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ORIGINAL ARTICLE

Guideline-adherent therapy in patients with cardiovascular diseases in Taiwan

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Background/Purpose: Aggressive and persistent control of risk factors is recommended for prevention of secondary comorbidities in patients with cardiovascular diseases. This study aimed to evaluate guideline recommendations for achieving targets for lipid and blood pressure (BP) control in patients with cardiovascular diseases in Taiwan.
Methods: This multicenter cohort study was conducted in 14 hospitals in Taiwan. A total of 3316 outpatients who had established cerebrovascular disease (CVD), coronary artery disease (CAD), or both were recruited. Risk factors for comorbid conditions such as high BP, sugar, hemoglobin A_{1C}, abnormal lipids, lipoproteins, and medication use were compared between patients with CVD, CAD, or both.
Results: Of all patients, 503 (15.2%) had CVD only, 2568 (77.4%) had CAD only, and 245 (7.4%) had both CVD and CAD. Compared with patients who had only CAD, those with CVD were older, had higher frequency of hypertension, and lower frequency of diabetes mellitus. Patients with CAD were more likely to receive lipid-lowering and antihypertensive drugs than those with CVD ($p < 0.001$). Only 54.8% and 55.9% of patients achieved the recommended lipid and BP control targets, respectively. Patients with CVD (adjusted odds ratio: 0.61; 95% confidence interval: 0.48−0.78; $p < 0.001$) and women (adjusted odds ratio: 0.65; 95% confidence interval: 0.55−0.78; $p < 0.001$) were less likely to achieve the recommended lipid and BP targets.
Conclusions: The guideline-recommended targets for lipids and BP in patients with CAD and CVD were still suboptimal in Taiwan. Greater efforts are required to achieve the targets, particularly in patients with CVD and in women.

Introduction

Cardiovascular disease, including both coronary artery disease (CAD) and cerebrovascular disease (CVD), accounts for nearly half of all noncommunicable diseases and is the world's major disease burden. It is the leading cause of global mortality and results in 17.3 million deaths every year, a number that is expected to grow to 23.6 million or 24% by 2030.[1] Cardiovascular mortality has been declining slowly, particularly in high-income countries, an outcome that can probably be attributed to risk factor reduction in recent decades.[2,3] A global target to reduce premature noncommunicative disease mortality by 25% before 2025 has been proposed by the World Health Organization. The Global Cardiovascular Disease Taskforce endorses some exposure targets on physical inactivity, hypertension, dietary salt intake, tobacco, obesity, and raised cholesterol as those required to achieve the goal.[4]

Of the numerous cardiovascular risk factors, both hypertension and dyslipidemia are commonly encountered and relatively easily modifiable; in addition, antihypertensive and lipid-lowering therapies have well-established benefits in the primary and secondary prevention.[5–7] A nationwide follow-up of ischemic stroke patients revealed that treatment with antiplatelets, oral anticoagulants, antihypertensives, and statins can improve secondary prevention in routine care.[8] However, hypertension and dyslipidemia are often undertreated, and established therapies, including antiplatelets, statins, antihypertensive agents, are consistently underused in atherothrombotic patients worldwide.[9] In the international REduction of Atherothrombosis for Continued Health (REACH) Registry Europe, less than 60% of patients with stable atherothrombotic diseases had good control of the following five major cardiovascular risk factors: systolic blood pressure (BP) <140 mmHg, diastolic BP <90 mmHg, fasting glycemia <110 mg/dL, total cholesterol <200 mg/dL, and nonsmoking.[10]

Among the cardiovascular disease patients, patients with CVD were probably more likely not to receive antihypertensive, lipid-lowering, and antiplatelet therapies than those with CAD.[11–14] The guideline-recommended treatment targets were also less likely to be achieved in CVD patients than in CAD patients. In the Taiwan Stroke Registry, only 38.7% of acute ischemic stroke patients with low-density lipoprotein cholesterol (LDL-C) ≥100 mg/dL received lipid-lowering drugs before discharge.[15] In addition, women with cardiovascular diseases were reported to be less likely to receive antihypertensives, antiplatelets, and statins than men.[12,16,17] This study aimed to evaluate to what extent the guideline-recommended targets for several comorbid conditions are achieved in patients with CVD and/or CAD selected from a multicenter registry.

