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Appropriate Use of Aspirin in Real-Life Cardiology Practice: Results from the Appropriateness of Aspirin Use in Medical Outpatients: A Multicenter, Observational Study (ASSOS) Study

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Background: Indications and appropriateness of aspirin use have not been well investigated in Turkey.

Aims: To investigate the prescription patterns and appropriateness of aspirin in a real-world clinical setting.

Study Design: Cross-sectional study.

Methods: The Appropriateness of Aspirin Use in Medical Outpatients: A Multicenter, Observational Study (ASSOS) is a cross-sectional and multicenter study that included 5007 consecutive patients aged 18 or over who presented to 30 different cardiology outpatient clinics from 14 cities throughout Turkey. Only patients using aspirin (80-325 mg) were included. The study population was divided into 2 groups regarding the use of aspirin: primary prevention (PP) group and secondary prevention (SP) group. The indication of aspirin use was evaluated following the 2016 European Society of Cardiology (ESC) and the 2016 United States Preventive Services Task Force (USPTF) guidelines in the PP group.

Results: A total of 5007 patients (mean age 62.15 ± 11.05, 39% female) were enrolled. The PP group included 1132 (22.6%)

patients, and the SP group included 3875 (77.4%) patients. Of the 1132 patients, inappropriate use of aspirin was determined in 100% of the patients according to the ESC guidelines, and 71% of the patients according to the USPTF guidelines. Multivariate logistic regression analysis showed age OR: 0.98 CI (0.97-0.99) $P = .037$, smoking OR: 0.60 CI (0.44-0.82) $P = .001$, heart failure OR: 2.11 CI (1.14-3.92) $P = .017$, hypertension OR: 0.51 CI (0.36-0.74) $P < .001$, diabetes mellitus OR: 0.34 CI (0.25-0.47) $P < .001$, oral anticoagulant use OR: 3.01 CI (1.10-8.25) $P = .032$, and female sex OR: 2.73 CI (1.96-3.80) $P < .001$ were independent predictors of inappropriate aspirin use in PP patients.

Conclusion: Although there are considerable differences between the USPTF and the ESC guidelines with respect to recommendations for aspirin use in PP, inappropriate use of aspirin in Turkey is frequent in real-world practice for both guidelines. Besides, heart failure, oral anticoagulant use, and the female sex of the patients were independent predictors of inappropriate use of aspirin.

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INTRODUCTION

Cardiovascular diseases (CVD) are responsible for nearly half of all deaths globally.¹ Minimizing the impact of CVD and related disabilities is a major challenge, and aspirin is the oldest and most reliable drug for this purpose.² It is an indispensable drug in the secondary prevention (SP) of CVD.² The net benefit is well established, and there is a large body of evidence supporting antiplatelet therapy for SP patients.³⁻⁵ However, there is no clear consensus on who aspirin therapy is appropriate for the primary prevention (PP) of CVD.

The 2016 European Society of Cardiology (ESC) guidelines on prevention of CVD did not recommend aspirin therapy in PP because of the increased risk of bleeding.⁶ While this recommendation includes both patients with and without diabetes mellitus (DM) in European guidelines, the American Diabetes Association (ADA) 2018 guidelines recommend aspirin therapy in patients with DM aged 50 years or older with at least one additional CVD risk factor, without increased risk of bleeding.⁷ In parallel, 2016 United States Preventative Services Task Force (USPTF)⁸ and 2019 American College of Cardiology/American Heart Association (ACC/AHA) guidelines on the PP of CVD states that aspirin (80-325 mg/day) may be used in selected patients aged 40-70 who have high CVD risk but not increased bleeding risk.⁹

