

Income differences in the type of antihypertensive medicines used in ambulatory settings in Finland: a register-based study

Härkönen Mirva¹ · Timonen Johanna¹ · Tervola Jussi² · Katri Aaltonen²

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Abstract

Purpose The objective of this study was to explore income differences in the prevalence of moderate-to-severe hypertension, and among patients, in the use and costs of medicines.

Methods Personal income was used to classify ≥ 25 -year-old population in quintiles (QI–QV). Patients ($N=497,560$) with moderate-to-severe hypertension were identified using special refund entitlements. Medicine use and costs derived from prescription register. Direct standardisation and multivariate regression were used to adjust for demographics and comorbidities.

Results Low income was associated with higher prevalence of moderate-to-severe hypertension (overall 13 %). After adjusting for age, gender, residence, diabetes and coronary heart disease, nearly all patients purchased at least one antihypertensive medicine (93 vs. 96 % in QI and QV). Differences in the purchased quantities were small (mean estimates 1028 vs. 1054 defined daily doses (DDDs)/patient/year in QIV and QI). High-income patients were more likely to use angiotensin receptor blockers (37 vs. 54 % in QI and QV). Low-income patients were more likely to use beta-blockers (59 vs. 49 %, respectively) and ACE inhibitors (35 vs. 28 %, respectively). Higher income was associated with higher annual out-of-

pocket costs (mean €66 vs. €71 in QI and QV) and reimbursements (€144 vs. €163, respectively).

Conclusions Use of more expensive medicines contributed to higher costs among patients with higher incomes.

Keywords Hypertension · Antihypertensive agents · Socioeconomic status · Income · Drug utilisation · Finland

Introduction

High blood pressure is the leading risk factor for the global burden of disease [1]. Hypertension leads to myocardial infarction, stroke, renal failure, and death if not detected early and treated appropriately [2]. In Finland, a low level of education is associated with increased risk of hypertension [3]. Coronary heart disease (CHD) is the leading cause of socioeconomic differences in mortality [4, 5]. Although evidence is scarce, socioeconomic differences have also been described in medicine use. Studies from Finland and from other countries suggest that patients with higher socioeconomic position are more likely to use lipid-lowering medicines [6–11]. Among Finnish CHD patients, upon discharge from the hospital after a myocardial infarction event, beta-blockers and antiplatelet agents were prescribed less often to patients with low socioeconomic position than to patients with high socioeconomic position [12]. However, no socioeconomic differences were found in the overall use of beta-blockers, angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers among CHD patients [6, 13].

According to current national and international guidelines, antihypertensive treatment can be initiated and maintained (alone or in combinations) with diuretic, calcium channel blocker, ACE inhibitor, or angiotensin receptor blocker, all of which have yielded comparable effects on overall mortality

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✉ Katri Aaltonen
katri.aaltonen@kela.fi

¹ School of Pharmacy, Faculty of Health Sciences, University of Eastern Finland, P.O. Box 1627, FIN-70211 Kuopio, Finland

² Research Department, The Social Insurance Institution of Finland, P.O. Box 450, FI-00101 Helsinki, Finland

and cardiovascular, cerebrovascular, and kidney outcomes. Under specific conditions, each class can be preferential. Beta-blockers are generally no longer recommended for the initial treatment of hypertension due to their slight inferiority in, e.g. preventing stroke [2, 14–16]. A Finnish study suggested of relative overuse of beta-blockers and of poor control of blood pressure in 2006. However, changes in use patterns between 2000 and 2006 suggested compliance to guidelines. It was also noted that ACE inhibitors were being replaced by increasingly marketed angiotensin receptor blockers [17].

International research has shown that prescribing can be influenced irrespective of medical reasons by, e.g. patients' socio-economic factors, prescriber and healthcare practice characteristics and marketing [18–23]. In the context of limited resources, this may have negative implications as regard equality and efficiency. Finnish Current Care Guideline of the management of hypertension states that the cost of the treatment should be one of the selection criteria for treatment [14]. However, there are no national recommendations based on cost-effectiveness. International comparisons suggest that Finnish patients pay a higher share of their medicines out-of-pocket and have a less equitable access to general practitioners (GP) and specialists than in many other high-income countries [24–26]. Patients with moderate-to-severe hypertension are, however, entitled to higher reimbursements for antihypertensive medicines. It is not known whether the costs of medicine (for the patient/public payer), the patient's ability to pay (for medicines and/or for the treatment) or the sector (public/private) where the patient is treated, or other non-medical reasons, lead to socioeconomic differences in the types of antihypertensive medicines used in Finland.