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Patients and methods

Study population

This study was conducted from a multicenter observational registry, the Taiwanese Secondary Prevention for patients with AtheRosCLErotic disease (T-SPARCLE) Registry, from 14 teaching hospitals in Taiwan.[18] This registry attempts to recruit and follow-up a large population of patients with cardiovascular diseases who have been receiving secondary prevention therapies so as to define the current status of these therapies and their effects on morbidity and mortality in Taiwan.

Adult patients who had stable symptomatic atherosclerotic diseases, including CAD and CVD, were recruited. Patients with CAD were defined as those who had significant coronary artery stenosis (>50%), or had a history of myocardial infarction, or who had angina showing ischemic electrocardiographic changes or positive response to stress tests. Patents with CVD were defined as those with cerebral infarction, intracerebral hemorrhage, and transient ischemic attack attributed to cervical or intracranial large artery stenosis (>50%). The study was approved by the Institutional Review Board of each participating hospital, and written informed consent was obtained from all patients.

Targets measurement

Eligible patients who fulfilled the enrollment criteria and agreed to participate in the study will be followed up every year for a total of 5 years. At every visit, vital signs, body mass index, lifestyle (smoking and drinking habits, physical activity), clinical end points, adverse events, information on concurrent medications, and blood test results, including lipid profile [total cholesterol, high-density lipoprotein cholesterol (HDL-C), triglyceride], complete blood cell counts, fasting glucose, hemoglobin A_{1C}, liver enzymes, creatinine, and creatine kinase were obtained as thoroughly as possible.

The concurrent medications and their dosage were recorded in detail, including antiplatelets (i.e., aspirin, clopidogrel, dipyridamole, aspirin + high-dose dipyridamole, cilostazol), oral anticoagulant, antihypertensive agents (i.e., calcium-channel blockers, β-blockers, α-blocker, diuretics, angiotensin-converting enzyme inhibitors, angiotensin receptor blockers), antidiabetic agents (oral hypoglycemic agents and insulin), and lipid-lowering drugs (e.g., statin, fibrate, Ezetimibe, bile acid sequestrants, nicotinic acid). The guideline-recommended lipid and BP targets were applied for evaluation of the achievement. The optimal lipid level was LDL-C <2.6 mmol/L (100 mg/dL) and the optimal BP was <140/90 mmHg for nondiabetic patients and <130/80 mmHg for diabetic patients.

Statistical analysis

Categorical variables are presented as percentage, and continuous or discrete variables as mean ± standard deviation. The risk factor conditions, including BP, fasting sugar, lipids and lipoproteins, and medication use, including antihypertensive, antidiabetic, lipid-lowering, and antithrombotic drugs were compared between patients with CVD, CAD, and patients who had both CVD and CAD. The χ^2 test was used to compare proportions; the Student t test or analysis of variance was applied to compare differences in continuous variables between groups. A logistic regression analysis was adapted to evaluate the odds ratio and 95% confidence intervals of the recommended lipid and BP control targets. Statistical analyses were performed using the SPSS software package (version 17.0; SPSS Inc, Chicago, IL, USA).

Results

From January 2010 to February 2011, 3316 patients (men: 72.3%; mean age: 66.7 ± 11.6 years) were included in this analysis. Of these, 503 (15.2%) had CVD only, 2568 (77.4%) had CAD only, and 245 (7.4%) had both CVD and CAD. Of the 748 patients with CVD (alone or co-existing CAD), 94 patients had a history of hemorrhagic stroke. About two-thirds of patients were recruited 2 years and more after their first vascular event. The demographics and clinical characteristics of the patients, and a comparison of these variables among the three groups of cardiovascular diseases are shown in Table 1. Compared with patients with CAD only, those with CVD were older, had higher frequency of hypertension, and lower frequencies of males, diabetes mellitus, and physical inactivity. Patients with CVD alone or co-existing CAD had higher systolic and diastolic BP than those with CAD alone ($p < 0.001$). The serum levels of total cholesterol, HDL-C, and LDL-C were significantly higher in patients with CVD alone than in those with CAD alone or co-existing CVD. By contrast, CAD patients had higher serum levels of fasting sugar, creatinine, and creatine kinase than did CVD patients.

