Trends in blood pressure, blood lipids, and smoking from 259 753 patients with hypertension in a Swedish primary care register: results from QregPV

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Aims
To describe 8-year trends in blood pressure (BP) control, blood lipid control, and smoking habits in patients with hypertension from QregPV, a primary care register in the Region of Västra Götaland, Sweden.

Methods and results
QregPV features clinical data on BP, low-density lipoprotein cholesterol (LDL-C), and smoking habits in 392 277 patients with hypertension or coronary heart disease or diabetes mellitus or any combination of the three diagnoses. Data from routine clinical practice have been automatically reported on a monthly basis to QregPV from all primary care centres in Västra Götaland (population 1.67 million) since 2010. Additional data on diagnoses, dispensed drugs and socioeconomic factors were acquired through linkage to regional and national registers. We identified 259 753 patients with hypertension, but without coronary heart disease and diabetes mellitus, in QregPV. From 2010 to 2017, the proportion of patients with BP <140/90 mmHg increased from 38.9% to 49.1%, while the proportion of patients with LDL-C <2.6 mmol/L increased from 19.7% to 21.1% and smoking decreased from 15.7% to 12.3%. However, in 2017, only 10.0% of all patients with hypertension had attained target levels of BP <140/90 mmHg, LDL-C <2.6 mmol/L, while being also non-smokers. The remaining 90.0% were still exposed to at least one uncontrolled, modifiable risk factor for cardiovascular disease.

Conclusions
These regionwide data from eight consecutive years in 259 753 patients with hypertension demonstrate a large potential for risk factor improvement. An increased use of statins and antihypertensive drugs should, in addition to lifestyle modifications, decrease the risk of cardiovascular disease in these patients.

Keywords
Hypertension • Low-density lipoprotein cholesterol • Smoking • Primary healthcare

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Introduction

Hypertension, high cholesterol, and smoking remain important cardiovascular risk factors. Adequate blood pressure (BP) control decreases the risk of stroke, myocardial infarction, and cardiovascular death in patients with hypertension, regardless of coexisting coronary heart disease or diabetes mellitus. Reduced smoking and cholesterol also decrease cardiovascular disease burden. Control of cardiovascular risk factors, including BP control, have broadly improved in the last decade in patients with hypertension in population-based samples. Although most patients with hypertension are managed in primary healthcare, clinical data on trends of risk factors in patients with hypertension treated and identified via primary healthcare are scarce.

QregPV is a Swedish, regional primary-care quality register, which since 2010 comprises clinical, longitudinal data that include BP, cholesterol, and smoking status. In this article, we present 8-year trends in BP control, blood lipid control, and smoking habits in patients with hypertension, but without coronary heart disease and diabetes mellitus, from QregPV while also describing the demographics of the patient population and the linkage to national and regional registers used for this study.

Methods

Setting

The Region of Västra Götaland has 1.67 million inhabitants (2017), the second largest population of all counties in Sweden, with both urban and rural residential areas. All regions in Sweden provide universal, low-cost health care and medical treatment for all residents. All primary care centres in Västra Götaland report to QregPV, which thus includes all public and private primary care in the region.

QregPV

QregPV is a register for primary care, ‘PrimärVård’ in Swedish, founded in 2006 as a tool for quality assurance. It comprises patients with five common chronic diseases: hypertension, diabetes mellitus, coronary heart disease, chronic obstructive pulmonary disease, and asthma. The register contains information about several risk factors: smoking status, weight, height, body mass index (BMI), BP, total cholesterol, low-density lipoprotein cholesterol (LDL-C), glycated haemoglobin A1c (HbA1c), and waist circumference. It also contains spirometry data. All data are collected from routine clinical practice. QregPV also contains information about age, sex, current primary care centre, and geographical district of any included patient. Patients with hypertension, diabetes mellitus, coronary heart disease, chronic obstructive pulmonary disease, and asthma are identified by a data extraction tool through their diagnosis codes according to the International Statistical Classification of Diseases and Related Health Problems-Tenth Revision (ICD-10), which are registered in primary-care electronic health records. Only the three first positions of the ICD-10 code are used (110–115 for hypertension; I20–I25 for coronary heart disease; E10–E14 for diabetes mellitus; J44 for chronic obstructive pulmonary disease; and J45 for asthma). All patients with any of these diagnoses registered in their electronic health record the last 900 days, prior to the date of data extraction, are included in QregPV. Data extraction occurs automatically once every month. For all patients included in QregPV, the data extraction tool then collects risk factor information from the electronic health record. For some variables, there are limits of exclusion beyond which data are not collected, see Supplementary material online, Table S1. If data on risk factors are available from more than one day in a month, only the last value is extracted.