Recently, 3 large-scale randomized controlled trials evaluated the use of aspirin in the PP of CVD. These trials provided further evidence for the use of aspirin in PP. The The Aspirin in Reducing Events in the Elderly (ASPREE) trial enrolled elderly patients,¹⁰ the Aspirin to Reduce Risk of Initial Vascular Events (ARRIVE) trial enrolled patients with moderate to high CVD risk,¹¹ and A Study of Cardiovascular Events in Diabetes (ASCEND) trial enrolled patients with DM.¹² While ARRIVE and ASPREE trials showed no benefit in terms of CVD risk reduction, only the ASCEND trial indicated a lower rate of major CV events. Still, a higher rate of major bleeding attenuated this effect. There was no all-cause mortality benefit in these trials.⁹⁻¹¹ However, indications, prescription patterns, and appropriateness of aspirin use have not been well investigated with randomized or observational studies in Turkey. Therefore, the Appropriateness of Aspirin Use in Medical Outpatients: A Multicenter, Observational Study (ASSOS) aims to investigate the potential misuse of aspirin in both primary and SP patients. The ASSOS is the largest multicenter domestic trial regarding this topic. The use of aspirin therapy was evaluated taking into account the risk of CVD and bleeding in this real-world trial.

MATERIAL AND METHODS

Study Design

The design of the ASSOS trial has already been described in detail.¹³ In brief, the ASSOS study is an observational and cross-sectional national registry study. In this study, 30 cardiologists performed it in 14 different cities, and the data were collected during a routine ambulatory visit from March 1, 2018 to June 31, 2018. All consecutive patients admitted to the outpatient

cardiology clinics who have been prescribed aspirin, irrespective of the indication for use, were included. The study did not obligate any diagnostic or treatment procedures and was approved by the local ethics committee (Mugla Sıtkı Koçman University School of Medicine) and registered at ClinicalTrials.gov (NCT03387384).

The number of patients was proportional to the population of each 7 regions of Turkey. Patients ≥ 18 years old at the time of enrollment who provided written consent to participate and treated with aspirin (80-325 mg) within the last 30 days were included. Pregnant patients, minors <18 years, and patients with mental disorders were excluded.

Patients were divided into 2 groups according to the use of aspirin: PP group patients were defined as participants who did not have any clinically apparent CVD and SP group patients were the participants who had documented CVD manifested by fatal or non-fatal myocardial infarction, aortic atherosclerosis, and thoracic or abdominal aortic aneurysm, angina pectoris, the cerebrovascular disease manifested by fatal or non-fatal stroke or transient ischemic attack, and peripheral artery disease manifested by intermittent claudication or critical limb ischemia. The study includes cardiology outpatients without acute coronary syndrome; therefore, all patients in the SP group can be classified as having the chronic coronary syndrome.

Data

The participants' demographic and clinical characteristics include age, gender, level of education, smoking history, body mass index, residence (rural or urban), and alcohol use.

Medical history, cardiovascular risk factors, comorbidities, physical examination details, and all concomitant medications were questioned. The duration for aspirin therapy, the reason for use (primary or SP), and the specialty of the physician who prescribed aspirin were analyzed.

The indication of aspirin use was assessed according to the 2016 ESC⁶ and 2016 United States Preventative Services Task Force (USPTF) guidelines.⁸ The risk of experiencing an atherosclerotic event was calculated using an online atherosclerotic cardiovascular disease (ASCVD) risk calculator prepared according to the 2013 ACC/AHA guidelines¹⁴ for each individual in the PP group.

HASBLED and other clinical parameters determined the bleeding risk. Although HASBLED score was not developed to assess bleeding risk in antiplatelet users, it was shown that the HASBLED score might be used in this setting.¹⁵ The HASBLED score adds one point for stroke, hypertension, bleeding history or predisposition, abnormal renal/liver function (one point each), labile international normalized ratio, drugs/alcohol concomitantly, and age 65 and older (one point each).¹⁵ Risk factors for gastrointestinal bleeding with aspirin use, such as higher dose and longer duration of use, history of gastrointestinal bleeding, bleeding disorders, ulcers or upper gastrointestinal pain, thrombocytopenia, renal failure, severe liver disease, uncontrolled hypertension, and concurrent

anticoagulation or non-steroidal anti-inflammatory drug use were analyzed.