Table 2 shows the prescription status of therapies for prevention of secondary comorbidities in patients with CVD and/or CAD. Antihypertensive agents were less likely to be administered in patients with CVD only than in other patients. About one half of patients received calcium-channel blockers, β-blockers, or angiotensin receptor blockers. The β-blockers and angiotensin-converting enzyme inhibitors were more likely to be used in patients with CAD than in those with CVD. The antidiabetic prescription rate was higher in patients with CAD than in patients with CVD, which may be related to a higher prevalence of diabetes mellitus. Patients with CVD only were significantly less likely to take lipid-lowering drugs, particularly statins, than those with CAD only (42.1% vs. 79.8%, $p < 0.001$). After excluding patients with a history of hemorrhagic stroke, antithrombotic agents were still less likely to be used in patients with CVD only than in those with CAD. Patients with CVD only were less commonly taking aspirin and clopidogrel, but more commonly taking aspirin plus extended release dipyridamole and ticlopidine than were those with CAD.

Overall, 54.8% and 55.9% of patients can achieve guideline-recommended targets of LDL-C (<2.6 mmol/L) and BP (<140/90 mmHg for nondiabetic patients and <130/80 mmHg for diabetic patients, respectively). Only 31.2% of

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Table 1 Demographics and clinical characteristics of the study patients.

	Overall (n = 3316)	CVD only (n = 503)	CAD only (n = 2568)	CVD + CAD (n = 245)	p
Age (years)	66.7 ± 11.6	68.5 ± 11.6	65.9 ± 11.6	70.7 ± 10.6	<0.001
Men	2399 (72.3)	320 (63.6)	1911 (74.4)	168 (68.6)	<0.001
Body mass index (kg/m^2)	26.1 ± 3.8	25.6 ± 3.4	26.2 ± 3.7	25.6 ± 4.3	<0.001
Waist-to-hip ratio	0.93 ± 0.07	0.92 ± 0.07	0.93 ± 0.07	0.94 ± 0.07	0.008
Hypertension	2485 (74.9)	423 (84.1)	1856 (72.3)	206 (84.1)	<0.001
Diabetes	1389 (41.9)	178 (35.4)	1088 (42.4)	123 (50.2)	<0.001
Heart failure	286 (8.6)	27 (5.4)	228 (8.9)	31 (12.7)	0.002
Smoking habit					
Current	473 (14.3)	68 (13.5)	376 (14.6)	29 (11.8)	0.435
Former	858 (25.9)	119 (23.7)	675 (26.3)	64 (26.1)	—
Never	1985 (59.9)	316 (62.8)	1517 (59.1)	152 (62.0)	—
Drinking habit[a]	586 (13.0)	51 (10.1)	398 (15.5)	17 (6.9)	<0.001
Physical inactivity[b]	1788 (53.9)	230 (45.7)	1437 (56.0)	121 (49.4)	<0.001
Time since vascular event					
≤2 years	1097 (36.2)	137 (33.3)	925 (38.8)	35 (15.0)	<0.001
>2 years	1934 (63.8)	274 (66.7)	1462 (61.2)	198 (85.0)	—
Systolic BP (mmHg)	133.1 ± 17.6	134.8 ± 16.6	132.3 ± 17.3	137.7 ± 21.0	<0.001
Diastolic BP (mmHg)	76.1 ± 11.3	78.2 ± 11.2	75.5 ± 11.2	77.6 ± 11.8	<0.001
Heart rate (bpm)	74.6 ± 12.9	73.0 ± 14.8	74.9 ± 12.5	75.3 ± 13.7	0.031
TC (mg/dL)	173.2 ± 40.3	184.3 ± 38.9	171.2 ± 40.1	172.1 ± 40.5	<0.001
TG (mg/dL)	143.1 ± 96.1	140.6 ± 80.5	144.6 ± 101.4	132.7 ± 64.4	0.169
HDL-C (mg/dL)	44.9 ± 13.1	46.4 ± 13.7	44.5 ± 12.9	45.5 ± 13.6	0.020
LDL-C (mg/dL)	99.6 ± 33.2	106.4 ± 33.7	98.2 ± 33.0	100.0 ± 33.0	<0.001
TC-to-HDL-C ratio	4.1 ± 1.5	4.2 ± 1.4	4.1 ± 1.4	4.2 ± 2.3	0.176
Fasting glucose (mg/dL)	120.0 ± 41.2	114.5 ± 33.5	120.6 ± 41.9	123.2 ± 45.2	0.018
Hemoglobin A_{1C} (%)	7.1 ± 1.4	7.1 ± 1.4	7.1 ± 1.5	7.2 ± 1.3	0.822
Creatinine (mg/dL)	1.2 ± 0.9	1.1 ± 0.6	1.2 ± 0.9	1.5 ± 1.4	<0.001
Creatine kinase (mg/dL)	129.1 ± 156.5	94.0 ± 73.1	134.3 ± 165.3	104.4 ± 95.1	0.018
AST (mg/dL)	29.4 ± 18.0	27.5 ± 17.8	29.5 ± 17.3	31.1 ± 24.0	0.197
ALT (mg/dL)	29.1 ± 20.3	26.7 ± 22.2	29.6 ± 20.0	27.2 ± 19.5	0.045
Hemoglobin (g/dL)	13.6 ± 1.8	13.4 ± 1.9	13.7 ± 1.8	13.0 ± 2.0	<0.001
WBC count ($\times 10^3/\mu L$)	7.2 ± 2.3	7.4 ± 2.2	7.1 ± 2.3	7.3 ± 2.3	0.363
Platelet count ($\times 10^3/\mu L$)	211.1 ± 60.8	227.6 ± 71.7	208.9 ± 58.6	204.2 ± 58.4	<0.001