Linking QregPV to other registers

For the purpose of the present study, patient data from QregPV was linked to individual data from national registers using the unique personal identity number assigned to all permanent residents of Sweden, see Figure 1. The National Board of Health and Welfare manages the National Patient Register, the Cause of Death Register, and the Swedish Prescribed Drugs Register. In short, the National Patient Register keeps data on diagnoses and procedures from all inpatient care since 1987 and hospital-based outpatient appointments since 2001; the Cause of Death register holds information on all deaths in Sweden; and the Swedish Prescribed Drug Register carries data on all dispensed prescription drugs in Sweden since July 2005. We obtained socioeconomic data on income, education, civil status and country of birth from the Longitudinal Integrated Database for Health Insurance and Labour Market Studies (LISA), which is managed by Statistics Sweden. Data from QregPV were also linked to data from the Regional Administrative Healthcare Database (Vega), which comprises data about diagnoses, procedures, dates, type of healthcare professional visits, and primary care centre enrolment from all primary healthcare appointments in the Region of Västra Götaland since 2000. The data linkage was performed by the National Board of Health and Welfare, which also replaced all personal identity numbers of the data file with anonymous serial numbers after completed linkage.

Ethics

Notices in the primary healthcare centres of the Region of Västra Götaland inform patients that their data may be uploaded to QregPV and provide a link to its homepage: qregpv.se. Via the homepage, patients can request a copy of their information in QregPV. Patients may at any time request to withdraw all their information from QregPV. The Regional Ethical Review Board at the University of Gothenburg approved this study (registration number 1062-15) and the linkage of QregPV data to national and regional registers.

Study population

The study population was a dynamic cohort which comprised all patients with hypertension, but without coronary heart disease and diabetes mellitus, and recorded measurements in primary care in the Region of Västra Götaland in consecutive years from 2010 to 2017. This article describes longitudinal risk factor trends in BP, LDL-C, and smoking. Hypertension was defined as an ICD-10 hypertension diagnosis in QregPV (I10–I15). Patients with a diagnosis of coronary heart disease (I20–I25) or diabetes mellitus (ICD E10–E14) were thus excluded from the hypertension study population. In addition, this article presents demographics at the month of inclusion into QregPV for all patients with hypertension (ICD 110–115), coronary heart disease (ICD I20–I25), and diabetes mellitus (ICD E10–E14). We omitted 27 serial numbers from the study population, because of erroneous input of personal identity number at some point in the data process.

Variables

Data on BP, LDL-C, smoking status, weight, height, BMI (calculated as weight in kg divided by height in metres squared), and HbA1c were collected in routine clinical practice, registered in electronic health records and obtained through QregPV. Measurements of BP were performed according to guidelines at hypertension-related clinical visits. Blood pressure recorded in QregPV also comprises measurements at clinical visits.
not related to hypertension. If multiple measurements of a variable were available in the same year, the last registered was used. Diagnostic data on whether hypertension, coronary heart disease, or diabetes mellitus was present were also obtained from QregPV, as were data on age and sex. We defined other baseline comorbidities of interest as the presence of selected ICD-10 diagnoses from the National Patient Register or Vega before the date of inclusion in QregPV. Baseline comorbidities were defined as: cerebrovascular disease (I60–I69, G45); heart failure (I50); atrial fibrillation/flutter (I48); peripheral artery disease (I70–I74); chronic obstructive pulmonary disease (J44); dementia (F00–03, G30); and cancer (C00–C97). Civil status was categorized as single, married, divorced or widowed. Educational level was categorized as low (9 years or less of education), medium (9–12 years), or high (12 years or more). Disposable income in Swedish kronor (1 $≈ 8 kronor in January 2021) was defined as total annual income after subtraction of taxes. For the socioeconomic variables, we used the last available value prior to inclusion in QregPV. We defined the following drug classes according to the Anatomical Therapeutic Chemical (ATC) Classification System: thiazide diuretics (C03A, C03B, C03EA, C09BA, C09DA); calcium-channel blockers (CCBs) (C07FB02, C08CA, C09BB, C09DB); beta-blockers (BBs) (C07); angiotensin-receptor blockers (ARBs) (C09C, C09D); angiotensin-converting-enzyme inhibitors (C09A, C09B); mineral-receptor antagonists (C03DA); and statins (C10AA, C10AX, C10BA). Use of a drug class for a calendar year was defined as at least one dispensed prescription of a drug in that class. We defined the number of antihypertensive drugs used per patient in a calendar year as the number of different drug classes dispensed in the same year. Blood pressure, LDL-C, and smoking were the risk factors of interest. Target BP was defined as BP <140/90 mmHg, which was the broadly recommended BP target in 2017. Target LDL-C was defined as <2.6 mmol/L, which was the recommended LDL-C target for patients with high risk of cardiovascular disease in 2017. Target smoking status was defined as non-smoking. Annual proportions of controlled BP and LDL-C and of smokers were calculated in patients with records of the respective variables. We also calculated annual proportions of at least one; at least two; or three controlled risk factors. In the calculation of these annual risk factor proportions, only patients with all three risk factors recorded in a year were included. The age-specific proportions of patients with hypertension in the Region of Västra Götaland were defined as the number of patients with hypertension, per age group, divided by the total number of inhabitants of Västra Götaland, per age group, in the year 2017. Age-specific population data for Västra Götaland were obtained from Statistics Sweden.

