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The relationship of socioeconomic factors to the use of preventative cardiovascular disease medications: A prospective Australian cohort study

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ABSTRACT

Cardiovascular disease (CVD) events are highly preventable through appropriate treatment and disproportionally affect socioeconomically disadvantaged individuals. This study quantified the relationship of socioeconomic factors to dispensing and persistent use of lipid- and blood pressure-lowering medication following hospital admission for a major CVD event (myocardial infarction, ischaemic stroke/transient ischaemic attack). Data from 8285 people with such events aged ≥45 years from the Australian 45 and Up Study with linked medication data were used to estimate relative risks (RRs) for combined lipid- and blood pressure-lowering dispensing at three-months following hospital discharge and for 12-month persistent use, in relation to education, income, and level of medication subsidisation. Overall, 56% were dispensed guideline-recommended medications at three months and 37% persistently used them across 12 months. After adjusting for demographic factors, type of CVD and history of CVD hospitalisation, RRs for lowest (no educational qualifications) compared to highest education level (university degree) were 1.14 (95% CI: 1.06, 1.22) for medication dispensing and 1.15 (1.02, 1.29) for persistent medication use; 1.14 (1.06, 1.22) and 1.17 (1.04, 1.32) respectively for lowest (<$20,000) versus highest (≥$70,000) household pre-tax income; and 1.25 (1.17, 1.33) and 1.28 (1.15, 1.43) respectively for those receiving highest versus lowest subsidisation. There was little to no evidence of a relationship of income and education to medication use after adjustment for medication subsidisation. While preventive medication use is sub-optimal, subsidisation is substantially associated with increased use and accounts for most of the relationship with socioeconomic position, suggesting subsidy schemes are working in the intended direction.

1. Introduction

Cardiovascular disease (CVD), the global leading cause of death and a leading contributor to the burden of disease (Naghavi et al., 2017), is highly preventable (Cholesterol Treatment Trialists' C et al., 2010; Xie et al., 2016). Risk of CVD events can be lowered through the control of risk factors, including smoking, high cholesterol levels, high blood pressure and obesity (Chiuve et al., 2011; Chiuve et al., 2006). Preventive medications play a central role in treating people with existing atherosclerotic CVD or who are at high risk of a primary CVD event. Lipid-lowering medications such as statins, blood pressure-lowering medications such as ACE inhibitors and beta-blockers, and antithrombotic medications such as antiplatelet medications are generally recommended following myocardial infarction (MI), ischaemic stroke or transient ischaemic attack (TIA) to lower the risk of future events (Chew et al., 2016; National Heart Foundation of Australia and the Cardiac Society of Australia and New Zealand., 2012; National Stroke Foundation, 2010). However, there are large shortfalls in the use of preventive medications. In Australia, in 2011–12 approximately 44% of people with broadly defined CVD were using both lipid- and blood pressure-lowering medications and 21% were using neither (Banks et al., 2016).

The extent to which variation in the use of preventive medications are related to socioeconomic factors, such as education and income is

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unclear. Previous studies in Australia have shown an inverse association between socioeconomic position and preventive CVD medication use, with people of lower socioeconomic position generally being more likely to use guideline-recommended medications than those of high socioeconomic position (Stocks et al., 2009; Stocks et al., 2004; Paige et al., 2018). In contrast, results from international studies have varied, showing either no association (Reid et al., 2002; Simpson et al., 2005; Thomsen et al., 2005) or that people of higher socioeconomic position are more likely to use some preventive CVD medications (Hyun et al., 2017). Previous studies have used a variety of measures of socioeconomic position from area-level disadvantage (Stocks et al., 2009; Stocks et al., 2004; Simpson et al., 2005; Hyun et al., 2017), occupation (Reid et al., 2002; Thomsen et al., 2005), education (Paige et al., 2018; Reid et al., 2002), neighbourhood income (Hyun et al., 2017) and individual-level income (Hyun et al., 2017). Differences in these previous studies also likely reflect differences in health care systems between countries.

Previous studies have shown that in countries with medication subsidisation or reimbursement schemes, continued use of medications tends to be higher among people paying the lowest out-of-pocket costs per medication (McRae et al., 2017; Despres et al., 2016; Knott et al., 2015). In Australia, socioeconomically disadvantaged individuals (i.e. those with low income and pensioners/seniors) are eligible for cheaper medications through Australia's medication subsidisation scheme, the Pharmaceutical Benefits Scheme (PBS). However, we lack large-scale local data on both the relation of medication subsidisation to the use of preventive medications following a major CVD event and the role of medication subsidisation on the relationship between socioeconomic position and CVD preventive medication use. Such evidence is needed to inform policy on interventions to improve use of CVD medications and reduce burden of CVD in the population.