Risk factors for colorectal cancer, such as a history of colonic adenomatous polyps, family or personal history of colorectal cancer or familial adenomatous polyposis, alcohol intake, obesity, and smoking were also noted.

Definition of Appropriate Use of Aspirin in PP of CVD

The appropriate use of aspirin was assessed according to the USPTF and ESC guidelines in the PP group. The ESC guidelines do not recommend aspirin for PP.⁶ The USPTF guidelines suggest aspirin for adults age 40-70 at higher risk of atherosclerotic CVD without higher bleeding risk.⁸ Therefore, we defined aspirin as inappropriate for all patients according to the ESC guidelines and for patients younger than 40, older than 70, ASCVD score < 10%, and those at high bleeding risk USPTF guidelines. Patients who had bioprosthetic or mechanic heart valves were excluded from the appropriateness evaluation.

Statistical Analysis

The sample size was calculated as 4896 with a power of 0.90 and a margin of error of 1%. Mean \pm standard deviation or median and interquartile range was used for continuous variables. Categorical variables were summarized as frequencies and percentages. Continuous variables were compared using univariate analysis (Student's *t*-test), and the chi-square test or Fisher exact test were performed for categorical variables. Multivariate logistic regression analysis was performed to find independent predictors of inappropriate aspirin use. A *P* value < .05 was accepted as statistically significant. Statistical analysis was performed using statistical software (SPSS version 13.0, SPSS Inc.; Chicago, IL, USA).

RESULTS

A total of 5007 patients (1955 females, 39%) were enrolled and divided into PP and SP groups according to the use of aspirin. The PP group included 1132 (22.6%) patients, and the SP group included 3875 (77.4%) patients.

Comparison of Primary and Secondary Prevention Groups

Baseline demographic characteristics, comorbid diseases of the population are demonstrated in Table 1. There were no significant differences between the 2 groups regarding age, place of residence, the prevalence of chronic pulmonary disease, or hepatic failure. However, patients in the SP group were more likely to be male, had a higher prevalence of DM, heart failure, hyperlipidemia, tobacco, and alcohol use. PP group patients had a higher prevalence of hypertension and atrial fibrillation than patients in the SP group. HASBLED scores were higher in the SP group (Table 1). While 45.9% of the patients with a HASBLED score \geq 3 were on proton pump inhibitor (PPI), 40.8% of HASBLED < 3 were on PPI (*P* = .010).

Aspirin treatment was utilized most frequently by cardiologists (*n* = 4167, 83.2%), followed by specialists of internal medicine

(*n* = 265, 5.3%) and neurology (*n* = 259, 5.2%). Aspirin was used more often in SP than PP by cardiologists and cardiovascular surgeons (Figure 1). Other specialists prescribed aspirin mainly for PP.

Appropriate Use of Aspirin in the PP Group

Aspirin use was inappropriate in all PP patients according to ESC guidelines. Of the PP patients whose ages were between 40 and 70 years, 322 were at high (\geq 10%) ASCVD risk and low bleeding risk (HASBLED < 3), whereas 51 were at high (\geq 10%) ASCVD risk and high bleeding (HASBLED \geq 3) risk (Figure 2). Therefore, 790 of the 1112 patients (71 %) accepted as inappropriate use of aspirin according to the USPTF guidelines. Univariate analysis showed being female, older age, smoking, educational status (literacy), having hypertension, atrial fibrillation, heart failure, hyperlipidemia, DM, major bleeding history, and being on Oral anticoagulant (OAC) therapy was associated with inappropriate use of aspirin (Table 2). Multivariate analysis was performed to find independent predictors of inappropriate use of aspirin in PP patients. Female sex, oral anticoagulant use, and heart failure were independent predictors of inappropriate aspirin use. However, older age, smoking, hypertension, DM were associated with appropriate use of aspirin (Table 3).