**Statistical analysis**

The primary analyses were descriptive. We used mean or median as measures of central tendency for continuous variables, depending on the distribution of the variable. Standard deviation or interquartile range was used as measures of spread. Categorical variables are presented in absolute (n) and relative frequency (%). We calculated 95% confidence intervals (95% CIs) for the point estimates of mean BP and LDL-C and for the proportions of patients who attained BP <140/90 mmHg.
BP ≤140/90 mmHg, LDL-C < 2.6 mmol/L, and for smokers from 2010 to 2017. We also performed secondary regression analyses, adjusted for age and sex, to model the effect of risk factor change by year. Linear and logistic mixed-effect models were used to account for repeat measurements in the same individuals. In the analysis of systolic blood pressure (SBP), we also included year as a quadratic term to account for non-linearity. All analyses were performed with R, version 4.0.3.17

Results

Demographics and data completeness of all patients in QregPV

In 2017, QregPV comprised 392,777 patients with a diagnosis of hypertension, coronary heart disease, or diabetes mellitus. Demographics of these patients are presented in Supplementary material online, Table S2. The mean age was 66.0 ± 13.7 years and women constituted 50.3%. A majority, 79.9%, were included because of hypertension. Diabetes mellitus was present in 21.4% and coronary heart disease in 15.4% of patients. Other common comorbidities on inclusion comprised cancer, 14.8%; atrial fibrillation/flutter, 8.6%; and heart failure, 7.0%. The most common education length was >9–12 years, completed by 41.5%, and 52.9% were married.

In total, 949,120 measurements of SBP were recorded. At least one measurement of SBP was recorded from 2010 to 2017 in 380,535 patients (97%). Registration of data at any point for other risk factors was lower: weight 83.2%; LDL-C 76.1%; height 53.4%; and HbA1c 40% (see Supplementary material online, Table S1).

Patients with hypertension

We identified 259,753 patients with hypertension, i.e. without coronary heart disease or diabetes mellitus, see Figure 1. Patients with hypertension constituted 14.7% of the inhabitants of the Region of Västra Götaland. The highest number, in absolute terms, of individuals with hypertension was recorded at the age of 64 years, while the highest prevalence of hypertension was seen among persons aged 84, where 50% were diagnosed with hypertension, see Figure 2. The number of patients with hypertension who had a variable recorded at a visit to a primary care centre increased from 109,663 in 2010 to 145,903 in 2017, see Table 1. Mean SBP decreased from 140.5 mmHg (95% CI 140.4–140.6 mmHg) in 2010 to 137.1 mmHg (95% CI 137.0–137.1 mmHg) in 2014, and then increased slightly to 137.6 mmHg (95% CI 137.5–137.7 mmHg) in 2017. Mean LDL-C changed little during the period, with all annual means in the 3.38–3.44 mmol/L interval. Slightly higher LDL-C levels were observed in women. There were no discernible differences in SBP and LDL-C trends over time between men and women, see Figure 3. Terminal digit preference was present for SBP measurements, with values ending in 0 or 5 being overrepresented, see Supplementary material online, Figure S1.