In this study we quantified the association between socioeconomic factors — education, income, and medication subsidisation, separately — and use of CVD preventive medications following a major CVD event, and the extent to which any observed relationship between education or income and medication use was explained by medication subsidisation.

2. Methods

2.1. Study population

We used data from participants in the Sax Institute's 45 and Up Study, a population-based cohort involving 267,153 men and women from New South Wales (NSW), Australia. The baseline questionnaire for this study was sent to participants between January 2006 and December 2009. Participants gave signed consent for follow-up and linkage of their information to routine health databases. The study has been described in detail elsewhere (45 and Up Study Collaborators, 2008). Briefly, participants in the Study were randomly sampled from the Services Australia (formerly the Australian Government Department of Human Services) Medicare enrolment database, which provides near complete coverage of the population. People aged 80 years or older and residents of rural and remote areas were oversampled. The Study includes approximately 11% of the NSW population aged 45 and over and had a response rate of 18%.

Baseline questionnaire data were linked to hospital data from the NSW Admitted Patient Data Collection, date of death from the NSW Registry of Births, Deaths and Marriages and the National Death Index, and national medication dispensing from the PBS. The PBS dataset does not capture over-the-counter medications, private prescriptions (pharmacy prescriptions not dispensed under the PBS) and medications issued in hospital. Linked data were available up until 31 December 2017 across all datasets. Data from the baseline 45 and Up Study questionnaire, hospitalisations and deaths were linked probabilistically by the Centre for Health Record Linkage (http://www.cherel.org.au) using personal information (including full name, date of birth, sex and address). Quality assurance data on the data linkage show false positive and negative rates of $<0.5\%$ and $<0.1\%$, respectively. PBS data were supplied by Services Australia and linked by the Sax Institute to baseline 45 and Up Study questionnaire data using a unique identifier.

We restricted our analyses to participants who had a hospital admission (primary diagnosis) for MI (International Statistical Classification of Diseases and Related Health Problems, Tenth Revision [ICD-10] codes I21 and I22), ischaemic stroke or transient ischaemic attack (TIA; ICD-10 codes I63 and G45) on or after 1 July 2012 (including incident and prevalent events), the date from which complete medication dispensing data for prescriptions were available. Prior to this time, only prescriptions that cost above the co-payment thresholds were recorded. The study population was restricted to participants with these major CVD events as these are generally well captured in hospital records. The date of first recorded hospital discharge with a diagnosis of MI, stroke or TIA was considered the index date. Inter-hospital transfers resulting in artefactual double counting of admissions were identified and treated as a single episode of care with the latest discharge date considered as the index date.

We excluded participants who self-reported holding a Department of Veteran's Affairs white or gold card on the baseline questionnaire, as these people have access to subsidised medications under a separate Australian Government program. We further restricted our analysis to participants with at least three months of follow-up and who had at least one PBS dispensing for any medication during the 12-month period from the index date, as PBS data were used to ascertain patient concession status, one of the exposures of interest.

2.2. Setting

The PBS scheme provides near-universal access to a wide range of medications subsidised by the Australian Government (Duckett, 2004). It is a 'cap and co-payment' scheme in which patients pay a contribution toward the cost of their medication—known as a co-payment—with the remainder covered by the Government. The co-payment level is substantially lower for people who hold a concession card (e.g. a low income Health Care Card, Pensioner Concession Card, or a Commonwealth Seniors Health Card; co-payment level of AUD$5.80 in 2012) compared to those who do not ('general beneficiaries'; co-payment of AUD$35.40 in 2012) (Australian Government Department of Health, 2021a; Australian Government Department of Health, 2021b). Additionally, once people have paid a certain cumulative amount toward the costs of their medications per year ('safety net threshold'; $348 for concessional and $1363.30 for general beneficiaries in 2012) any further medications dispensed that year are free for people with a concession card and are charged at the lower concessional co-payment for everyone else (Australian Government Department of Health, 2021b).