The first objective of this study was to explore the prevalence of moderate-to-severe hypertension in the Finnish adult population by income. The second objective was to explore, among patients with moderate-to-severe hypertension, the patterns of use and costs of different types of antihypertensive medicines.

Material and methods

Data

Data included all Finnish residents aged 25 and older with permanent residence in Finland at the beginning and at the end of the year 2011. Data were previously combined from several administrative register sources [27]. Demographic variables (age, gender and residence) originated from the Population Register. Residence was classified into three classes (urban/semi-urban/rural) based on the degree of urbanisation of the municipality. Income data were retrieved from the Finnish Tax Administration. Annual personal taxable income was used to divide the ≥ 25 -year-old population into quintiles.

Taxable income consists of earned income, capital income and income transfers.

Special refund entitlements based on moderate-to-severe hypertension and important comorbidities (coronary heart disease (CHD) and diabetes) were linked from the Kela Special Refund Entitlement Register ([28], see ESM 1 Supplementary document for context and setting).

Data on medicine use and costs were retrieved from the Kela Nationwide Prescription Register, which contains data on all reimbursed purchases of medicines [28, 29]. Included were all purchases used in the treatment of moderate-to-severe hypertension within anatomical therapeutic chemical (ATC [30]) classes listed by the Finnish Current Care Guideline [14] (hereafter: antihypertensive medicines): Diuretics C03, beta-blockers C07 (BBs), calcium-channel inhibitors C08 (CCBs), angiotensin-converting enzyme inhibitors C09A (ACEIs) and angiotensin-II receptor blockers C09C (ARBs). All purchases were classified and treated in the analyses at ATC level 2/3. Purchases of combination products within classes C09B (ACEIs, combinations) and C09D (ARBs, combinations) were reclassified into the respective classes based on active ingredients. The annually purchased quantity of medicines was calculated using units of defined daily doses (DDDs) [31]. Cost data contained total costs, reimbursements and out-of-pocket costs (see ESM 1 Supplementary document for context and setting).

Statistical analyses

First, the prevalence of moderate-to-severe hypertension was assessed in the population. The proportion (%) of patients with special refund entitlement based on moderate-to-severe hypertension was calculated using the ≥ 25 -year-old population as the denominator. The proportions were stratified by income quintile. Direct standardisation was used to adjust for age, gender and residence, since there were substantial differences in the age structures and other characteristics between income groups. The total ≥ 25 -year-old population was used as the standard population.

Second, income disparities in different medicines used (0/1) and the quantities purchased (DDDs) were assessed among patients with moderate-to-severe hypertension. In both analyses, patients' age, gender and residence were controlled for in addition to important comorbidities (diabetes and CHD) to demonstrate whether income disparities would persist after controlling for other characteristics. When analysing the total number of DDDs (classes of medicines combined), the distribution of different classes of medicines used was also adjusted for, since DDDs do not necessarily reflect therapeutically equivalent doses of different medicines. The large number of adjusted variables resulted in too small cell sizes, and a direct standardisation method could not be applied. Consequently, the adjusted figures were calculated as population marginal

means (i.e. least square means [32]) derived from generalised linear models. In contrast to direct standardisation, the interaction of variables was not taken into account to avoid too few degrees of freedom. This was seen as an insignificant loss.

Use of medicine (any medicine and different classes of medicine) was adjusted based on coefficients from logistic regression. The DDDs were adjusted based on a generalised linear model with an identity link function and the assumption of gamma-distributed response. This was observed to fit best according to the residual plots. Each class of medicine was modelled separately. For the use of medicine, the standard population was set to all patients entitled to the special refund based on moderate-to-severe hypertension. For the DDDs, the standard population contained all patients having purchased the particular class of medicine. The 95 % confidence intervals of adjusted figures were calculated based on Student's *t* distribution. The intervals were only calculated for adjusted proportions, and DDDs as the unadjusted figures were based on total population and did not contain uncertainty.

Unadjusted mean out-of-pocket costs, reimbursements and total costs for antihypertensive medicines were calculated for patients with moderate-to-severe hypertension who had purchases during the study year. Costs were stratified by income, age and gender. Costs could not be assessed by class of medicine because of the high share of combination products. Additionally, costs adjusted by class of medicine were calculated, to assess whether differences between income quintiles were caused by differences in the prices or quantities of purchased medicines.

Statistical analyses were performed using SAS software version 9.2/9.3 (SAS Institute Inc., Cary, NC).