DISCUSSION

Our study showed that in a large real-world population of aspirin users, nearly one-fourth of the patients received the drug for PP. Most of the patients (>90% were on a lower dose of aspirin (\leq 100 mg)). The other main findings of our study were: 1, female patients were more likely to be prescribed aspirin for PP compared to males; 2, aspirin was prescribed more often for PP than SP by specialists other than the cardiologists and cardiovascular surgeons; 3, the rate of inappropriate use of aspirin was high according to both ESC and USPTF guidelines in the real-world practice; 4, independent predictors of inappropriate aspirin use were female sex, oral anticoagulant use and heart failure in PP patients and older age, smoking, hypertension, DM were associated with appropriate use of aspirin.

The benefit of aspirin therapy in SP has been well established. It was associated with a 51% lower rate of ischemic events in unstable angina patients and a significantly lower rate of reinfarction in suspected myocardial infarction patients.^{3,5} We included patients who were on aspirin therapy. Therefore all patients with CVD were appropriately using aspirin. Although aspirin has been used in the SP of atherosclerotic events for more than 40 years,¹⁶ it has acquired a negative image in PP trials, which showed that aspirin did not reduce the overall mortality and did not have a net benefit.¹⁰⁻¹² However, there are different recommendations between the European and American guidelines regarding the use of aspirin in PP. The ESC guidelines recommended that aspirin not be used for PP, and subjects without clinical manifestations of CVD should not take aspirin (class III, level A).⁶ The USPTF guidelines recommended that low-dose aspirin might be considered in persons of 40-70 years of age who were at higher CVD risk but not

TABLE 1. Patient Demographics, Characteristics, and Comorbidities

	Overall (n = 5007)	Primary Prevention (n = 1132)	Secondary Prevention (n = 3875)	P
Female	1955 (39.0)	634 (56.0)	1321 (34.1)	<.001
Age, years	62.15 ± 11.05	61.79 ± 11.90	62.26 ± 10.79	.238
Body mass index	28.50 ± 4.57	29.04 ± 5.14	28.34 ± 4.38	<.001
Smoking	2768 (55.3)	469 (41.4)	2299 (59.3)	.004
Alcohol use	336 (6.7)	58 (5.1)	278 (7.2)	.015
Educational status				
Illiterate	790 (15.8)	210 (18.6)	580 (15.0)	
Primary	2332 (46.6)	526 (46.5)	1806 (46.6)	
Secondary	672 (13.4)	143 (12.6)	529 (13.7)	
High	889 (17.8)	178 (15.7)	711 (18.3)	
University	324 (6.5)	75 (6.6)	249 (6.4)	
Place of residence				
Rural	1072 (21.4)	228 (20.1)	844 (21.4)	.237
Urban	3935 (78.6)	904 (79.9)	3031 (78.6)	
Hypertension	3467 (69.2)	848 (74.9)	2619 (67.6)	<.001
Hypertension (uncontrolled)	1599 (31.9)	366 (32.3)	1233 (31.8)	.745
Atrial fibrillation	322 (6.4)	99 (8.7)	223 (5.8)	<.001
Heart failure	742 (14.8)	99 (8.7)	643 (16.5)	<.001
Diabetes mellitus	1537 (30.7)	313 (27.7)	1224 (31.6)	.012
Chronic kidney disease	247 (4.9)	44 (3.9)	203 (5.2)	.065
Dialysis	165 (3.3)	24 (2.1)	141 (3.6)	.012
Hyperlipidemia	2577 (51.5)	331 (29.2)	2246 (58.0)	<.001
Pacemaker/ICD/CRT	64 (1.3)	13 (1.1)	51 (1.3)	.659
COPD	488 (9.7)	109 (9.6)	379 (9.8)	.880
Hepatic failure	17 (0.3)	2 (0.2)	15 (0.4)	.284
Mechanical valve	46 (0.9)	16 (1.4)	30 (0.8)	.047
Malignancy	80 (1.6)	17 (1.5)	63 (1.6)	.770
CHA ₂ DS ₂ VASc	3 (2-4)	2 (1-3)	3 (2-4)	<.001
HASBLED	1 (1-2)	1 (1-2)	2 (1-2)	<.001
Aspirin dose				
≤100 mg	4671 (93.3)	1047 (92.5)	3624 (93.5)	.273
150 mg	218 (4.4)	59 (5.2)	159 (4.1)	
300 mg	118 (2.4)	26 (2.3)	92 (2.4)	