2.3. Socioeconomic factors

Three socioeconomic variables, education, income and patient concession status, were considered as exposures. Education was measured by self-reported highest level of educational attainment, categorised into three groups: no qualifications ("no school certificate or other qualifications"), certificate/diploma/trade ("school or intermediate certificate or equivalent", "higher school or leaving certificate or equivalent", "trade/apprenticeship", or "certificate/diploma") and university degree ("university degree or higher", reference category). Income was defined based on self-reported annual pre-tax household income, categorised as $<$$20,000, $20,000–$39,999, $40,000–$69,999, $\geq$$70,000. To assess patient concession status, including for those not using CVD medications, we used data from across all medication dispensings during the 12-month study period. We categorised participants as general beneficiaries (reference category, representing those with the greatest patient co-payment costs per medication), concessional beneficiaries (lowest patient co-payment costs per medication), and mixed

concession status which included people who had both general and concessional dispensings. Those with missing information on the exposures were excluded from the relevant analyses.

2.4. Outcomes

The two outcomes, both binary, were (i) dispensing of both a lipid- and blood pressure-lowering medication at three months after the index date and (ii) 12-month persistent use of lipid- and blood pressure-lowering medications, categorised as persistent use if ≥80% days were covered by lipid- and blood pressure-lowering medications, and otherwise as non-persistent. The latter outcome was restricted to participants who had at least 12-months of follow-up data and were classified as medication users, defined as having at least two lipid- and blood pressure lowering medication dispensings during follow-up since people who are dispensed a medication do not always use the medication (Wilke et al., 2013). Estimation of the proportion of days covered by medication takes into account medication switching and the use of multiple medications concurrently within the same broad class of medication (details in Appendix 1) (Martin et al., 2009). A list of the anatomical therapeutic chemical codes used to identify the medications is provided in Appendix 2.

2.5. Covariates

Covariates included sex (male, female), age (45–54, 55–64, 65–74, 75–84, 85 years or older), country of birth (Australia/New Zealand or other), and region of residence (major cities, inner regional, or outer regional/remote). Data on type of CVD event recorded at time of discharge (MI, stroke/TIA, or both) and prevalent cases of prior CVD events (hospital admission for MI, stroke/TIA prior to the index date) were ascertained from the hospitalisation data. Missing values for covariates were included in the analyses as separate categories.

2.6. Statistical analyses

We calculated the proportion of people in each education and income category by participant characteristics and the proportion dispensed CVD medications by education and income. We also calculated and plotted the proportion of people dispensed both a lipid- and blood pressure-lowering medication at 3, 6, 9 and 12 months following the index CVD event. Using Poisson regression with robust standard errors, we estimated the relative risks (RRs) and 95% confidence intervals (CI) for the two outcomes in relation to each of the socioeconomic factors. Modified Poisson regression is suitable for estimating relative risks for common outcomes, where odds ratios from logistic regression tend to overestimate relative risks (Zou, 2004). We first modelled education, income, and patient concession status separately, with analyses sequentially adjusted for sex and age (Model 1); then additionally country of birth, region of residence, type of CVD and prior CVD (Model 2). Patient concession status was then adjusted for in the models with education and income as the exposures (Model 3). Tests for linear trend were performed for each model using the exposures as ordinal variables.

2.7. Sensitivity analyses

We conducted a series of sensitivity analyses. First, we redefined medication dispensing as use of either lipid- and/or blood pressure-lowering medications versus using neither medication. Second, we included antithrombotic medications in the outcome measure. Antithrombotic medications are generally recommended for use in people with prior CVD without contraindications. However, aspirin, a common prescribed antiplatelet, can be obtained over-the-counter and may not be sufficiently captured in the PBS data. Third, we excluded participants who had been readmitted to hospital during the study period since PBS dispensings do not include medications dispensed in hospital. Fourth, for analyses examining 12-month persistent use, we redefined users as those with at least one (rather than two) dispensing of a lipid- and blood pressure-lowering medication. Fifth, since sicker people might be prescribed or use more medications, we assessed whether the relationship between education, income and medication use might be explained by the number of comorbid conditions measured by Charlson index and derived from hospitalisation records (Sundararajan et al., 2004).

The 45 and Up Study was approved by the University of New South Wales Human Research Ethics Committee (HREC). Ethics approval for this project was obtained from the NSW Population and Health Services Research Ethics Committee (Study Reference HREC/12/CIPHS/31; CI NSW Study Reference 2012/05/389) and the Australian National University Human Research Ethics Committee (Study Reference 2012/504). Data were accessed through the Secure Unified Research Environment (SURE) and analyses were conducted using Stata 16.0.