Results

The ≥ 25 -year-old general population consisted of 3.8 million people among whom 497,560 (13 %) had moderate-to-severe hypertension. Of these patients, 53 % were female and 47 % were male (Table 1). Female patients were on average older than male patients (70 vs. 65 years). When compared with general ≥ 25 -year-old population, patients were on average older (68 vs. 53 years); they were less likely to live in an urban area (59 vs. 67 %) and more likely to have CHD (14 vs. 5 %) or diabetes (24 vs. 6 %). The gender distribution was similar among patients and general population.

The unadjusted prevalence of moderate-to-severe hypertension was highest, 21 %, in the second lowest income quintile and lowest, 7 %, in the highest income quintile (Fig. 1). After adjusting for age, gender and residence, the differences between income quintiles became smaller (Fig. 1).

Among all patients with moderate-to-severe hypertension, 94 % had purchased at least one antihypertensive medicine (Fig. 2a). The proportion of patients with purchases was larger

in high-income quintiles than in low-income quintiles (96 % in the highest quintile vs. 93 % in the lowest quintile, adjusted by demographics and comorbidities). Overall, the most commonly used classes of medicines were diuretics (56 %) and beta-blockers (55 %). Beta-blockers and ACE inhibitors were more commonly used by low-income than high-income patients; angiotensin receptor blockers were more commonly used by high-income than low-income patients. Within these classes of medicines, all differences between income quintiles were statistically significant. For diuretics and calcium-channel inhibitors, differences between income quintiles were small. Due to the large number of observations, statistically significant differences were also observed within these classes.

The average number of different classes of medicines used was 2.3 in all income quintiles (unadjusted). Among patients with purchases, the mean quantity of medicines bought was 1039 DDDs/person/year (Fig. 2b). After adjusting for demographics, comorbidities and distribution of different classes of medicines, the purchased quantity was higher in the two lowest income quintiles than in the three highest. The largest difference in the adjusted number of DDDs was 1.03-fold, between quintiles I and IV. When each class of medicines was examined separately, low-income patients had higher mean DDDs for diuretics, beta-blockers and calcium-channel inhibitors; whereas, they had lower mean DDDs for angiotensin receptor blockers when compared to patients with higher incomes. No consistent income differences were observed for the quantity of ACE inhibitors purchased. The largest observed within-class difference in the number of DDDs was a 1.2-fold difference for diuretics between the lowest and highest income quintiles.

Patients paid on average €67 for antihypertensive medicines in 2011. The mean reimbursement was €149 per patient. Thus, total costs were €216 per patient on average. Annual costs tended to increase with increasing income (Fig. 3). Average overall costs were €24 (1.11-fold) higher, reimbursements were €19 (1.13-fold) higher and out-of-pocket costs were €5 (1.08-fold) higher in the highest income quintile when compared with the lowest. According to the additional analyses adjusted by the amounts of medicine from different classes, nearly all income differences in costs disappeared (data not shown). Differences in costs between income quintiles were thus mainly caused by using different classes of medicines.

Discussion

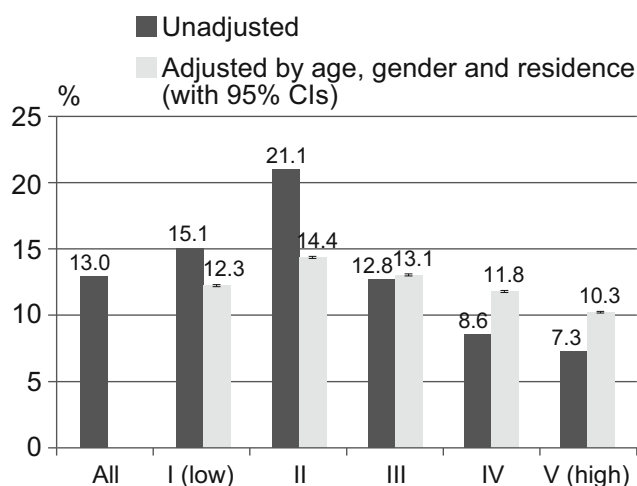
According to this study, the prevalence of moderate-to-severe hypertension was more common among low-income than among high-income people. Income differences were mostly, but not entirely, explained by the different demographic

Table 1 Characteristics of patients with moderate-to-severe hypertension by income

