Franziska Valder
franziskavalder@econ.ku.dk
University of Copenhagen
http://franziskavalder.com/
PhD obtained December 13, 2021

My research focuses on the intersection of health and the labor market. I study the role of mental, but also physical health for education and labor market outcomes, with a particular focus on gender inequality.

As a young female scholar working on the intersection of health, labor and gender economics I hope I can contribute diversity to the Economics of Health or Economics of Gender session. My research touches upon topics that are often discarded or overlooked due to women-specific health issues that are however crucial as they are often closely intertwined with economic inequality. I would love to participate in those meetings and to gain access to the research community that is often out of reach for someone from Europe.

Franziska Valder

Employment

University of Copenhagen
Assistant Professor (non-tenure-track), 2025-2028

University of Copenhagen
Postdoc, 2022-2024

Education

Ph.D. KU Leuven, 2021
Economics

M.Sc. University of Erlangen-Nürnberg, 2017
Economics

B.Sc. University of Bonn, 2015
Economics

Fields of Interest

Applied Microeconomics, Labor Economics, Economics of Education, Health Economics

Publications

Iris Kesternich, Heiner Schumacher, Bettina Siflinger, and Franziska Valder (2022), "Reservation Wages and Labor Supply" **Journal of Economic Behavior and Organization, 194, 583-607**

Franziska Valder (2025), "Two Sides of the Same Pill? Fertility Control and Mental Health Effects of the Contraceptive Pill" *forthcoming at* **Journal of Labor Economics, 43(4)**

Franziska Valder, Simon Reif, and Harald Tauchmann (2025) "Diagnosis Related Payment for Inpatient Mental Health Care: Hospital Selection and Effects on Length of Stay" *accepted at* **Health Economics**

Working Papers

Iris Kesternich, Bettina Siflinger, James P. Smith, and Franziska Valder (2024) "Relationship Stability - Evidence from Labor and Marriage Markets" *R&R at Scandinavian Journal of Economics*

Selected Work In Progress

Franziska Valder "Gender Differences in Heart Disease: The Role of Individual and Provider behavior"

Alina Bartscher, Sonia Bhalotra, Mathias F. Jensen, Thomas H. Jørgensen, Sebastian Seitz, and Franziska Valder "Disability insurance: fiscal goals and individual well-being"

Paul Hufe, Sonja Settele, and Franziska Valder "Child penalties unpacked: The effect of beliefs and preferences on the time allocation of new parents"

Research Visits

2019 RAND Corporation Santa Monica, visiting Prof. James P. Smith (3 months)

2019 University of Erlangen-Nürnberg, visiting Prof. Harald Tauchmann (2 months)

2018 University of Erlangen-Nürnberg, visiting Prof. Harald Tauchmann (2 months)

Grants and Scholarships

2024 Economic Policy Research Network Project Grant (249.548 DKK) for project *The Impact of Teachers on Children with ADHD Evidence from Danish Register Data*, PI

2023 Rockwool Foundation Project Grant (1.196.750 DKK) for project *Child penalties unpacked*, Co-PI jointly with Paul Hufe and Sonja Settele

2021 1-year postdoctoral mandate KU Leuven (declined)

2019 FWO Grant Long Research Stay Abroad, KU Leuven Junior Researcher Outgoing Mobility Grant

Seminars and Conferences

2024 UAM-UJI Workshop on the Economics of Health and Human Capital (Madrid), HEFUU Workshop in Causal Health Economics (Uppsala)

2023 RES Glasgow, SEHO (Copenhagen), University of Hamburg Research Seminar, EEA (Barcelona), WOLFE (York)

2022 EUHEA (Oslo), Essen Economics of Mental Health Workshop, Workshop on Behavioral responses to Health Innovations and the Consequences for Socioeconomic Outcomes (Copenhagen), EALE (Padua)

2021 ZEW Mannheim Research Seminar, DGGÖ virtual conference, KU Leuven Household Economics Day, ASHEcon Annual Conference, EUHEA Student Supervisor Conference, Essen Economics of Mental Health Workshop, AEA Mentoring Workshop for PhD Students in Health Economics & Health Policy