3. Results

Of the 10,147 participants with a recorded hospital admission with MI, stroke and/or TIA between 1 July 2012 and 31 December 2017, we excluded, sequentially: 1475 (15%) participants with fewer than three months of follow-up (1115 due to death); 340 (4%) participants who held a DVA card at baseline; and 47 (<1%) participants who had no PBS dispensing of any medication during the study period.

Of the 8285 participants included in the analysis, mean age at baseline was 69 years (range = 45–98, standard deviation [SD] = 10.5) and 60% (n = 4991) were men. Just under half the participants had an index hospital admission for MI (49%, n = 4075), with 51% (n = 4210) being hospitalised for ischaemic stroke or TIA. Overall, 16% (n = 1305) of participants had no educational qualifications, 67% (n = 5449) had a certificate/diploma/trade and 17% (n = 1360) had a university degree (Table 1). Over one third (38%, n = 2393) of the participants had an annual household income of AUD$20,000 while 18% ($n$ = 1145) had an income of AUD$70,000 or more (Table 1). Eighteen percent (n = 1507) of participants were general beneficiaries, 8% (n = 675) had mixed concession status, 72% (n = 5990) were concessional beneficiaries, and concession status was unknown for 1% (n = 113).

Over half of the participants (56%, n = 4665) were dispensed both lipid- and blood pressure-lowering medication at three months following the index CVD event, 11% (n = 933) were dispensed only lipid-lowering medication, 19% (n = 1575) were dispensed only blood pressure-lowering medication and 13% (n = 1112) were dispensed neither medication (Table 2). The proportion of participants dispensed both lipid- and blood pressure-lowering medication declined over time, with 50% (n = 4162) of participants dispensed both medications at 6 months, 46% (n = 3824) at 9 months and 42% (n = 3498) at 12 months.

Of participants who were initially dispensed both medications and had 12 months of follow-up (n = 6036), 37% (n = 2242) were classified as persistent users.

3.1. Dispensing of both lipid- and blood pressure-lowering medication at three-months following CVD hospital discharge

After adjusting for age, sex, country of birth, region of residence, type of CVD and prior CVD, all three socioeconomic factors were significantly associated with dispensing of both lipid- and blood pressure-lowering medications at three months following the index CVD hospitalisation. Compared to those with a university degree, the risk of being dispensed both a lipid- and blood pressure-lowering medication was 11% (RR = 1.11 [95% CI: 1.06, 1.18]) higher for those with a certificate/trade/diploma and 14% (1.14 [1.06, 1.22]) higher for those with no qualifications (Fig. 1). Similarly, those with the lowest (<$20,000) compared to the highest (≥$70,000) income had a 14% (RR = 1.14 [1.06, 1.22]) higher risk of being dispensed both a lipid- and blood pressure-lowering medication (Fig. 1). Compared to general beneficiaries (those who

Table 1
Baseline characteristics of the study sample by education and income.

	Education				Income ('000 s)				
	No qualifications % (no.)	Cert/dip/trade % (no.)	University degree % (no.)	Total % (no.)	<$20% (no.)	$20- < $40% (no.)	$40- < $70% (no.)	≥$70% (no.)	Total % (no.)
All participants	16 (1305)	67 (5449)	17 (1360)	100 (8114)	38 (2393)	26 (1639)	18 (1180)	18 (1145)	100 (6357)
Sex									
Male	53 (695)	60 (3259)	70 (948)	60 (4902)	54 (1299)	66 (1087)	70 (829)	77 (878)	64 (4093)
Female	47 (610)	40 (2190)	30 (412)	40 (3212)	46 (1094)	34 (552)	30 (351)	23 (267)	36 (2264)
Age, years									
45–64	28 (366)	36 (1947)	46 (628)	36 (2941)	22 (522)	30 (498)	51 (597)	72 (830)	39 (2447)
65–84	67 (873)	60 (3304)	52 (704)	60 (4881)	73 (1743)	67 (1096)	48 (567)	27 (308)	58 (3714)
≥85	5 (66)	4 (198)	2 (28)	4 (292)	5 (128)	3 (45)	1 (16)	1 (7)	3 (196)
Region of residence									
Major cities	47 (605)	52 (2798)	62 (825)	53 (4228)	51 (1189)	49 (798)	51 (586)	65 (730)	53 (3303)
Inner regional	37 (480)	37 (1984)	30 (403)	36 (2867)	36 (858)	40 (642)	39 (451)	28 (315)	36 (2266)
Outer regional/ remote	16 (203)	11 (583)	8 (105)	11 (891)	13 (315)	11 (173)	10 (122)	7 (78)	11 (688)
Country of birth									
Australia/NZ	79 (1010)	79 (4248)	74 (1000)	78 (6258)	76 (1796)	77 (1246)	81 (944)	79 (902)	78 (4888)
Other	21 (271)	21 (1148)	26 (354)	22 (1773)	24 (564)	23 (378)	19 (220)	21 (238)	22 (1400)
Patient concession status									
General only	37 (507)	17 (911)	6 (81)	18 (1499)	2 (40)	8 (123)	27 (323)	64 (736)	19 (1222)
Mixed	9 (117)	8 (461)	7 (89)	8 (667)	5 (126)	8 (134)	14 (163)	10 (113)	8 (536)
Concession only	52 (712)	74 (4005)	86 (1124)	72 (5841)	92 (2198)	83 (1362)	57 (677)	24 (272)	71 (4509)