Income quintile		All	I (low)	II	III	IV	V (high)
	Number	497,560	116,223	161,677	97,866	66,019	55,775
Age	25–54	14 %	9 %	5 %	14 %	29 %	32 %
	55–64	26 %	19 %	19 %	29 %	38 %	41 %
	65–74	29 %	24 %	36 %	34 %	21 %	18 %
	75+	31 %	49 %	40 %	22 %	12 %	9 %
Gender	Male	47 %	30 %	42 %	52 %	58 %	74 %
	Female	53 %	70 %	58 %	48 %	42 %	26 %
Residence	Urban	59 %	45 %	59 %	65 %	66 %	72 %
	Semi-urban	18 %	21 %	19 %	17 %	17 %	14 %
	Rural	22 %	33 %	22 %	18 %	18 %	14 %
Co-morbidity	Diabetes	24 %	27 %	26 %	24 %	20 %	19 %
	CHD	14 %	17 %	17 %	13 %	9 %	8 %

CHD coronary heart disease

structures of the income quintiles. Nearly all patients, regardless of income, purchased antihypertensive medicines during the studied year. Purchased quantities were also similar across income groups. The most commonly used classes of antihypertensive medicines were diuretics and beta-blockers. However, the use of angiotensin receptor blockers was more common among people in higher-income quintiles; whereas, the use of ACE inhibitors and beta-blockers was more common among people in lower-income quintiles, even after adjusting for demographic characteristics and comorbidities. Differences in the types of medicines used contributed to higher out-of-pocket costs, reimbursements and total costs among higher-income patients.

**Fig. 1** Unadjusted (%) and adjusted (%; with 95 % confidence intervals) prevalence of moderate-to-severe hypertension in the Finnish population aged 25 years and older, by income

Low socioeconomic position is one of the risk factors for non-adherence [33, 34]. In Finland, cost-related barriers to care and prescription medicines have been found to be common among respondents with low income and/or poor health [35]. In the present study, the proportion of diagnosed patients who purchased at least one antihypertensive medicine during 2011 was very high, over 90 % in all income groups. The proportion of patients without purchases includes those who no longer need medication due to changes in their clinical status and people who do not adhere to their treatment. A slightly lower proportion in the lowest income group may be related to using personal income (please see “Strengths and limitations” section).

When examined by class of medicine, angiotensin receptor blockers were more commonly used by high-income than low-income patients. Conversely, beta-blockers and ACE inhibitors were more commonly used among patients with lower income than among patients with higher income. Although the Finnish clinical guideline states no preference of one medicine over another, cost of treatment is mentioned as one selection criterion [14]. Angiotensin receptor blockers were the newest and most expensive among examined options [36]. Earlier studies from Sweden have found similar patterns with antihypertensive medicines; angiotensin receptor blockers were more commonly used by highly educated than less educated males although the association between education and use of other classes of antihypertensive medicines was reversed [37]; in Skåne region, high-income patients were more likely than low-income patients to initiate treatment with angiotensin receptor blockers instead of ACE inhibitors [38]. More generally, increased use of newly marketed medicines has been found to be associated with higher socioeconomic position [20, 21]. Also in a Dutch study, GPs who reported frequent use of

