensive medications, the odds ratio (OR) of healthcare provider and the OR of antihypertensive medications cannot be estimated separately.
BP, blood pressure; CI, confidence interval.

the years 2004–2009. Aspirin use rates between the years 2004–2006 and the years 2008–2009 were compared, and a significant difference was observed for primary prevention (p=0.0028, 38% [2004–2006] vs. 42% [2008–2009]), and no significant difference was observed for secondary prevention.

Discussion

This study spanned the time before and after introduction of the 2007 AHA guidelines for CVD preventive care in women. Our data indicate that more than half of women who should consider taking aspirin for primary or secondary prevention of CVD events are not. This problem is most acute in women of color and those not under the care of a physician.

The results from our study are different from those of previous studies. This is likely because of such factors as population and methodologic differences. Previous studies, including the BRFSS and REACH studies, have found higher aspirin use rates (83% and 71%, respectively) for secondary prevention compared with results from our study.[15,16,19] On the other hand, the Household Component Medical Expenditure Panel Survey (MEPS) found a lower aspirin use rate of 54% among men and women who were told they have indicators of heart disease.[20] The overall aspirin use rates cited in these previous studies are difficult to compare with our findings because they include aspirin use in men and women combined. Our study differed in that it examined only aspirin use in women. Despite the combined men and women higher aspirin use rates, these and other previous smaller studies have demonstrated that women are less likely than men to be taking aspirin.[11–13,15,16] The findings from the REACH Registry found 66% of women to be taking aspirin for secondary prevention compared with 76% of men.[16] We found similar results (66%) among women in the secondary prevention group when diabetes was excluded as a criterion for secondary prevention (diabetes was not included in the definition of coronary heart disease [CHD] in the REACH study). The findings from the MEPS study found 47% of women to be taking aspirin for indicators of heart disease.[20] We found similar results (48%) among women in the secondary prevention group when diabetes was included as a criterion for secondary prevention. We do not know if the MEPS survey included diabetes as a CHD equivalent.

It is difficult to compare studies because not all studies include diabetes as a CHD equivalent. However, the BRFSS survey conducted in 1999 did include diabetes as a CHD equivalent.[15] The 2003 BRFSS update did not include diabetes as a CHD equivalent and found an aspirin use rate of 83% for

Table 4. Multivariate Logistic Regression Analysis of Factors of Self-Reported Use of Aspirin for Secondary Prevention Group of Cardiovascular Disease Events ($n = 158180$)

Variable	*Aspirin* n *(%)*	*No aspirin* n *(%)*	*Parameter estimate*	*Odds ratio (95% CI)*	p *value*
Ethnicity					< 0.0001
Caucasian[a]	6,383 (49.68)	6,465 (50.32)		1.000	
Other	264 (40.24)	392 (59.76)	− 0.2761	0.759 (0.639-0.900)	0.0016
Hispanic	193 (35.22)	355 (64.78)	− 0.4629	0.629 (0.520-0.762)	< 0.0001
African American	742 (39.11)	1,155 (60.89)	− 0.3937	0.675 (0.607-0.749)	< 0.0001
Smoking status					< 0.0001
Never[a]	4,572 (46.43)	5,276 (53.57)		1.000	
Current	1,015 (44.09)	1,287 (55.91)	0.0130	1.013 (0.918-1.118)	0.7970
Prior	2,059 (53.82)	1,767 (46.18)	0.2028	1.225 (1.130-1.328)	< 0.0001
Healthcare provider					< 0.0001
None[a]	938 (38.54)	1,496 (61.46)			
Both PCP and cardiologist	3,108 (68.88)	1,404 (31.12)	1.4313		< 0.0001
PCP only or cardiologist only	3,609 (39.39)	5,553 (60.61)	0.1375		0.0875
Antihypertensive medication					
No[a]	2,004 (32.31)	4,198 (67.69)			
Yes	5,651 (57.05)	4,255 (42.95)	1.3194		< 0.0001
Family history of CVD					
No[a]	3732 (43.11)	4,924 (56.89)			
Yes	3923 (52.64)	3,529 (47.36)	0.2158	1.241 (1.160-1.328)	< 0.0001
Interaction[b]					< 0.0001
None and BP medications[a]	673 (54.41)	564 (45.59)			
Both and BP medications	2,418 (72.37)	923 (27.63)	− 0.7195		< 0.0001
One and BP medications	2,560 (48.05)	2,768 (51.95)	− 0.4165		< 0.0001
None and no BP medications	265 (22.14)	932 (77.86)			
Both and no BP medications	690 (58.92)	481 (41.08)			
One and no BP medications	1,049 (27.36)	2,785 (72.64)			