Values are number (percentage) or mean (standard deviation).
ALT = alanine aminotransferase; AST = aspirate aminotranferase; BP = blood pressure; CAD = coronary artery disease; CVD = cerebrovascular disease; HDL-C = high-density lipoprotein cholesterol; LDL-C = low-density lipoprotein cholesterol; TC = total cholesterol; TG = triglyceride; WBC = white blood cell.
[a] Indicating a habit of alcohol consumption at least once per month currently.
[b] Indicating no vigorous exercise corresponding to brisk walking >30 minutes each time currently.

patients achieved both LDL-C and BP targets. Patients with CVD only were less likely to achieve the BP and LDL-C targets than those with CAD, especially in achieving the LDL-C target. A gender difference was observed in BP target achievement among CVD and/or CAD patients and in lipid target achievement for CAD patients. Women were less likely to meet the recommended targets than were men (Fig. 1).

Results of multivariate logistic regression analysis of variables associated with separate or both lipid and BP target achievements are presented in Table 3. Compared with patients with CAD only, those with CVD only, and patients with co-existing CVD and CAD were less likely to achieve the guideline-recommended lipid and BP targets. Women were also less likely to meet the BP and lipid targets, and diabetic patients had opposite effects on lipid and BP target achievement.

Discussion

As in several previous observational studies,[11–14] the present study showed that secondary prevention therapies in patients with atherosclerotic diseases were suboptimal in the ethnic Chinese population in Taiwan. Only 54.8% and 55.9% of patients achieved lipid and BP targets, respectively, and 31% achieved combined BP and lipid targets. It is clearly recognized that patients with atherosclerotic diseases are at an elevated risk for recurrent vascular events and death, which can be diminished by intensive risk factors modification, including lifestyle amendment and secondary prevention therapy.[19–21] However, there was a wide gap between the guideline-recommendation, which is mainly based on large randomized clinical trials and meta-analysis, and the routine clinical practice. In a cross-

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Table 2 Antihypertensive, lipid-lowering, antidiabetic, and antithrombotic treatment.