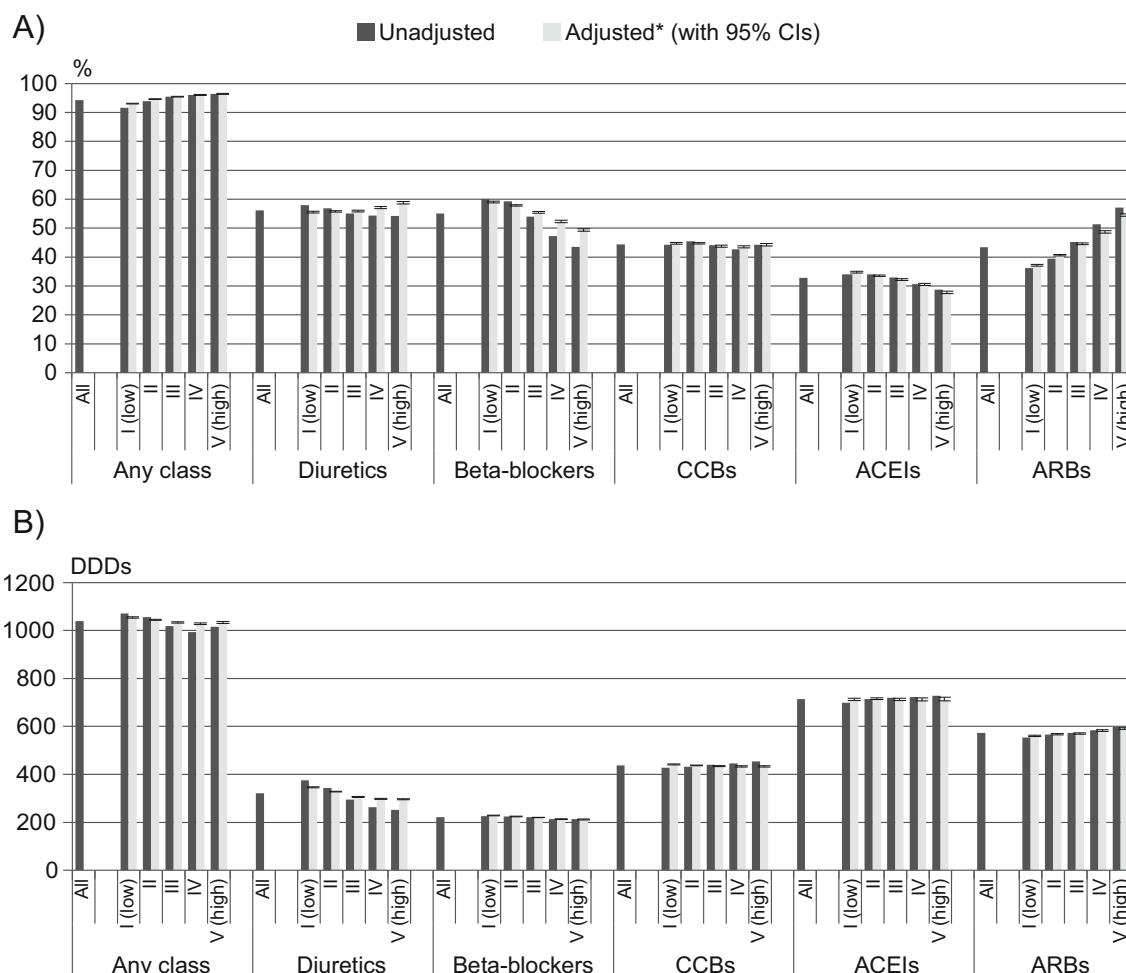


Fig. 2 Use of antihypertensive medicines among patients with moderate-to-severe hypertension, by income and by medicine class. **a** Unadjusted and adjusted proportions of patients who purchased at least one antihypertensive medicine, % (with 95 % confidence intervals for adjusted figures). **b** Unadjusted mean and adjusted estimated mean

(with 95 % confidence intervals) number of defined daily doses (DDD) among patients with purchases of antihypertensive medicines. *Adjusted for age, gender, residence, diabetes, coronary heart disease. DDDs for “any class” (**b**) were also adjusted for the distribution of different classes of medicines

commercial information sources were more likely to prescribe angiotensin receptor blockers routinely in preference to other

antihypertensives [39]. Swedish GPs working in the public sector were more adherent to cost-containing treatment

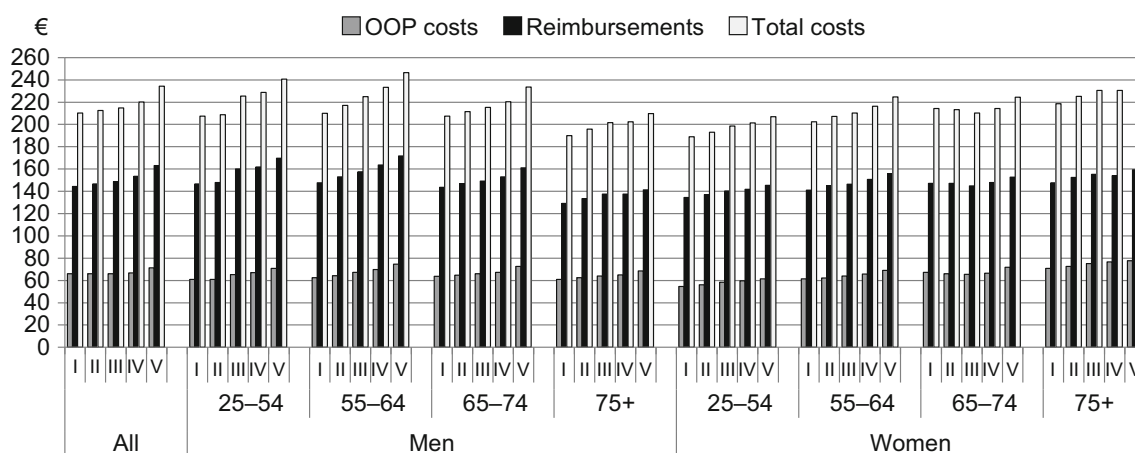


Fig. 3 The unadjusted mean annual out-of-pocket (OOP) costs, reimbursements and total costs for antihypertensive medicines among patients with moderate-to-severe hypertension, by income, gender and age group

options than hospital specialists and private practitioners [21, 40, 41].