Notes: (1) NZ = New Zealand; cert/dip/trade = certificate/diploma/trade. (2) Percentages are within education/income category for each characteristic and do not include missing values. (3) Number of missing values in total sample: region of residence = 132 (2%); country of birth = 102 (1%). Overall, there were 171 (2%) missing values for education, 1928 (23%) for income and 113 (1%) for patient concession status.

Table 2
Number and percent dispensed lipid- and blood pressure-lowering medications at three months following major CVD event by education, income and patient concession status.

	Medication dispensing				Total % (no.)
	Neither % (no.)	Lipid-lowering only % (no.)	Blood pressure-lowering only % (no.)	Both % (no.)	
All participants	13 (1112)	11 (933)	19 (1575)	56 (4665)	100 (8285)
Education					
University degree	17 (227)	14 (189)	18 (250)	51 (694)	100 (1360)
Cert/dip/trade	13 (714)	11 (594)	19 (1015)	57 (3126)	100 (5449)
No qualifications	11 (147)	10 (129)	21 (274)	58 (755)	100 (1305)
Income					
≥$70,000	17 (198)	14 (161)	17 (195)	52 (591)	100 (1145)
$40,000–$69,999	15 (177)	12 (143)	18 (213)	55 (647)	100 (1180)
$20,000–$39,999	13 (209)	11 (179)	18 (289)	59 (962)	100 (1639)
<$20,000	12 (267)	10 (237)	20 (482)	59 (1407)	100 (2393)
Patient concession status					
General only	19 (290)	14 (207)	20 (296)	47 (714)	100 (1507)
Mixed	12 (81)	11 (75)	19 (125)	58 (394)	100 (675)
Concession only	11 (630)	11 (651)	19 (1152)	59 (3557)	100 (5990)

Notes: There were 171 (2%) missing values for education, 1928 (23%) for income and 113 (1%) for patient concession status.

generally pay the highest co-payment per medication), adjusted RRs were 1.21 (1.11, 1.32) for those with mixed concession status and 1.25 (1.17, 1.33) for those with concessional dispensings (paying the lowest co-payments per medication) (Fig. 1, test for trend $p < 0.001$). The association between education, income and medication dispensing was attenuated substantively and no longer statistically significant for the relationship between income and medication dispensings after additional adjustment for patient concession status (Fig. 1).

3.2. 12-month persistent use of lipid- and blood pressure-lowering medications

Adjusted RRs for 12-month persistent use of both medications were 1.14 (95% CI: 1.03, 1.25) for those with a certificate/diploma/trade and 1.15 (1.02, 1.29) for those with no educational qualifications, compared to those with a university degree (Fig. 2). Those with the lowest income (<$20,000) had a 17% (RR = 1.17 [1.04, 1.32]) higher risk of being persistent medication users compared to those with the highest level of income (≥$70,000) (Fig. 2). Compared to general beneficiaries, adjusted RRs were 1.04 (0.89, 1.21) for those with mixed concessional status, and 1.28 (1.15, 1.43) for those with concessional only status (test for trend $p < 0.001$; Fig. 2). The relationship between education, income and persistent medication use was attenuated and no longer statistically significant after additional adjustment for patient concession status (Fig. 2).