COPD, chronic obstructive pulmonary disease; ICD, implantable cardioverter defibrillator; CRT, cardiac resynchronization therapy.

at increased bleeding risk (class IIb, level A). In contrast, it should not be routinely administered in subjects aged >70 years (class III, level B) and should be avoided in subjects of any age at increased risk of bleeding (class III, level C).⁸ The presence of such differences between the guidelines usually leads to physicians having different treatment recommendations for patients without overt CVD. However, indications and the appropriateness of aspirin use were not well studied among patients in Turkey. In the WARFARIN-TR study, all consecutive patients using warfarin were enrolled to assess the prevalence of the inappropriate combination of aspirin and warfarin therapy.¹⁷ Although performed on a very different patient population, the WARFARIN-TR study revealed

that one-fifth of patients who receive warfarin were receiving aspirin inappropriately.¹⁷

Data is very limited about patterns of inappropriate aspirin use in Turkey, but studies from Europe¹⁸ and the US^{19,20} have previously documented overutilization of aspirin for PP. Manes and colleagues screened 20 599 patients from primary care physicians' clinics in Italy and determined 400 patients were on treatment with aspirin for PP.¹⁸ The authors found an overprescription of aspirin in 18% of the 400 patients. In a cross-sectional study, individuals aged 30-79 years in the Marshfield Epidemiologic Study Area were analyzed in the United States.¹⁹ This study used electronic health records from a large database. It showed that 19% of the

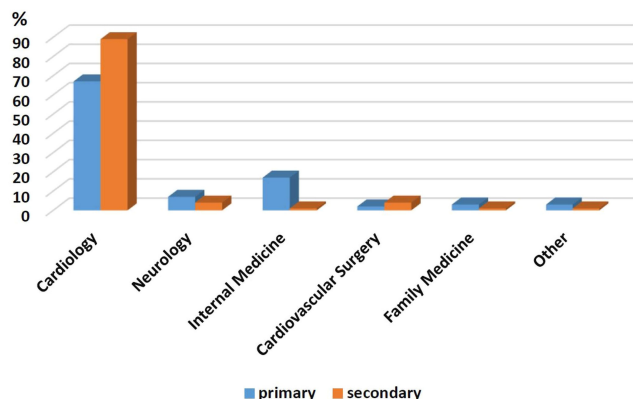


FIG. 1. Distribution of aspirin use in secondary and primary prevention according to specialists.

16 922 subjects who were not clinically indicated for aspirin therapy for PP of CVD were regular aspirin users.¹⁹ In the previous study, 68 808 patients receiving aspirin for PP of CVD were assessed in the National Cardiovascular Disease Registry’s Practice Innovation and Clinical Excellence registry. Inappropriate aspirin use frequency was detected in 11.6% of the study cohort.²⁰ However, all of these studies were performed before the publication of large

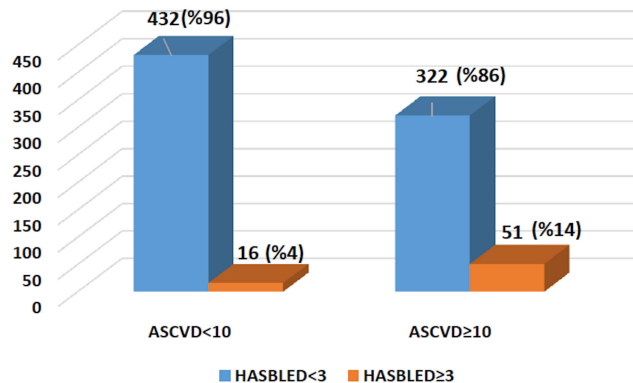


FIG. 2. Distribution of primary prevention patients between the ages of 40 and 70 according to ASCVD and HASBLED score.