The quantity of purchased medicines and the number of different classes of medicines used were relatively similar across income groups, although differences between income groups reached statistical significance due to the large number of observations. The use of diuretics in large doses in the treatment of renal diseases may have contributed to larger variation in the number of DDDs in this class. Small yet consistent income-related differences were found in the costs of antihypertensive medicines. Higher-income patients paid higher out-of-pocket costs and received higher reimbursements. These differences were mainly caused by prices of medicines and thus seem to be due to higher-income people being prescribed more expensive medicines.

No evident disparities were thus observed in the overall use of antihypertensive medicines among diagnosed patients, after controlling for demographic factors and comorbidities. Based on inequity in utilisation of health care services, it is, however, possible that income differences persist in the prevalence of undiagnosed moderate-to-severe hypertension [26, 42]. Furthermore, results from the present study suggest that patients' socioeconomic background has an influence on the type of medicine prescribed, which may also lead to increased costs for the public payer. Further research is needed to confirm the observed trends and to explain the reasons behind them.

Strengths and limitations

The strengths of this study were that the used data encompassed the entire Finnish population instead of a sample and, due to the explicit criteria for special refund entitlements, it was also possible to examine a comprehensive population of patients with clinically diagnosed moderate-to-severe hypertension. In addition, combination products were examined as separate active ingredients which allowed calculating unbiased prevalence for different types of antihypertensive medicines used.

However, several limitations need to be noted. Only patients with a reimbursement entitlement based on moderate-to-severe hypertension were included. Therefore, the results of the present study should not be generalised to all patients with elevated blood pressure. The total number of people in Finland who purchased antihypertensive medicines was approximately 1 million, twice as high as the number of people who were eligible for higher reimbursements [14]. A difference of similar size was observed in Finland in a comparison of survey and register data [43]. Based on the survey health 2011, where a nationally representative sample of people were examined clinically, 53 % of all Finnish men aged 30 years and older and 46 % of women had elevated blood pressure (140/90 mmHg or more) or used antihypertensive medicines [44]. The prevalence of high blood pressure (160/95 mmHg) was

14.6 % for men and 11.9 % for women (age-adjusted). These results are close to the prevalence of moderate-to-severe hypertension in the present study (13 %).

It must also be noted that the determinant of income used in this study consisted of personal taxable income, which does not take into account income of other household members, or the number of family members, property and possible tax-free social benefits (e.g. social assistance). However, most social benefits (pensions, student benefits, sickness allowance, parental allowance) and capital income are included. An earlier comparison of the proportion of reimbursement recipients (for any medicines) by income quintiles resulted in roughly similar findings regardless of whether personal income or equivalent household income was used, especially after adjusting for age, gender and area of residence [27]. Nevertheless, the differences between income quintiles were slightly narrower when household income was used. It is therefore possible that using household income would have led to slightly narrower income differences, but it is unlikely that the trends would have entirely disappeared or changed direction. Also, the proportion of reimbursement recipients was disproportionately lower in the lowest quintile when personal income was used. This was presumably because institutionalised people and people who in reality lived mostly abroad, had no taxable income and received no reimbursements, and could not be excluded from the data.

Furthermore, there are several other possible reasons behind differences in prescribing patterns that we were not able to include in our analyses. These include other comorbidities as well as patient's, prescriber's and practice's characteristics [18–23].

Conclusions

Prevalence of moderate-to-severe hypertension was higher among people with lower income, but income differences were mostly explained by the different demographic structures between income quintiles. Overall use of antihypertensive medicines among patients was similar across income quintiles. Angiotensin receptor blockers were more commonly used by patients within higher-income quintiles, beta-blockers and ACE inhibitors by patients in lower-income quintiles. Using different types of antihypertensive medicines contributed to higher out-of-pocket costs and reimbursements among patients with higher income.

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Conflict of interest The authors declare that they have no competing interests.

Contributions of authors Mirva Härkönen drafted the first version of the manuscript. Katri Aaltonen drafted the revised version of the manuscript. Katri Aaltonen, Mirva Härkönen and Johanna Timonen contributed to the acquisition, conception, design, and interpretation of data and drafting of the manuscript. Mirva Härkönen, Katri Aaltonen and Jussi Tervola contributed to the analysis of data. All authors contributed to the critical revision of the manuscript and approved the final manuscript.