[a]Reference group used for comparison.
[b]Interaction between healthcare provider and antihypertensive medications. Because of the interaction between healthcare provider and antihypertensive medications, the OR of healthcare provider and the OR of antihypertensive medications cannot be estimated separately.

secondary prevention.[19] There are other differences in methodologies that make it difficult to compare our study with previous studies. The REACH study ascertained the use of aspirin alternatives, whereas the BRFSS and our study did not.[15,16,19]

The time periods for these studies also differ, which may impact aspirin use. An aspirin alternative, clopidogrel, was introduced in the late 1990s. As the use of clopidogrel may have increased over time, aspirin may have decreased. BRFSS was conducted in 1999 and again in 2003, REACH was conducted between the years 2003 and 2004, and the MEPS survey was conducted in 2005.[15,16,19,20] Our study was conducted between the years 2004 and 2009. Among those that report aspirin use rates for women, REACH (2003–2004) had a 66% aspirin use, MEPS (2005) had a 47% aspirin use, and our study (2004–2009) had a 66% aspirin use (excluding diabetes as secondary prevention, similar to the REACH definition).[16,20] Additionally, recruitment for these studies also differed. BRFSS and MEPS are national representative surveys, REACH recruited from physician offices internationally, and our study recruited through an online survey and mass media marketing among many healthcare centers across the United States.[15,16,19,20]

Studies by Mosca et al.[21,22] have shown that misperceptions and barriers to heart disease prevention exist and that most women feel uninformed about their personal risk. Although

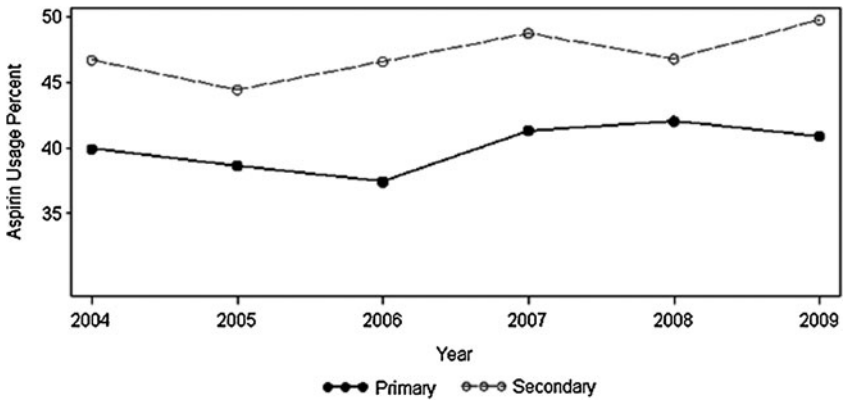

FIG. 2. Yearly aspirin use trend by prevention group.

Table 5. Survey Respondents by Year

(1) Entire Group (Primary and Secondary Prevention)

Year	Aspirin		
Frequency row %	No	Yes	Total
2004	732 (55.79%)	580 (44.21%)	1,312
2005	925 (58.03%)	669 (41.97%)	1,594
2006	1,622 (57.36%)	1,206 (42.64%)	2,828
2007	4,531 (54.68%)	3,756 (45.32%)	8,287
2008	6,620 (55.43%)	5,322 (44.57%)	11,942
2009	2,040 (54.57%)	1,698 (45.43%)	3,738
Total	16,470	13,231	29,701

(2) Primary Prevention Group Only

Year	Aspirin		
Frequency row %	No	Yes	Total
2004	289 (60.08%)	192 (39.92%)	481
2005	416 (61.36%)	262 (38.64%)	678
2006	761 (62.58%)	455 (37.42%)	1,216
2007	2,241 (58.66%)	1,579 (41.34%)	3,820
2008	3,231 (57.98%)	2,342 (42.02%)	5,573
2009	1,079 (59.12%)	746 (40.88%)	1,825
Total	8,017	5,576	13,593