	No. (%) dispensed both lipid- and blood pressure-lowering medications	Model 1 RR (95% CI)	Model 2 RR (95% CI)	Model 3 RR (95% CI)
Education				
University degree	694/1,360 (51)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Cert/trade/dip	3,126/5,449 (57)	1.14 (1.07, 1.20)	1.11 (1.06, 1.18)	1.08 (1.02, 1.14)
No qualifications	755/1,305 (58)	1.15 (1.08, 1.24)	1.14 (1.06, 1.22)	1.07 (1.00 1.15)
Income (AUD)				
≥$70,000	591/1,145 (52)	1.00 (ref)	1.00 (ref)	1.00 (ref)
$40,000-$69,999	647/1,180 (55)	1.05 (0.98, 1.14)	1.05 (0.98, 1.13)	1.00 (0.92, 1.08)
$20,000-$39,999	962/1,639 (59)	1.13 (1.05, 1.21)	1.12 (1.05, 1.21)	1.03 (0.96, 1.12)
<$20,000	1,407/2,393 (59)	1.16 (1.08, 1.25)	1.14 (1.06, 1.22)	1.04 (0.96, 1.12)
Patient concession status				
General-only	714/1,507 (47)	1.00 (ref)	1.00 (ref)	
Mixed concession status	394/675 (58)	1.23 (1.13, 1.34)	1.21 (1.11, 1.32)	
Concessional-only	3,557/5,990 (59)	1.27 (1.19, 1.35)	1.25 (1.17, 1.33)	

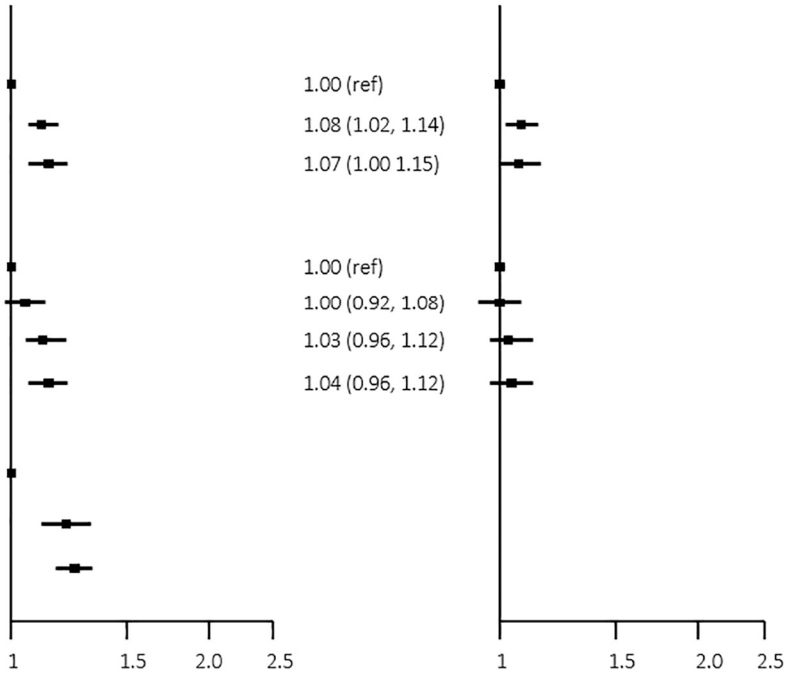

Fig. 1. Association of socioeconomic position and patient concession status with the dispensing of combined lipid- and blood pressure-lowering medications at 3 months following hospital admission for myocardial infarction, stroke or transient ischaemic attack.
CI = confidence interval; RR = relative risk.
Notes: (1) Model 1 is adjusted for age and sex. Model 2 is adjusted for age, sex, country of birth, region of residence, type of CVD and prior CVD. Model 3 is adjusted for age, sex, country of birth, region of residence, type of CVD, prior CVD and patient concession status. (2) Relative risks and 95% confidence intervals plotted on log scale. (3) Sample sizes for each analysis: Education analyses: $n = 8114$; Income analyses: $n = 6357$; Patient concession status analyses: $n = 8285$.