2020 EEA Virtual Congress, Verein fuer Socialpolitik Virtual Congress, DGGÖ Workshop Allocation and Distribution

2019 UCLA Proseminar Series (Los Angeles), RAND Corporation Labor, Education, Ageing and Population Seminar (Santa Monica), All-California Labor Economics Conference (Santa Cruz)

2018 DGGÖ Conference (Hamburg)

Refereeing

Journal of Public Economics, Journal of Health Economics, Journal of Economic Behavior & Organization

Teaching

2024 Guest lecture Health Economics (course by Prof. M. Daysal, University of Copenhagen)

2023 Guest lecture Gender Economics (course by Prof. M. Wüst, University of Copenhagen)

2022 Guest lecture Mental Health Economics (PhD course by Prof. B. Eugster, University of St. Gallen)

2021 Teaching Assistant for Health Economics, (master level, KU Leuven)

2019-21 Teaching Assistant for Seminar in Methods for Economic Research (bachelor level, KU Leuven)

2018-20 Teaching Assistant for Empirical Evaluation of Economic Policy (master level, KU Leuven)

2017-21 Daily supervisor for 10 master theses (applied, labor, health economics)

2017 Teaching Assistant for Applied Econometrics, computer tutorial and exam preparation (master level, University of Erlangen Nuremberg), TA

Language Skills

English (fluent), German (native), Spanish (intermediate), Dutch (beginner), Danish (beginner)

Gender Disparities in Heart Disease: Individual and Provider Behavior

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Franziska Valder* Mette Gørtz† and Marianne Benn‡

April 14, 2025

Abstract

Ischaemic heart disease is the leading cause of death worldwide. Despite a lower (diagnosed) lifetime prevalence of heart disease, women are significantly more likely to die if hospitalized with acute myocardial infarction (AMI). This is puzzling, as one would expect those who are sicker and thus more likely to die from AMI to have a higher likelihood of being diagnosed in the first place. We show that healthcare providers are important drivers of this puzzle: While the mortality gap is substantially smaller for users of lipid-lowering drugs, women are typically less likely to use these drugs. Providers have substantial power over their patients' medication usage: Switching to a provider with a higher female usage rate of lipid-lowering drugs due to a clinic closure increases the uptake of these drugs and reduces mortality. We then exploit cholesterol measures from outside the health care setting to investigate the role of diagnostics: compared to men with the same cholesterol measurement, women are still less likely to use lipid-lowering medication. This gap does not vary with GP characteristics, but reduces for women who switch GPs. Lastly, we demonstrate that these gender differences also spill over to the labor market: women reduce their labor supply and increase disability benefit receipt much more than men – after AMI but also in anticipation.

*Center for Economic Behavior and Inequality, University of Copenhagen.

†Center for Economic Behavior and Inequality, University of Copenhagen

‡Institut for Klinisk Medicin, University of Copenhagen

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1 Introduction

Gender differences in health are a widely recognized phenomenon (World Economic Forum, 2024; Cabral and Dillender, 2024), yet our understanding of the underlying causes is limited. This paper focuses on ischaemic heart disease, which is not only the leading cause of death worldwide (WHO, 2020) but also a condition characterized by significant gender inequality. We show that the behavior of both the healthcare provider and the individual contributes to the undertreatment of heart disease in women. These inequalities not only have large implications for health outcomes but are also associated with gender inequalities in the labor market.

While men are overall more likely to be diagnosed with ischaemic heart disease (7%) compared to women (5%) (Mozaffarian et al., 2015), women experience significantly higher mortality rates after acute events such as acute myocardial infarction (AMI).[1] This is puzzling: those who are sicker (and thus more likely to die from AMI) should be more likely to be diagnosed in the first place. We refer to this as the *prevalence-mortality puzzle*.