Risk factor trends

The proportion of patients with hypertension who attained the target BP of <140/90 mmHg increased from 38.9% in 2010 to 49.1% in 2017. Considering terminal digit preference, if target BP had included SBP and diastolic blood pressure of 140 and 90 mmHg, respectively (i.e. a target of <140/90 mmHg), there would instead be an increase in well-controlled BP from 56.2% in 2010 to 63.1% in 2017. Both measures are shown in Figure 4. The proportion of patients with LDL-C <2.6 mmol/L increased from 19.7% in 2010 to 21.1% in 2017.

Figure 2 Frequency of hypertension in the Region of Västra Götaland in 2017. Bar plot of the total population of the Region of Västra Götaland (RVG, grey bars) and patients with hypertension (HTN, red bars) in the Region of Västra Götaland in numbers (left y-axis), by age. In addition, the line plot shows the proportion of individuals in the Region of Västra Götaland with hypertension (right y-axis), by age.
Table 1  Longitudinal data on risk factors and drug use in patients with hypertension 2010–2017

| 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|------|------|------|------|------|------|------|------|
| **Patients with recorded variables, n** | 109 663 | 123 421 | 128 853 | 133 798 | 136 358 | 136 303 | 140 891 | 145 903 |
| Age, years (SD) | 67.7 (12.6) | 67.7 (12.7) | 67.9 (12.6) | 68.0 (12.6) | 68.3 (12.6) | 68.5 (12.6) | 68.6 (12.6) | 68.7 (12.7) |
| Female sex, n (%) | 63 888 (58.3%) | 71 417 (57.9%) | 74 085 (57.5%) | 76 568 (57.2%) | 77 899 (57.1%) | 77 575 (56.9%) | 79 751 (56.6%) | 82 428 (56.5%) |
| SBP, mmHg (SD) | 140.5 (17.0) | 138.9 (16.3) | 138.1 (15.8) | 137.6 (15.8) | 137.1 (15.6) | 137.6 (15.7) | 137.4 (15.6) | 137.6 (15.7) |
| SBP measurements, n (%) | 97 248 (88.7%) | 112 930 (91.5%) | 119 250 (92.5%) | 123 949 (92.6%) | 125 491 (92%) | 123 907 (90.9%) | 122 927 (87.2%) | 123 418 (84.6%) |
| LDL-C, mmol/L (SD) | 3.38 (0.940) | 3.39 (0.955) | 3.40 (0.952) | 3.35 (0.951) | 3.40 (0.971) | 3.43 (0.986) | 3.44 (0.997) | 3.38 (0.988) |
| LDL-C measurements, n (%) | 39 441 (36%) | 49 607 (40.2%) | 52 614 (40.8%) | 63 757 (47.7%) | 66 392 (48.7%) | 68 231 (50.1%) | 71 348 (50.6%) | 78 464 (53.8%) |
| Smoker, n (%) | 3592 (15.7) | 8749 (14.1) | 10 015 (13.6) | 10 764 (13.3) | 11 075 (12.9) | 11 101 (13.2) | 10 008 (12.5) | 10 615 (12.3) |
| Smoking data, n (%) | 22 835 (20.8%) | 61 941 (50.2%) | 73 455 (57%) | 80 913 (60.5%) | 85 857 (61.5%) | 83 858 (63%) | 80 088 (56.8%) | 86 389 (59.2%) |
| ≥1 risk factor controlled, n (%) | 9502 (92.3%) | 29 637 (93.9%) | 36 159 (94.1%) | 45 690 (94.6%) | 48 666 (94.8%) | 48 257 (94.6%) | 46 252 (95%) | 49 275 (95.3%) |
| ≥2 risk factors controlled, n (%) | 4724 (45.9%) | 15 677 (49.6%) | 19 467 (50.6%) | 25 463 (52.7%) | 27 375 (53.3%) | 26 942 (52.8%) | 26 386 (54.2%) | 28 436 (55%) |
| 3 risk factors controlled, n (%) | 835 (8.1%) | 2776 (8.8%) | 3412 (8.9%) | 4769 (9.9%) | 4906 (9.4%) | 4806 (9.6%) | 4806 (9.4%) | 5186 (10%) |
| Complete risk factor data, n (%) | 10 292 (9.4%) | 31 576 (25.6%) | 38 435 (29.8%) | 48 312 (36.1%) | 51 319 (37.6%) | 50 316 (37.4%) | 48 672 (34.5%) | 51 725 (35.5%) |
| Antihypertensive use, n (%) | 102 105 (93.1%) | 114 123 (92.7%) | 119 470 (92.7%) | 124 601 (93.1%) | 127 705 (93.7%) | 128 056 (93.9%) | 132 294 (93.9%) | 136 917 (93.8%) |
| Antihypertensive drugs, n (SD) | 1.89 (1.08) | 1.85 (1.08) | 1.85 (1.07) | 1.86 (1.07) | 1.86 (1.06) | 1.86 (1.04) | 1.85 (1.03) | 1.85 (1.04) |
| Thiazide diuretic use, n (%) | 40 490 (36.9%) | 43 240 (35%) | 44 062 (34.2%) | 44 468 (33.2%) | 43 942 (32.2%) | 42 535 (31.2%) | 42 542 (30.2%) | 42 810 (29.3%) |
| Calcium-channel blocker use, n (%) | 40 434 (36.9%) | 45 816 (37.1%) | 49 310 (38.3%) | 52 152 (39%) | 53 387 (39.2%) | 54 106 (39.7%) | 56 693 (40.2%) | 59 855 (41%) |
| Beta-blocker use, n (%) | 47 015 (42.9%) | 50 303 (40.8%) | 50 856 (39.5%) | 51 499 (38.5%) | 51 729 (37.9%) | 50 409 (37.0%) | 50 872 (36.1%) | 51 196 (35.1%) |
| Angiotensin-receptor blocker use, n (%) | 27 118 (24.7%) | 32 577 (26.4%) | 37 208 (28.9%) | 42 216 (31.6%) | 45 737 (33.5%) | 48 677 (35.7%) | 52 926 (37.6%) | 57 118 (39.1%) |
| ACE inhibitor use, n (%) | 36 849 (33.6%) | 40 261 (32.6%) | 41 057 (31.9%) | 41 757 (31.2%) | 41 802 (30.7%) | 40 616 (29.8%) | 40 800 (29%) | 41 215 (28.2%) |
| Mineral-receptor antagonist use, n (%) | 3169 (2.9%) | 3511 (2.8%) | 3561 (2.8%) | 3705 (2.8%) | 3959 (2.9%) | 3907 (2.9%) | 4142 (2.9%) | 4432 (3.0%) |
| Statin use, n (%) | 30 841 (28.1%) | 33 436 (27.1%) | 34 741 (27.0%) | 36 564 (27.3%) | 37 666 (27.6%) | 38 206 (28.0%) | 40 307 (28.6%) | 42 234 (28.9%) |