randomized clinical trials¹⁰⁻¹² examining the use of aspirin in PP. These studies used different definitions for inappropriate aspirin use, such as a 10-year risk of a CVD event < 6% or a cardiovascular risk < 1.0 event/100 patients/year. A recent study that used electronic health records to identify aspirin overuse in PP showed 38% of aspirin users were >70 years old. The authors concluded opportunities exist for aspirin de-prescription and the current guidelines

TABLE 2. Univariate Analysis for the Appropriate of Use Aspirin in Primary Prevention Patients

	Overall (n = 1132)	Appropriate (n = 324)	Inappropriate (n = 808)	P
Female	623 (56.0)	127 (39.4)	496 (62.8)	<.001
Age, years	61.76 ± 11.91	62.96 ± 5.66	61.27 ± 13.63	.004
Smoking	460 (41.4)	179 (55.6)	281 (35.6)	<.001
BMI	29.09 ± 5.16	29.39 ± 4.78	28.96 ± 5.30	.209
Alcohol use	57 (5.1)	16 (5.0)	41 (5.2)	.880
Educational status, illiterate versus literate	206 (18.5)	40 (12.4)	166 (21.0)	.001
Place of residence, rural versus urban	220 (19.8)	65 (20.2)	155 (19.6)	.830
Hypertension	836 (75.2)	263 (81.7)	573 (72.5)	.001
Hypertension (uncontrolled)	362 (32.6)	99 (30.7)	263 (33.3)	.411
Atrial fibrillation	995(8.5)	15 (4.7)	80 (10.1)	.003
Heart Failure	95 (8.5)	15 (4.7)	80 (10.1)	.003
Diabetes mellitus	307 (27.6)	131 (40.7)	176 (22.3)	<.001
Chronic kidney disease or dialysis	63 (5.7)	17 (5.3)	46 (5.8)	.722
Hyperlipidemia	328 (29.5)	118 (36.6)	210 (26.6)	.001
COPD	108 (9.7)	23 (7.1)	85 (10.8)	.065
Malignancy	16 (1.4)	3 (0.9)	13 (1.6)	.365
NSAID	128 (11.5)	31 (9.6)	97 (12.3)	.209
Dyspepsia	277 (24.9)	71 (22.0)	206 (26.1)	.159
Major bleeding	10 (0.9)	0 (0)	10 (1.3)	.072
Minor bleeding	123 (11.1)	32 (9.9)	91 (11.5)	.446
OAC	41 (3.7)	6 (1.9)	35 (4.4)	.039
Other antiplatelet	64 (5.8)	25 (7.8)	39 (4.9)	.066
PPI	332 (29.9)	93 (28.9)	239 (30.3)	.650
Specialist, cardiology or surgeon	787 (70.8)	228 (70.8)	559 (70.8)	.987

TABLE 3. Predictors Associated With Inappropriate Use of Aspirin in Primary Prevention Patients; Results of the Logistic Regression Analysis

Variable	OR	95% CI	P
Age, every one year	0.98	0.97-0.99	.037
Education, illiterate	0.74	0.49-1.13	.169
Smoking	0.60	0.44-0.82	.001
Atrial fibrillation	1.36	0.70-2.63	.358
Heart failure	2.11	1.14-3.92	.017
Hypertension	0.51	0.36-0.74	<.001
Diabetes mellitus	0.34	0.25-0.47	<.001
Hyperlipidemia	0.85	0.63-1.17	.329
Oral anticoagulant	3.01	1.10-8.25	.032
Female	2.73	1.96-3.80	<.001

for low-dose aspirin are difficult to apply to electronic data at a population level.²¹

In this study, we used the definitions of 2016 USPTF and 2016 ESC guidelines. We found that inappropriate aspirin use frequency was 100% according to ESC and 71% according to USPTF guidelines. The current study also showed that 56% of the PP group were female. (The present study is comprised of 56% female in the PP group.) We also detected that aspirin was usually preferred and prescribed by specialists other than cardiologists and cardiovascular surgeons in the PP group.