There are many potential explanations for this puzzle, and they are widely debated in medical science. The medical literature has suggested differences in the disease process across gender (pathophysiology) and gender differences in symptoms, care-seeking, and care provision (Aggarwal et al., 2018; Mehta et al., 2016; Greenwood et al., 2018).[2] There is, however, no consensus on whether pathophysiological differences are indeed responsible for the higher female mortality after AMI (Aggarwal et al., 2018). Studies investigating the role of care-seeking and care provision (Bairey Merz, 2014; Hanratty et al., 2000; Karcioğlu et al., 2002) point to the importance of medical treatment choices as well as patient characteristics such as health behaviors or demographics. The most debated factor is provider behavior (Roeters van Lennep et al., 2023; Wenger, 2012), with the argument that women are often underdiagnosed and thus do not receive the necessary preventive care, e.g., in the form of medication. This claim, however, lacks causal evidence. It is also not well understood why women would be underdiagnosed. This has been supported by calls for action to achieve better outcomes for women with heart disease, e.g., by the European Atherosclerosis Society(Roeters van Lennep et al., 2023). Potential reasons for underdiagnosis are difficulties in diagnostics due to women presenting with different symptoms than men, physicians' potential lack of attention, empathy, and communication skills towards women, or beliefs about the efficacy of medication for women (Roeters van Lennep et al., 2023). Another potential explanation is individual behavior, such as gender differences in care-seeking, and other health behaviors, such as preventive care. Crucially, provider and individual behavior are often analyzed in isolation despite the reality of important interactions between the two.

[1] This holds even when accounting for the fact that AMIs occur on average later for women than for men (Emanuel et al., 2021; Greenwood et al., 2018; Mehta et al., 2016) and despite general advances in survival following cardiovascular disease events.

[2] Pathophysiology studies "biological processes that are directly related to disease processes of physical, mental, or psychophysiological conditions and disorders" (Witthöft, 2013). This could, for example, mean that women experience stronger AMIs than men.

The likely reason is that it is often challenging to disentangle both.

This paper investigates the joint role of individual and provider behavior for the *prevalence-mortality puzzle* using a unique combination of Danish register data with medical examination data. We provide evidence for the important role of the general practitioner's (GP) prescription of lipid-lowering drugs, which are a cheap and easy way to reduce the gender gap in post-AMI mortality, but are much less used by women. Lower usage seems largely affected by the GPs: switching to a GP with a higher share of female patients using lipid-lowering drugs increases uptake of lipid-lowering drugs and reduces mortality in the long run. We then show that underdiagnosis does not seem to be a driving factor. Investigating the uptake of lipid-lowering drugs among men and women who received a (first) high cholesterol measurement in the CCHS shows a substantial gender gap. This gap does not vary along a range of GP characteristics but is reduced for women who switch their GP. Lastly, we demonstrate that AMI has substantial negative effects on labor supply and disability benefit receipt, which are significantly larger for women and emerge years prior to AMI.

We use administrative records on hospitalizations, deaths, prescription drug pick-ups, doctor visits, and labor market status. We leverage these records with survey and medical examination data from the Copenhagen City Heart Study (CCHS).[3] The CCHS is a cardiovascular population study that provides data on heart markers through examinations outside of the standard healthcare system. While objective health measurements are rare in general, they are also not actively pursued by the patient or the provider in this setting. We use information shocks created by receiving a high cholesterol measurement for the first time to investigate whether difficulties in recognizing women's symptoms contribute to the *prevalence-mortality puzzle*.

First, we document the existence of gender disparities in heart disease for the entire Danish population. We show that while men have a higher likelihood of being diagnosed in the hospital with AMI (0.4% versus 0.2% between ages 30 and 90), women are up to 33% (3-5 p.p.) more likely to die within the first year after AMI. This gap also persists when controlling for the fact that women are typically older at first AMI. These first results confirm previous results across different populations and countries (Berger et al., 2009; Tan et al., 2016). Second, using information on individual use of prescription medicine, we show that the gender gap in mortality is much smaller for those who used lipid-lowering drugs prior to AMI. Over the life course, women, however, have 18% lower usage rates of lipid-lowering drugs than men. This suggests an important margin where higher use of lipid-lowering drugs for women would lower female post-AMI mortality substantially.