(3) Secondary Prevention Group Only

Year	Aspirin		
Frequency row %	No	Yes	Total
2004	443 (53.31%)	388 (46.69%)	831
2005	509 (55.57%)	407 (44.43%)	916
2006	861 (53.41%)	751 (46.59%)	1,612
2007	2,290 (51.26%)	2,177 (48.74%)	4,467
2008	3,389 (53.21%)	2,980 (46.79%)	6,369
2009	961 (50.24%)	952 (49.76%)	1,913
Total	8,453	7,655	16,108

(4) Secondary Prevention Without Diabetes Group

Year	Aspirin		
Frequency row %	No	Yes	Total
2004	66 (31.43%)	144 (68.57%)	210
2005	98 (38.74%)	155 (61.26%)	253
2006	132 (32.51%)	274 (67.49%)	406
2007	406 (34.85%)	759 (65.15%)	1,165
2008	586 (35.26%)	1,076 (64.74%)	1,662
2009	154 (30.08%)	358 (69.92%)	512
Total	1,442	2,766	4,208

heart disease awareness among women increased significantly between 1997 and 2009, only 54% of women correctly identified heart disease as the leading cause of death among women.[21] These factors may contribute to underuse of aspirin in women, but we cannot exclude the possibility that some women may not have received appropriate guidance from their healthcare provider. Although aspirin use in primary prevention is somewhat controversial and in women appears to confer an advantage only for stroke and not for MI,[7] the guidelines are clear and indistinguishable for women and men with respect to secondary prevention; yet we still observe remarkably high rates of aspirin underuse in women with a (self-reported) history of CVD.

We found that women from racial or ethnic minorities were less likely to be taking aspirin for primary and secondary prevention compared with Caucasians. African Americans were less likely to be taking aspirin for primary prevention, and both African Americans and Hispanics were less likely than Caucasians to be taking aspirin for secondary prevention. Our findings are consistent with previous studies that have shown decreased aspirin use among ethnic minorities.[11,13] Other recent surveys have found that minority populations have less awareness of heart disease, which may result in decreased preventive actions.[21] Although heart disease awareness has increased overall among all women since 1997, it has been shown that awareness among ethnic minorities has not increased over time.[1] These findings suggest a need for culturally appropriate education targeted toward not only women but also minorities.

We also examined aspirin use in relation to certain lifestyles, such as exercise and smoking. We found that the more a woman reported exercising each week, the more likely she was to be taking aspirin. Among those women who should be taking aspirin for primary prevention, those who have never smoked were more likely to be taking aspirin than those who currently smoke. These findings for both exercise and smoking may be a reflection of the healthy user effect, that is, that women who take a more active role in preventive health habits are more likely to use aspirin according to guidelines. Among those women who should be taking aspirin for secondary prevention, women who smoked in the past were more likely to be taking aspirin than those who never smoked. We cannot ascertain the reason for this observation from our survey but speculate that women with CVD who smoked in the past are either more interested in preventive care or are seen as higher-risk patients, resulting in more emphasis on prevention by their physicians.

Other predictors of aspirin use in our study include having either a primary care provider, a cardiologist, or both, reporting taking antihypertensive medication, and reporting a family history of CVD. It is not surprising that women who are under the care of a PCP and cardiologists are more likely to take aspirin; others have reported similar findings. Stafford and Blumenthal[12,23] reported that patients who regularly see a general internist or cardiologist are more likely to receive counseling on CVD risk factors and prevention of CVD and are more likely to be taking aspirin. Previous cross-sectional studies have also found that patients with hypertension are more likely to be taking aspirin.[13] These findings emphasize that the clinician encounter remains an important part of patient education aimed at preventive healthcare.

We chose the 2007 AHA evidence-based guidelines for CVD prevention in women because they were targeted specifically toward women. Our data collection time frame was the years 2004–2009. As a result, we were able to examine changes in aspirin use after the guidelines were released in February 2007. The 2007 guidelines were a departure from prior recommendations for primary prevention, and a significant increase (trend of linear increase) in the percent of women using aspirin for primary prevention was observed over the years 2004–2009, although the overall use rate was still around 41%. With respect to aspirin use rates for secondary prevention, no significant trend was observed, and the

overall use rate was still < 50 %, a rate that has been unchanged for more than a decade.[24] When diabetes was excluded from the secondary prevention group, overall use was 66%. Although this aspirin use rate is slightly higher, it is still less than the use rate found in men in other studies.[16] Why has such little progress been made to improve these data, and how can healthcare providers respond to this challenge more effectively? Clinicians may benefit from specific educational efforts targeting appropriate use of aspirin. Such educational efforts may include improved guideline availability and implementation.