	No. (%) dispensed both lipid- and blood pressure-lowering medications	Model 1 RR (95% CI)	Model 2 RR (95% CI)	Model 3 RR (95% CI)
Education				
University degree	298/774 (39)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Cert/trade/dip	1,518/3,368 (45)	1.16 (1.05, 1.28)	1.14 (1.03, 1.25)	1.10 (1.00, 1.21)
No qualifications	369/805 (46)	1.17 (1.04, 1.32)	1.15 (1.02, 1.29)	1.09 (0.97, 1.23)
Income (AUD)				
≥$70,000	261/681 (38)	1.00 (ref)	1.00 (ref)	1.00 (ref)
$40,000-$69,999	308/698 (44)	1.13 (0.99, 1.28)	1.12 (0.99, 1.27)	1.05 (0.92, 1.20)
$20,000-$39,999	458/1,017 (45)	1.14 (1.01, 1.29)	1.13 (1.00, 1.28)	1.01 (0.88, 1.15)
<$20,000	695/1,489 (47)	1.19 (1.05, 1.34)	1.17 (1.04, 1.32)	1.03 (0.90, 1.18)
Patient concession status				
General-only	314/884 (36)	1.00 (ref)	1.00 (ref)	
Mixed concession status	169/446 (38)	1.05 (0.90 1.22)	1.04 (0.89, 1.21)	
Concessional-only	1,744/3,712 (47)	1.29 (1.16, 1.44)	1.28 (1.15, 1.43)	

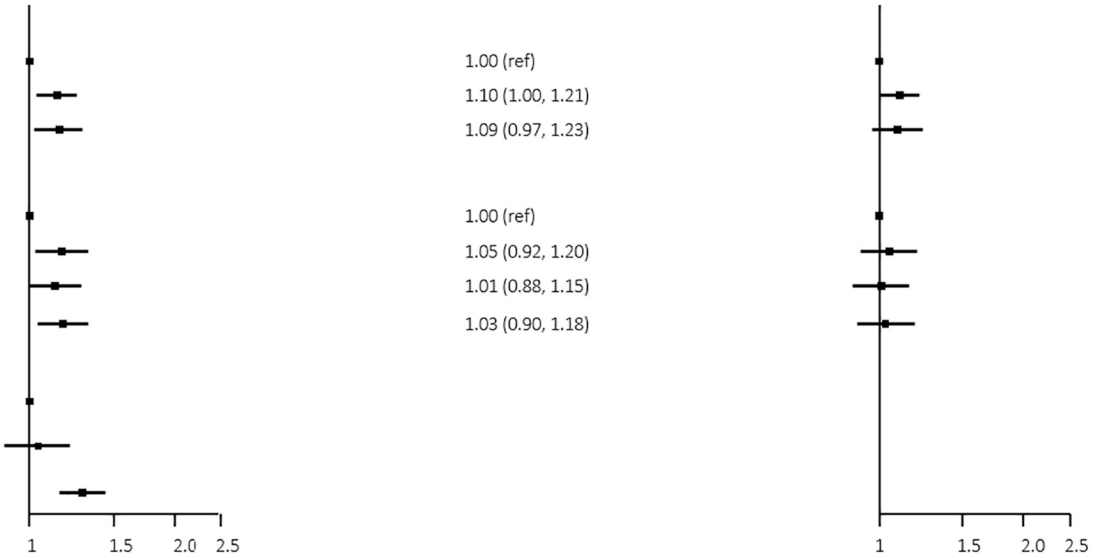

Fig. 2. Associations of socioeconomic position and patient concession status with 12-month persistence with combined lipid- and blood pressure-lowering medication use following hospital admission for myocardial infarction, stroke or transient ischaemic attack.
CI = confidence interval; RR = relative risk.
Notes: (1) Model 1 is adjusted for age and sex. Model 2 is adjusted for age, sex, country of birth, region of residence, type of CVD and prior CVD. Model 3 is adjusted for age, sex, country of birth, region of residence, type of CVD, prior CVD and patient concession status. (2) Relative risks and 95% confidence intervals plotted on log scale. (3) Sample sizes for each analysis: Education analyses: $n = 4947$; Income analyses: $n = 3885$; Patient concession status analyses: $n = 5042$.

3.3. Sensitivity analyses

Results were robust to the different sensitivity analyses, showing similar patterns to that observed in the main results, although associations did not always reach statistical significance (Supplementary Tables 1–9).