Variables are presented with mean (standard deviation) or count (%).
ACE, angiotensin-converting enzyme; LDL-C, low-density lipoprotein cholesterol; SBP, systolic blood pressure.
The LDL-C values can be converted from mmol/L to mg/dL through division by 0.02586.
*aThis dynamic cohort study comprised 239 753 unique patients, but not every patient had a variable recorded in each year. The number of patients with recorded variables per year is thus lower than the total number of unique patients.*
The proportion of smokers decreased from 15.7% in 2010 to 12.3% in 2017. From 2010 to 2017, the proportion of patients with at least one controlled risk factor increased from 92.3% to 95.3%; those with at least two controlled risk factors increased from 45.9% to 55.0%; and the proportion of patients who reached both BP <140/90 mmHg and LDL-C <2.6 mmol/L and were non-smokers increased from 8.1% to 10.0%, see Table 1. Control of BP and LDL-C was lower in patients who were overweight or obese, see Supplementary material online, Table S3.

Use of antihypertensive drugs and statins
Antihypertensive drug use and mean number of antihypertensive drugs per patient remained more or less constant from 2010 to 2017, see Table 1. The use of different drug classes from 2010 to 2017 is shown in Figure 5. The largest increases were observed in ARBs, which increased from 24.7% to 39.1%, and CCBs, which increased from 36.9% to 41.0%. Conversely, the largest decreases were observed in BBs, which decreased from 42.9% to 35.1%, and thiazide diuretics, which decreased from 36.9% to 29.3%. Statin use stayed essentially unchanged from 2010 to 2017.