We acknowledge that there are limitations to our study. First, our study uses a voluntary online CVD risk assessment tool; therefore, the potential for healthy user bias exists, but we expect that this would tend to favor aspirin use. Thus, aspirin underuse in women who elected not to take the survey may be even higher than we observed. The HeartAware survey does not ask why women are taking aspirin; as a result, it is possible that some women were taking aspirin for reasons other than CVD prevention, such as arthritis. Additionally, some women who may have fit into our definition of primary or secondary prevention may not have been taking aspirin because their personal risks outweighed the benefits or they had a specific contraindication to aspirin therapy, such as a history of gastrointestinal bleeding or hemorrhagic stroke. These types of specific contraindications to aspirin therapy are not asked as part of the survey. We do not have information on the use of other antiplatelet agents, anticoagulants, or other medical conditions (atrial fibrillation, valvular heart disease, stroke) that may require the use of these medications without the use of aspirin. The REACH study found 7.9% of outpatients surveyed to be on anticoagulants only and 4.6% to be on antiplatelets other than aspirin.[16] As a result, appropriate antithrombotic use in our respondents may be higher than reported by our survey. Another limitation is recall bias when relying on self-reported data. A Framingham risk score used to guide the need for aspirin use in primary prevention was estimated as part of the survey but excluded from the analysis because not all questions aligned with Framingham cutoff points (e.g., for the blood pressure and cholesterol levels).

Finally, the 2007 AHA CVD guidelines for preventive care in women include the diagnosis of diabetes in the high-risk or CHD equivalent. One of the aims of this study was to determine if aspirin use changed after these guidelines were released in 2007. For this reason, we chose to categorize our patients (primary and secondary prevention groups) as close to these guidelines as possible. We acknowledge that recent trials in patients with diabetes have not shown a significant benefit of aspirin in diabetics with no other risk factors for CVD and that the use of aspirin in this group is currently debated.[25,26] We performed a subgroup analysis excluding those with diabetes from the secondary prevention group. We found that among those with known CVD (secondary prevention group) and no diagnosis of diabetes, 66% were taking aspirin. This suggests a higher rate of aspirin use among those with known disease; however, we were unable to determine the aspirin use among those with known CVD and diabetes. Our preliminary multivariate analyses indicate future directions for research and practice.

Despite these limitations, there are many strengths of our study. Data were collected from 127 healthcare centers across the United States. These healthcare centers are from both geographically and ethnically diverse populations; therefore, we believe our findings are more representative of the general population than are smaller clinic-based studies. Our large study is the only study to our knowledge that specifically examines aspirin use in women for both primary and secondary prevention of CVD events. Finally, we were able to collect data over a period of 5 years and determine if aspirin use changed during that period, especially in relation to a critical guidelines release.

This study provides direct evidence for the need for education about aspirin among clinicians and women for increased awareness and prevention of CVD events. Public health initiatives aimed at promoting appropriate aspirin use may favorably impact CVD event rates in a cost-effective manner, especially in the African American population. An economic analysis of the impact of dispensing aspirin through pharmacies to patients with CVD is also an area of future research to address the underuse of this effective and inexpensive therapy. At the healthcare level, providers need to be aware that women, especially those in certain ethnic groups, should be instructed about the importance of daily aspirin use as well as guarding against inappropriate use where the risk/benefit ratio may be unfavorable, such as in women < 65 years of age who have poorly controlled hypertension. Given that CVD is projected to surpass infectious diseases as the world's leading cause of death and disability and that current direct and indirect costs are estimated at over $400 billion, the impact of preventive measures on our future healthcare costs is vast, yet the cost of one aspirin is minute.[27]

Disclosure Statement

C.B. is an employee of Navigant Healthcare. None of the authors received any financial remuneration or were offered any financial incentives from Navigant Healthcare for the organization's participation. No other competing financial interests exist.

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