4. Discussion

In this large-scale prospective Australian study, among people with established major CVD, those eligible for the greatest compared to the lowest level of medication subsidisation were more likely to use medications for prevention of future CVD events. Overall, there were shortfalls in preventative CVD treatment across the board with around 56% and 37% of participants dispensed guideline-recommended therapy at 3 months and persistently across 12 months following a major CVD event. Replicating previous studies, we provide further evidence that, in Australia, the most disadvantaged are more likely than the least disadvantaged to be dispensed and to continue to use CVD medication following a CVD event. We expand on this, showing for the first time that a person's concession status, which determines how much they pay toward their medications, explains most of this relationship and is itself independently related to medication dispensing and use. Those paying the lowest compared to the highest per-medication out-of-pocket costs were 1.25 times more likely to be dispensed lipid and blood pressure-lowering medications at three months and 1.28 times more likely to use both medications persistently over 12 months, even after adjustment for a range of confounders.

Our findings support previous Australian studies that have shown that those with low compared to high socioeconomic position are more likely to use CVD medications following a CVD event (Stocks et al., 2009; Stocks et al., 2004; Paige et al., 2018). We build on these previous findings, showing that this relationship between increasing use of medication among those with increasing level of disadvantage is likely due to Australia's subsidisation scheme for medications. In Australia people with greater levels of disadvantage, including those with low income and pensioners, are entitled to health concession cards which allow them to pay a lower co-payment contribution toward the cost of a wide range of medications. Consistent with our findings, previous studies from Australia and other countries with similar medication subsidisation schemes have shown that the use of individual medications increases among those who pay the least for their medication (McRae et al., 2017; Despres et al., 2016; Knott et al., 2015). We extend these findings by focusing on the combined use of two classes of CVD preventive medications and examining the role of medication subsidisation on the socioeconomic position-CVD medication use relationship.

Linkage of large-scale cohort data to hospital admissions and medication dispensing data allowed us to examine both individual-level socioeconomic position and medication subsidisation with the use of CVD preventive medications within the same study. Medication dispensing data allowed us to ascertain medication use at different time points following a CVD event with likely less bias than using self-report data. Our findings were also robust to a range of assumptions, tested using sensitivity analyses. Despite these strengths, there are some limitations that may affect interpretation of the results. PBS data do not capture medications dispensed in hospital or private scripts. We examined dispensings at three months following discharge from hospital to account for the use of any remaining medications dispensed during the hospital stay and conducted a sensitivity analysis excluding those with hospital readmissions during the relevant analysis periods. Few data are available on the number of medications dispensed as private scripts in Australia but these are likely less than 10% (estimated as 7.3% in 2003) (Australian Institute of Health and Welfare et al., 2007). Private scripts for CVD are likely much lower than this since private scripts do not count toward the safety net. Although income is a better measure of a person's ability to pay for medications, due to a high proportion of missing income data within our study (23%) we also used education as an exposure, a different but related measure of socioeconomic position, which was better captured in our cohort and is more stable over time. Additionally, our analyses were restricted to participants who had a major CVD event in a NSW hospital and would have missed a small number of CVD hospitalisations occurring elsewhere in Australia. Finally, our analysis of medications use was conditioned on survival as it was not feasible to define medication use without a minimum follow-up period.

The findings of this study suggest that greater subsidisation of medications for those least able to pay is having certain intended effects, likely contributing to greater access to necessary preventive medications in more disadvantaged people. This is supported by a recent evaluation of the effects of a reduction in 2010 to co-payments paid by Aboriginal and Torres Strait Islander peoples for chronic disease medication, which were associated with a 39% relative increase in the use of medications (Trivedi and Kelaher, 2020). Our results suggest that lowering the co-payment for general beneficiaries or negotiating lower overall costs for CVD preventive medications could further reduce barriers to use and increase the use of preventive medications across the board. Moreover, regardless of socioeconomic position, there are currently shortfalls in preventative medication use, and if co-payment levels were substantially increased this might have negative repercussions for medication use and hence CVD burden within the population.

Our finding that dispensing and persistent use of CVD preventive medications increases with decreasing level of medication co-payment contribution suggests there is potential to influence the use of recommended preventive medications by lowering cost barriers. Improving the affordability of preventive medications across the population would be likely to substantially reduce the gap in medication use between the different socioeconomic groups, including reducing observed socioeconomic differences in preventive medication use following a CVD event. This, in turn, would be likely to reduce morbidity and mortality from CVD.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ypmed.2021.106884.

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