Secondary analyses
The associations between year and changes in SBP, LDL-C, control of BP, control of LDL-C, and smoking were statistically significant (P-value < 0.001) in mixed model regression analyses, which were adjusted for age and sex.

Discussion
This article describes 8-year risk factor trends in 259 753 patients with hypertension. The main findings were improved BP control, which increased from 38.9% to 49.1% from 2010 to 2017; slightly improved LDL-C control, which increased from 19.7% to 21.1%; and decreased smoking, which fell from 15.7% to 12.2%. Despite these improvements, only 10.0% of all patients with hypertension attained BP <140/90 mmHg and LDL-C < 2.6 mmol/L and who are smokers, by year. The remaining 90.0% were still exposed to one or more uncontrolled modifiable risk factors for cardiovascular disease. Additionally, although BP control improved, the mean SBP actually increased slightly from 2014 to 2017 (137.1 to 137.6 mmHg). The mean LDL-C was essentially unchanged (3.4 mmol/L) from 2010 to 2017. Several population-based studies have also described a decrease in BP in high-income countries during the last decades.6–8,18 Previous data from primary care show the same trend in BP.19,20 Our results also show an overall decrease in SBP from 2010 to 2017, albeit with a slight increase during the last three years. This possible trend towards higher SBP after 2014 is discernible in American population-based data as well. The decrease in smoking rates, too, is similar to that observed in the USA.2 Smoking is, however, less common in Sweden than in many other high-income countries, which has largely been attributed to the widespread use of smokeless tobacco (snus).21Unlike in the referenced studies, there was little or no difference in
SBP between men and women. Our analyses, however, were not age-standardized and the women in our material were 3.5 years older than men, which may account for the lack of difference in SBP, since SBP rises with age. Our figures on BP control, proportion of women and statin use were similar to data of patients with antihypertensive treatment in the EUROASPIRE V primary-care survey, although our patients were older, smoked less frequently and featured a far lower proportion with LDL-C <2.6 mmol/L.22

A major difference between our study and population-based cohort studies is how data are collected. Population-based surveys allow for stringent data collection and high internal validity. By contrast, register data are collected in real patients who visit primary healthcare for any reason. This has implications for comparisons of variables, such as BP, which may be affected by emotions such as pain or anxiety, which are likely to be more commonplace in primary care than in population-based studies. Consequently, there may be systematic differences in measurements between population-based studies and clinical practice. Diagnoses and medications are also defined differently. Population-based surveys often employ self-reporting of comorbidities and drug treatment. Our diagnosis data, instead, come from ICD 10-diagnoses determined by health care professionals and our drug data are based on dispensed prescriptions.

The decrease in smoking and the increase in BP control (49.1% in 2017) are linked to the decreasing incidence of myocardial infarction and stroke, which began in the early 1980s. This large decrease in cardiovascular incidence was driven by progress in smoking cessation and lifestyle modifications that have resulted in reductions of risk factors, including hypertension and cholesterol.23 Both the rate of decrease of SBP and the rate of decrease in cardiovascular incidence may now be attenuating.9,19,24–26

As for BP treatment, the mean number of antihypertensive drugs per patient stayed more or less the same when comparing 2010 to 2017 (1.89 to 1.85) and was barely higher than the 1.8 antihypertensive drugs per patient observed 10 years prior in another primary care cohort in Sweden.20 In the Systolic Blood Pressure Intervention Trial (SPRINT), the intervention group used 2.8 drugs per patient, had 14.8 mmHg lower SBP and suffered a lower rate of cardiovascular disease compared to the control group, which used 1.8 drugs per patient.27 Regardless of the BP measurement debate that surrounded SPRINT,28 it is worth noting that the mean number of antihypertensive drugs per patient in the control group was similar to the number

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**Figure 5** Drug class use from 2010 to 2017. Proportion of use of antihypertensive drugs and statins in patients with hypertension, by year. ACEi, angiotensin-converting enzyme inhibitor; ARB, angiotensin-receptor blocker; BB, beta-receptor blocker; CCB, calcium-channel blocker; MRA, mineral-receptor antagonist.
in our study. Several other key baseline demographics (age, SBP, cholesterol, and frequency of current smokers) were also very similar to that of the study population in SPRINT, although manifest cardiovascular disease was much more common in the trial.