References

- Lim SS, Vos T, Flaxman AD et al (2012) A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 380(9859):2224–2260
- James PA, Oparil S, Carter BL et al (2014) 2014 evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8). *JAMA* 311(5):507–520
- Reunanen A, Kattainen A, Salomaa V (2009) Biological risk factors. In: Palosuo H et al (eds) *Health inequalities in Finland. Trends in socioeconomic health differences 1980–2005*. Publications of the Ministry of Social Affairs and Health 9, Helsinki, pp 169–177
- Statistics Finland (2011) Causes of death http://tilastokeskus.fi/til/ksyyt/2011/ksyyt_2011_2012-12-21_tie_001_en.html. Accessed 11 March 2014
- Valkonen T, Ahonen H, Martikainen P et al (2009) Socio-economic differences in mortality. In: Palosuo H et al (eds) *Health inequalities in Finland. Trends in socioeconomic health differences 1980–2005*. Publications of the Ministry of Social Affairs and Health 9, Helsinki, pp 40–60
- Manderbacka K, Keskimäki I, Reunanen A et al (2008) Equity in the use of antithrombotic drugs, beta-blockers and statins among Finnish coronary patients. *Int J Equity Health*. doi:10.1186/1475-9276-7-16
- Vehko T, Sund R, Arffman M et al (2013) Monitoring the use of lipid-lowering medication among persons with newly diagnosed diabetes: a nationwide register-based study. *BMJ Open*. doi:10.1136/bmjopen-2013-003414
- Brown AF, Gross AG, Gutierrez PR et al (2003) Income-related differences in the use of evidence-based therapies in older persons with diabetes mellitus in for-profit managed care. *J Am Geriatr Soc* 51:665–670
- Thomsen RW, Johnsen SP, Olesen AV et al (2005) Socioeconomic gradient in use of statins among Danish patients: population-based cross-sectional study. *Br J Clin Pharmacol* 60(5):534–542
- Dominguez H, Schramm TK, Norgaard ML et al (2009) Initiation and persistence to statin treatment in patients with diabetes receiving glucose-lowering medications 1997–2006. *Open Cardiovasc Med J* 3:152–159
- Selmer R, Sakshaug S, Skurtveit S et al (2009) Statin treatment in a cohort of 20 212 men and women in Norway according to cardiovascular risk factors and level of education. *Br J Clin Pharmacol* 67(3):355–362
- Salomaa V, Miettinen H, Niemelä M et al (2001) Relation of socioeconomic position to the case fatality, prognosis and treatment of myocardial infarction events; the FINMONICA MI Register Study. *J Epidemiol Community Health* 55:475–482
- Vehko T, Manderbacka K, Arffman M et al (2010) Changing patterns of secondary preventive medication among newly diagnosed coronary heart disease patients with diabetes in Finland: a register-based study. *Scand J Public Health* 38:317–324
- Working group appointed by the Finnish Medical Society Duodecim and the Finnish Hypertension Society (2009, updated version in 2014) *Current Care Guideline: Hypertension*. Duodecim, Helsinki
- National Clinical Guideline Centre commissioned by the National Institute for Health and Clinical Excellence (2011) *Hypertension. The clinical management of primary hypertension in adults*. Clinical Guideline 127. National Clinical Guideline Centre, London
- Mancia G, Fagard R, Narkiewicz K et al (2013) 2013 ESH/ESC Guidelines for the management of arterial hypertension: the task force for the management of arterial hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). *J Hypertens* 31(7):1281–1357
- Ahola TL, Kantola IM, Mäki J et al (2012) Adding a low-dose antihypertensive regimen would substantially improve the control of hypertension and reduce cardiovascular morbidity among uncomplicated hypertensive patients. *Eur J Prev Cardiol* 19(4):712–722
- Tamblyn R, McLeod P, Hanley JA et al (2003) Physician and practice characteristics associated with the early utilization of new prescription drugs. *Med Care* 41(8):895–908
- Buusman A, Andersen M, Merrild C et al (2007) Factors influencing GPs' choice between drugs in a therapeutic drug group. A qualitative study. *Scand J Prim Health Care* 25(4):208–213
- Haider SI, Johnell K, Ringbäck Weitof G et al (2008) Patient educational level and use of newly marketed drugs: a register-based study of over 600,000 older people. *Eur J Clin Pharmacol* 64:1215–1222
- Ohlsson H, Chaix B, Merlo J (2009) Therapeutic traditions, patient socioeconomic characteristics and physicians' early new drug prescribing—a multilevel analysis of rosuvastatin prescription in south Sweden. *Eur J Clin Pharmacol* 65:141–150
- Ohlsson H, Lynch K, Merlo J (2010) Is the physician's adherence to prescription guidelines associated with the patient's socio-economic position? An analysis of statin prescription in south Sweden. *J Epidemiol Community Health* 64(8):678–683
- Semark B, Engström S, Brudin L et al (2013) Factors influencing the prescription of drugs of different price levels. *Pharmacoepidemiol Drug Saf* 22:286–293
- OECD (2011) *Health at a glance 2011: OECD Publishing*. http://dx.doi.org/10.1787/health_glance-2011-63-en. Accessed 1 November 2013
- Mossialos E, Srivastava D. (2008) *Pharmaceutical policies in Finland. Challenges and opportunities*. Observatory studies series 10. European Observatory on Health Systems and Policies. http://www.euro.who.int/_data/assets/pdf_file/0020/80651/E91239.pdf
- Organisation for Economic Co-Operation and Development (2005) *OECD reviews of health systems*. OECD, Paris, Finland
- Blomgren J, Aaltonen K, Tervola J et al. (2015) Kelan sairaanhoidokorvaukset tuloryhmittäin: kenelle korvauksia maksetaan ja kuinka paljon? (Finnish: National Health Insurance (NHI) reimbursements by income group) Sosiaali- ja terveysturvan selosteita 93. Kelan tutkimusosasto, Helsinki. <http://hdl.handle.net/10138/154606>
- Saastamoinen LK, Aaltonen K, Maljanen T et al (2012) Health registers as a source of data for research and policy making. *Dosis* 28(3):199–205
- Furu K, Wettermark B, Andersen M et al (2010) The Nordic countries as a cohort for pharmacoepidemiological research. *Basic Clin Pharmacol Toxicol* 106:86–94
- WHO Collaborating Centre for Drug Statistics Methodology (2013) *ATC/DDD Index 2013* <http://www.whocc.no/atcddd/>. Accessed 11 September 2013