	Overall (n = 3316)	CVD only (n = 502)	CAD only (n = 2568)	CVD + CAD (n = 245)	p
Antihypertensive drugs					
Current use	2867 (86.5)	387 (76.9)	2270 (88.4)	210 (85.7)	<0.001
One kind	992 (29.9)	158 (31.4)	755 (29.4)	79 (32.2)	<0.001
Two kinds	1135 (34.2)	136 (27.0)	921 (35.9)	78 (31.8)	—
Three kinds	586 (17.7)	74 (14.7)	468 (18.2)	44 (18.0)	—
More than three kinds	154 (4.6)	19 (3.8)	126 (4.9)	9 (3.7)	—
Diuretics	552 (16.6)	109 (21.7)	407 (15.8)	36 (14.7)	0.004
Calcium-channel blocker	1458 (44.0)	250 (49.7)	1092 (42.5)	116 (47.3)	0.007
Beta blocker	1542 (46.5)	116 (23.1)	1323 (51.5)	103 (42.0)	<0.001
Angiotensin-converting enzyme inhibitor	551 (16.6)	30 (6.0)	479 (18.7)	42 (17.1)	<0.001
Angiotensin receptor blocker	1439 (43.4)	215 (42.7)	1129 (44.0)	95 (38.8)	0.279
Alpha blocker	103 (3.1)	10 (2.0)	82 (3.2)	11 (4.5)	0.156
Antidiabetic drugs					
Current use	921 (27.8)	102 (20.3)	702 (27.3)	82 (33.5)	<0.001
Oral hypoglycemic agents	893 (26.9)	106 (21.1)	710 (27.6)	77 (31.4)	0.003
Insulin	61 (1.8)	4 (0.8)	50 (1.9)	7 (2.9)	0.100
Lipid-lowering drugs					
Current use	2420 (73.0)	212 (42.1)	2048 (79.8)	160 (65.3)	<0.001
One kind	2208 (66.6)	194 (38.6)	1861 (72.5)	153 (62.4)	<0.001
More than one kind	211 (6.4)	18 (3.6)	186 (7.2)	7 (2.9)	—
Statins	2285 (68.9)	197 (39.2)	1932 (75.2)	156 (63.7)	<0.001
Fibrate	190 (5.7)	21 (4.2)	163 (6.3)	6 (2.4)	0.011
Other lipid-lowering drugs	156 (4.7)	12 (2.4)	139 (5.4)	5 (2.0)	0.002
Antithrombotic drugs[a]	2759 (85.6)	329 (71.7)	2270 (88.4)	160 (82.1)	<0.001
Anticoagulants[a]	79 (2.5)	12 (2.6)	62 (2.4)	5 (2.6)	0.963
Antiplatelets[a]					
Current use	2750 (85.4)	329 (71.7)	2262 (88.1)	159 (81.5)	<0.001
One kind	2268 (70.4)	295 (64.3)	1849 (72.0)	124 (63.6)	<0.001
More than one kind	482 (15.0)	34 (7.4)	413 (16.1)	35 (17.9)	—
Aspirin	2168 (67.3)	242 (52.7)	1806 (70.3)	120 (61.5)	<0.001
Clopidogrel	715 (22.2)	39 (8.5)	626 (24.4)	50 (25.6)	<0.001
Aspirin + extended release dipyridamole	89 (2.8)	24 (5.2)	58 (2.3)	7 (3.6)	0.001
Dipyridamole	50 (1.6)	2 (0.4)	45 (1.8)	3 (1.5)	0.110
Ticlopidine	70 (2.2)	28 (6.1)	38 (1.5)	4 (2.1)	<0.001
Cilostazol	60 (1.9)	5 (1.1)	51 (2.0)	4 (2.1)	0.416

Values are number (percentage).
CAD = coronary artery disease; CVD = cerebrovascular disease.
[a] 94 patients with a history of hemorrhagic stroke were excluded.

sectional study among 7649 in-hospital CAD patients from 76 centers in 22 European regions, only half of CAD patients achieved BP control, with emphasis on CAD patients with obesity, diabetes, and dyslipidemia.[22] In a cohort study of 12,830 stroke patients in England, only 25.6% of male and 20.8% of female patients received adequate secondary prevention therapies.[23] In the Vitamin Intervention for Stroke Prevention trial, more than half of ischemic stroke patients with LDL-C >100 mg/dL were not on statins.[24] The Lipid Treatment Assessment Project 2 showed that the proportion of patients achieving appropriate LDL-C goals for the patient's level of risk ranged from 47% to 84% across countries, with a level of 67% among the high-risk patients. Moreover, among CAD patients with more than two risk factors, only 30% attained the optional LDL-C goal of <70 mg/dL.[25]

This study also revealed that the target-achieved rates of BP and lipids, and the frequencies of secondary prevention therapy prescription were significantly lower in patients with CVD than in those with CAD. Some previous studies also showed similar findings.[11–14] In the World Health Organization study on the Prevention of Recurrence of myocardial Infarction and StrokE conducted in several developing countries, the prescription rate for antiplatelets, antihypertensives, and statins was lower in patients with CVD than in those with CAD.[11] In the REACH Registry, CVD patients were less likely to receive antihypertensive drugs and attain good BP control than were CAD