Therefore, we investigate why women do not use these potentially life-saving medications as much as men. Combining administrative data on healthcare use with objective health data from the CCHS, we show that women consistently seek more care, even conditional on objective health, health behaviors, and self-assessed health. It thus seems unlikely that women are not receiving medication simply because they generally do not seek care. We

[3] For an overview article about the study see Aguib and Al Suwaidi (2015).

then examine whether providers drive the lower usage of these drugs. There is indeed substantial variation in female usage rates of lipid-lowering drugs across GPs. Importantly, there are more often GPs with low female user shares than with low male user shares. Exploiting clinic closures, we demonstrate large effects of providers on medication usage: changing to a GP with a higher female usage rate of lipid-lowering drugs increases the likelihood of using these drugs and reduces mortality in the five years after the GP change. Importantly, women do not actively select into low usage share GPs after a closure, thus, this cannot explain women's lower usage. The results also apply to men. This emphasizes the role of the general and not gender-specific prescription styles. The importance of GPs with high female user shares could reflect many things, such as better diagnostic skills or better medication management (e.g., convincing patients of medication importance).

We then examine underdiagnosis as a potential mechanism driving lower prescribing to women. Difficulties in communication or recognizing symptoms might deter GPs from administering relevant laboratory tests and examinations, thus leading women to be underdiagnosed and undertreated. We exploit the fact that such laboratory tests are performed as part of the CCHS. The test results were sent to the respondents with the note to contact their GP if they exceeded a threshold. We test whether the use of lipid-lowering drugs differs between men and women after they receive a high cholesterol measurement for the first time during the CCHS examination. The measures of high cholesterol are clear markers for heart disease and, according to guidelines, should be treated with lipid-lowering drugs. If lower prescribing to women is purely driven by difficulties in recognizing and interpreting female symptoms of heart disease, we should not find gender differences once the cholesterol level is known. We show that even with a first high cholesterol measurement, women are on average less likely to use lipid-lowering drugs than men with a first high cholesterol measurement. Nevertheless, usage in general goes up for the group with high cholesterol measurements, just not as much for women as for men. The gap in uptake of lipid-lowering drugs does not vary along a range of GP characteristics, but is reduced for women who switch their GP.

Lastly, we investigate spillovers to the labor markets. If women are undertreated, this will not only affect their health but could also imply important labor market limitations. We show that after AMI, both men and women are less likely to work and more likely to be on disability benefits. This labor market penalty of AMI is, however, larger for women than for men. Using event studies, we show that women also reduce their labor supply and increase disability benefit receipt drastically in the years before AMI - much more than men. This is consistent with undetected health issues before AMI, which negatively affect labor supply. The gender differences with respect to heart diseases, thus could amplify already existing gender disparities in the labor market.

This paper adds to several strands in the literature. One strand discusses gender differences in mortality and its causes. Most of the studies, however, focus on the overall (increasing) female mortality advantage - i.e., the fact that women typically live longer than men. This advantage is often explained by gender-specific preferences and behavior (Schünemann et al.,

2017), such as smoking (Preston and Wang, 2006) and reductions in maternal mortality (Jayachandran et al., 2010). It is, however, also recognized that much remains unexplained about the female mortality advantage (Goldin and Lleras-Muney, 2019). We focus on an area that is under-explored in this literature – given that the gap in mortality here favors men. Nevertheless, some of the mechanisms are also relevant in the discussion of the overall male mortality disadvantage. Furthermore, we shift the focus to the behavior of both providers and individuals as an explanation.

A second strand studies gender differences in healthcare use and health behavior. This literature has established that women seek more healthcare and have higher expenditures (Bertakis et al., 2000; Wardle et al., 2004; OECD, 2016). Many studies suggest that these gender differences are caused by/related to gender differences in personality (Cobb-Clark et al., 2014), preferences (Schünemann et al., 2023; Cohen and Einav, 2007), and health perceptions (Arni et al., 2021). We provide evidence that gender differences in healthcare-seeking and health behavior persist conditional on objectively measured health, which emphasizes the above-mentioned role of preferences, personality, and health perceptions.