As mentioned, the proportion of patients (~28%) who used statins was similar to that in the EUROASPIRE V primary-care survey. Statin use, surprisingly, changed little from 2010 to 2017. This was unexpected, considering the patent expirations of atorvastatin and rosuvastatin during this period. It is possible that the 2012 recalibration of the SCORE system, after which fewer patients from Sweden and several other countries met the criteria for high risk, affected statin prescription. Patient perceptions of statins likely also play a role, although this may be more of a global phenomenon.

The use of CCB and ARB increased from 2010 to 2017. Although use of ACEi decreased, the overall use of renin-angiotensin-system blockers still increased because of the rise in ARB use. Thiazide diuretic use and BB use also decreased. Data from older British patients in primary care show similar trends, with the exception of BB use, which increased in their material.

The marked difference in the relative frequencies for SBP <140 and SBP ≤140 mmHg is in large part due to terminal digit preference, previously described in primary care. This means that an SBP of exactly 140 mmHg in QregPV should in part be interpreted as a label for real SBP values in the 135–144 range. The increasing use of electronic, semi-automatic sphygmomanometers is likely to decrease the occurrence of terminal digit preference.

Strengths and limitations

The major strengths of QregPV are its large size; the unbiased inclusion of all patients with hypertension, coronary heart disease and diabetes mellitus in primary care in an entire region of Sweden; the longitudinal data on important clinical variables; and the linkage to national and regional registers with excellent coverage of data on comorbidities, dispensed drugs and socioeconomic factors.

QregPV also has important limitations: first, all variables were recorded as part of routine clinical practice in over 200 different primary care centres. The measurement of variables, such as BP, was not formally standardized and there may be systematic differences in measurement between primary care centres. Second, because patients in QregPV are identified through ICD-10 diagnoses from primary care, valid diagnoses are important. ICD-10 diagnoses for hypertension and diabetes mellitus have proven valid in primary care, but diagnoses of coronary heart disease are less accurate. Third, the large frequency of missing data on smoking status and LDL-C limit the internal validity of our study. If these data are not missing at random, estimates that involve these risk factors may not be representative for the studied population. Unfortunately, the large frequency of missing data on height—which should be easy to measure—limits our ability to assess BMI, which also is an important risk factor for cardiovascular disease. Additionally, the high proportion of missing data on HbA1C may contribute to misclassification of patients with diabetes as not having diabetes. Fourth, we defined drug treatment as drug dispensing. This may result in misclassification errors in patients who collect medications, but do not take them as prescribed.

Conclusion

If further decrease in myocardial infarctions and stroke is desirable, then better risk factor control is needed. In this study, the most prevalent risk factors were suboptimal LDL-C (78.9%) and uncontrolled SBP (50.9%). From a public health perspective, there is thus great potential to further reduce the burden of cardiovascular disease by improving control of these risk factors. Previous work from QregPV has shown that intensified statin treatment might aid the reduction of that burden. In our population, only 29% of patients were on statins. Only 10% of the patients without statin treatment reached LDL-C 2.6 mmol/L (data not shown), which suggests that more widespread statin use may be helpful in reducing LDL-C and cardiovascular disease in primary care. The higher use of antihypertensive drugs in the intervention group of SPRINT, which lead to a lower rate of cardiovascular disease, suggests that more ambitious use of antihypertensive drugs in patients in Swedish primary care would also lead to less cardiovascular disease and death. Previous data from QregPV also suggest that older patients without previous cardiovascular disease may benefit from more ambitious antihypertensive treatment. In addition to pharmacological treatment of patients with hypertension, primary care also plays an important role in promoting lifestyle modifications that lead to smoking cessation, regular exercise, weight control, and a healthy diet—all key components in decreasing cardiovascular disease burden.

In summary, these region-wide data over an 8-year period from 259 753 patients with hypertension, but without coronary heart disease and diabetes mellitus, show a large potential for risk factor improvement. Only 10.0% of patients reach BP <140/90 mmHg and LDL-C <2.6 mmol/L and are non-smokers. Striving for an increased use of statins and antihypertensive drugs should decrease cardiovascular risk in these patients with hypertension and in similar populations elsewhere.

Supplementary material

Supplementary material is available at European Journal of Preventive Cardiology online.

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