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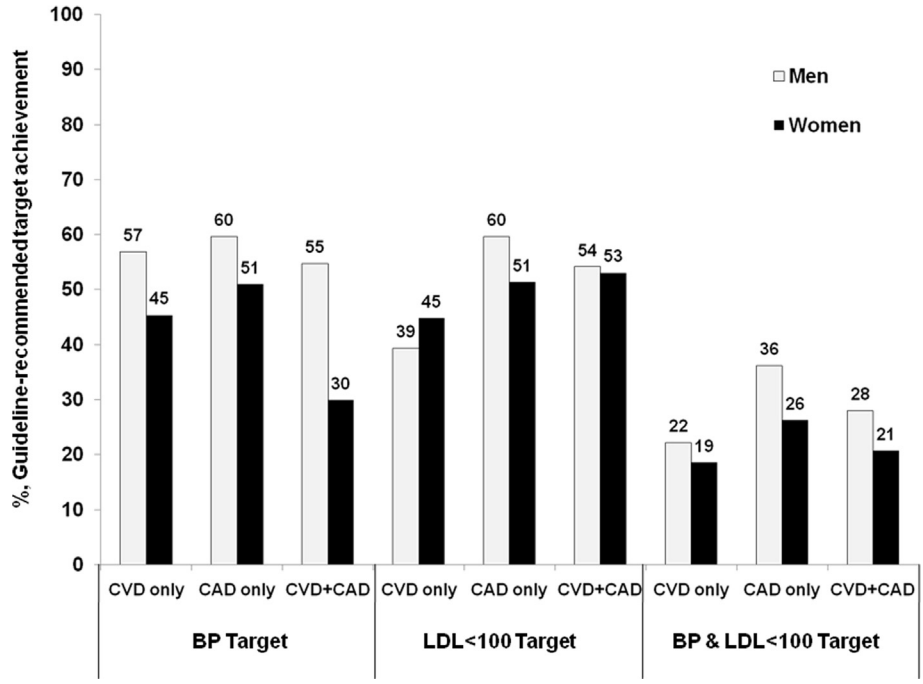

Figure 1 The guideline-recommended BP and LDL target achievement rates by cardiovascular disease category and gender. BP = blood pressure; LDL = low-density lipoprotein; CVD = cerebrovascular disease; CAD = coronary artery disease. The BP target is <140/90 mmHg for nondiabetic patients and <130/80 mmHg for diabetic patients; and the LDL target is LDL cholesterol <2.6 mmol/L (100 mg/dL).

patients.[13] In the Vascular Protection and Guideline-Oriented Approach to Lipid-Lowering registries in Canada, the BP and LDL-C target achievement, and statin and antihypertensive use were approximately 10% lower in patients with CVD than in those with CAD.[12]

The CVD—CAD discrepancy in secondary prevention therapy of cardiovascular diseases can be explained in several ways. First, there are disparities of risk perception between CVD and CAD. Both patients and physicians regarded CAD as a higher risk than CVD, and the risk-scoring was lower in patients than in physicians.[14] Therefore, the management of risk factors and target attainment may be dissimilar. Knowledge of risk factors for stroke and warning signs of stroke is often suboptimal;[26] only 30% of patients

Table 3 Multivariate logistic regression analysis of variables associated with lipid and BP targets achievement.

	LDL target		BP target		LDL and BP targets	
	OR (95% CI)	*p*	OR (95% CI)	*p*	OR (95% CI)	*p*
Age						
<65 years	1.00	—	1.00	—	1.00	—
65—74 years	1.30 (1.10—1.55)	0.002	0.93 (0.79—1.11)	0.428	1.13 (0.94—1.35)	0.194
≥75 years	1.31 (1.09—1.55)	0.003	0.91 (0.76—1.09)	0.289	1.20 (0.99—1.45)	0.062
Women	0.72 (0.61—0.85)	<0.001	0.72 (0.62—0.85)	<0.001	0.65 (0.55—0.78)	<0.001
Diabetes mellitus	1.36 (1.17—1.57)	<0.001	0.38 (0.33—0.43)	<0.001	0.60 (0.52—0.71)	<0.001
Statin use	1.58 (1.34—1.87)	<0.001	—	—	1.37 (1.14—1.65)	0.001
Fibrate use	0.90 (0.66—1.22)	0.483	—	—	0.80 (0.57—1.14)	0.223
Antihypertensive drugs use (more than three kinds)	—	—	0.74 (0.62—0.88)	<0.001	0.80 (0.73—1.05)	0.158
Cardiovascular disease category						
CAD only	1.00	—	1.00	—	1.00	—
CVD only	0.67 (0.55—0.83)	<0.001	0.78 (0.64—0.95)	0.015	0.61 (0.48—0.78)	<0.001
CAD and CVD	0.84 (0.64—1.10)	0.212	0.71 (0.54—0.93)	0.014	0.70 (0.52—0.96)	0.025