31. WHO Collaborating Centre for Drug Statistics Methodology (2014) Guidelines for ATC classification and DDD assignment 2015 Oslo
32. Searle SR, Speed FM, Milliken GA (1980) Population marginal means in the linear model: an alternative to least squares means. *Am Stat* 34(4):216–221
33. Sabaté E (2003) Adherence to long-term therapies: evidence for action. WHO/MNC/03.01, World Health Organization, Geneva
34. Lemstra M, Alsabbagh MW (2014) Proportion and risk indicators of nonadherence to antihypertensive therapy: a meta-analysis. *Pat Pref Adhere* 8:211–218
35. Aaltonen K, Miettinen J, Airio I, Martikainen JE, Saastamoinen LK, Bell JS, Hartikainen S, Norris P (2015) Cost-related barriers to use of health services and prescription medicines in Finland: a cross-sectional survey. *Eur J Public Health* 25(3):368–372
36. Social Insurance Institution of Finland. Statistical database Kelasto. <http://www.kela.fi/kelasto> Accessed 17 September 2014
37. Ringbäck Weitöft G, Rosén M, Ericsson Ö et al (2008) Education and drug use in Sweden—a nationwide register-based study. *Pharmacoepidemiol Drug Saf* 17:1020–1028
38. Merlo J, Ohlsson H, Carlsson M (2009) Tål inte rika skåningar ACE-hämmare? <https://www.skane.se/upload/Webbplatser/UMAS/VERKSAMHETER%20UMAS/Socialmedicin/08-1%C3%A4kemedel/tal-inte-rika-skaningar-ace.pdf>
39. Greving JP, Denig P, van der Veen WJ et al (2006) Determinants for the adoption of angiotensin II receptor blockers by general practitioners. *Soc Sci Med* 63(11):2890–2898
40. Håkansson A, Andersson H, Cars H et al (2001) Prescribing, prescription costs and adherence to formulary committee recommendations: long-term differences between physicians in public and private care. *Eur J Clin Pharmacol* 57(1):65–70
41. Andersson K, Carlsten A, Hedenrud T (2009) Prescribing behaviour after the introduction of decentralized drug budgets: is there an association with employer and type of care facility? *Scand J Prim Health Care* 27:117–122
42. van Doorslaer E, Masseria C, Koolman X, for the OECD Health Equity Research Group (2006) Inequalities in access to medical care by income in developed countries. *CMAJ* 174(2):177–183
43. Entonen AH, Suominen SB, Korkeila K et al (2014) Migraine predicts hypertension—a cohort study of the Finnish working-age population. *Eur J Public Health* 24(2):244–248
44. Jula A, Salomaa V, Aromaa A et al (2012) Verenpaine (Finnish: hypertension). In: Koskinen S et al (eds) Health, functional capacity and welfare in Finland in 2011. National Institute for Health and Welfare (THL), Report 68, Helsinki, pp 66–69