Prevalence of aspirin use in PP of cardiovascular disease was found 23.4% among adults 40 years or older in the National Health Interview Survey from the United States. Of those, 22.8% were using aspirin without a physician's recommendation. Of note, male, older age, and cardiovascular risk factors (hyperlipidemia, diabetes, hypertension, and smoking) were significantly associated with aspirin use in this study as per statistics.²² Similarly, this study showed older age, smoking, hypertension, DM was associated with appropriate aspirin use.

Female sex, heart failure, and oral anticoagulant use were independent predictors of inappropriate aspirin use in our study. Previous studies on the appropriate use of aspirin have shown female gender was associated with improper aspirin use.^{18,20} The lower risk profile of females comparing males might explain the higher overuse of aspirin in these patients. Aspirin use in heart failure is controversial. A retrospective study included ischemic heart disease patients and showed that aspirin use was significantly associated with a reduction in morbidity and mortality in a long term follow-up.²³ However, aspirin use was associated with an increased risk of readmission for heart failure (HF) in another propensity-matched study which included a lower rate of CVD patients.²⁴

Having heart failure was associated with inappropriate use of aspirin in our study. The controversy of aspirin use in heart failure patients might be a reason for this result. A combination of aspirin with the oral anticoagulant drug was associated with a higher rate of major bleeding.²⁵ Hence antiplatelet therapy should be avoided in patients with an indication of oral anticoagulant unless there is a

compulsory indication. Oral anticoagulant use was an independent predictor of inappropriate aspirin use in our study.

The results of the ASSOS study revealed the overuse of aspirin in low-risk patients despite the recent introduction of randomized controlled trials and international guidelines, suggesting the need for improved management of patients who had no overt CVD.

Limitations

The cross-sectional design of our study and the lack of safety and efficacy outcomes could be regarded as major limitations. However, the ASSOS study is the first to evaluate the use of aspirin in real clinical practice in Turkey. Our preference of 7 regions of Turkey instead of Nomenclature des Unites Territoriales Statistiques (NUTS) classification for the recruiting sites distribution to reflect Turkey's population distribution is another major limitation of the study. However, we preferred to use the classical 7 regions that were created according to human habitat, climate, agricultural diversity, and topography during the first geography congress of Turkey. As this study was conducted only in cardiology centers, the results cannot be generalized to the medical care in the whole country, including primary care and other specialties. Therefore, the appropriate use could be overestimated compared to general practice. Lastly, the exclusion of mental disorders such as Parkinson's, Dementia, and Alzheimer diseases could be regarded as a limitation.

To the best of our knowledge, the ASSOS study represents the most significant number of patients treated with aspirin in Turkey. The present study provides recent data on aspirin use both in PP and SP group patients. The results of our study suggest that the overuse of aspirin is common because of physicians' poor compliance with the guideline recommendations in patients without documented CVD. Female patients who were on oral anticoagulants and had heart failure were at the highest risk for inappropriate use of aspirin; however, older age, smoking, hypertension, DM were associated with appropriate use of aspirin. Thus, a greater emphasis should be given to these patients' characteristics.

Ethics Committee Approval: Ethics committee approval was received for this study from the Local Ethics Committee of Muğla Sıtkı Koçman University School of Medicine and registered at ClinicalTrials.gov (NCT03387384).

Patient Consent for Publication: Written informed consent was obtained from the patients.

Data-sharing Statement: The authors elect not to share data.

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