The BP target is <140/90 mmHg for nondiabetic patients and <130/80 mmHg for diabetic patients; and the LDL target is LDL cholesterol <2.6 mmol/L (100 mg/dL).
BP = blood pressure; CAD = coronary artery disease; CI = confidence intervals; CVD = cerebrovascular disease; LDL = low-density lipoprotein; OR = odds ratio.

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recognized transient ischemic attack and minor stroke immediately after stroke in a population-based study of behavior.[27] Second, stroke comprises heterogeneous etiologies, and the approach to management may be differential depending on the etiology. Statins, for example, are recommended for use in patients with atherosclerotic ischemic stroke or transient ischemic attack,[20] but it is arguable whether statins should be routinely used in every CVD patient, including nonatherosclerotic diseases such as dissection of small artery lacune.[28] Third, the choice of antihypertensive agents in CAD patients should not depend only on BP status. According to the American Heart Association guideline, patients with coronary and other atherosclerotic vascular disease who have BP >140/90 mmHg should be treated initially with β-blockers and/or angiotensin-converting enzyme inhibitors; and patients with heart failure should consider the use of β-blockers, angiotensin-converting enzyme inhibitors, and/or angiotensin receptor blockers.[4] However, in guidelines for stroke prevention, the optimal antihypertensive drug regimen to achieve the recommended level of BP reduction is uncertain.[20] As a result, our study also showed β-blockers and angiotensin-converting enzyme inhibitors were more likely to be prescribed in patients with CAD than in those with CVD.

The present study showed a gender difference of target achievement. Women with CVD and/or CAD were less likely to receive secondary prevention therapies, and reach the guideline-recommended targets. Previous studies have also demonstrated that women were less likely to receive secondary prevention therapies.[16,17] According to the Get With The Guidelines-Stroke, the quality of care for women with acute ischemic stroke was lower than that for men.[29] Gender difference of the medication may be explained by older age, greater comorbidity, and higher stroke severity in women.[30] Elderly CVD patients were substantially less likely to receive secondary prevention after a stroke, especially the lipid-lowering drugs.[23]

This study has several limitations. First, this study's patients were recruited mainly from the departments of cardiology and neurology of the teaching hospitals, unlike the case in some studies where the patient source was mainly from the general practitioners. Although the results from this study may have the problem of generalizability of our results, in Taiwan there was little restriction of patients' assessment to hospitals, and patients often continued their outpatient clinics management at the same hospitals where they were hospitalized for the major diseases. Second, it is likely that patients with severe stroke with ambulation difficulty may have restricted their presentation to an outpatient clinic and hence to inclusion in the study. It is possible that an overestimation of medication use in CVD patients occurred in this study. The disparity of medication between CAD and CVD patients may be even wider than shown here. Third, we had no detailed information about patients' compliance and duration of secondary prevention therapies, contraindication or reasons for discontinuing some medications, and lifestyle modifications. The information about each participant was obtained from direct medical records and interviewing, and will be followed up periodically. The validity of these data is high. Fourth, there were disproportionately fewer CVD patients than CAD patients in this study, as compared with the real-world prevalence of CVD and CAD in Taiwan population, owing to cardiologists comprising the majority of the T-SPARCLE Registry investigators. It is mandatory to recruit more CVD patients in this ongoing registry for better representation of cardiovascular diseases in Taiwan.

In conclusion, the guideline-recommended medication and target achievement among patients with cardiovascular diseases are still suboptimal. Greater efforts are required to direct health-care professionals and patient education, and awareness and adherence to guidelines, particularly in patients with CVD and in women.

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