A third strand concerns provider behavior and, in particular, provider bias. Several papers have demonstrated the importance of providers (Ginja et al. (forthcoming)) in general but also particularly for heart disease (Currie et al., 2016; Koulayev et al., 2017; Simeonova et al., 2024). Provider beliefs often seem to outweigh patient demand, which is problematic as a considerable share of those beliefs is unsupported by clinical evidence (Cutler et al., 2019). The importance of provider behavior is accentuated by substantial heterogeneity along patient and provider characteristics. Several studies highlight the importance of general provider characteristics such as age, gender, race, experience, or practice style (Currie et al., 2016) while others emphasize concordance between patient and provider according to gender, race, or SES (Greenwood et al., 2018; Cabral and Dillender, 2024; Alsan et al., 2019; Kristiansen and Sheng, 2022). These studies suggest that concordance in patient and provider characteristics might be crucial for communication. We study provider behavior in a setting where objective health information is available but not mandated by the providers themselves. This makes it possible to dig deeper into potential mechanisms of provider and patient behavior. The external measurement of health distinguishes this paper from a closely related study by Simeonova (2013), which shows that patient responses to provider input matter more than provider behavior itself for the racial mortality gap, but where patient severity is endogenously measured. Another closely related study is Kämpfen and Mosca (2024), who demonstrate stronger responses of males to blood pressure measurements than for females but cannot establish any mechanisms.

The findings of this paper contribute to a better understanding of the high female mortality after AMI and the labor market consequences of poor heart health. The study of AMI is particularly policy-relevant due to its high rank in the cause of death statistics, but also due to the well-established treatment. High female mortality furthermore not only reduces women's lifespan but also points toward poor health in the years before acute events, likely undetected. The costs for both society and the individual are also not limited

to health but spill over to the labor market. A larger AMI penalty for females in the form of reductions in labor supply and increases in disability benefit receipt, as well as larger anticipatory behavior, show that women with heart disease struggle more to stay attached to the labor market than men with the same condition. Gender differences in heart disease have accordingly received a lot of attention, e.g., in a report by the World Economic Forum from 2024 that calls for closing the "Women's Health Gap" (World Economic Forum, 2024). In addition, if underdiagnosis is carried through until death, i.e., if many women with heart disease are never diagnosed, this will bias the underlying data used to develop widely-used risk assessment tools such as the SCORE2 (ESC Cardiovasc Risk Collaboration and SCORE2 Working Group, 2021; Mortensen et al., 2022). Our findings suggest an important role of physician prescription behavior but also testing, which could be improved by policies targeting more testing or the training of physicians.

The remainder of this paper is organized as follows: Section 2 describes the institutional background and the data used. Section 3 documents the prevalence-mortality puzzle in the Danish population. Section 4 explores the drivers of the prevalence-mortality puzzle, and Section 5 investigates spillovers to the labor market. Section 6 concludes.

2 Institutional Background and Data

2.1 Institutional Background

Denmark has a universal public health insurance system for all citizens funded by taxes.[4] While the national government organizes overall health policies, primary and secondary healthcare is organized by the five regions and the 98 municipalities (Christensen et al., 2016).

Primary healthcare is mainly organized by privately owned clinics. These self-employed GPs provide (subsidized) services to their patients free of charge.[5] The number of GPs was around 3,500 in 2010, organized in about 2,200 clinics, with each GP having an average of 1,600 patients affiliated with their clinic (Forde et al., 2017). Citizens are free to choose a specific GP, but the availability of GPs varies across the country. There is a (modest) fee associated with switching GP (≈US$30) unless the change is either related to the patient moving to a different municipality or a closure of the current GP's clinic. When a GP clinic closes, patients can choose among clinics that are open for intake of new patients in the area.[6] The information available to the patient when choosing a clinic is limited but includes the names, ages, and genders of GPs in the clinic.[7]

The GP acts as the primary link between their patient and the rest of the healthcare

[4] This means that access barriers are not among the mechanisms explored here. However, as the next section will show, the *prevalence-mortality puzzle* exists despite free access to care.
[5] The reimbursement framework for the primary care clinics combines capitation and fee-for-service fees.
[6] Within a 15-kilometer radius of the patient's home; 5 kilometers in the Copenhagen area.
[7] Many clinics also provide information about their clinic on the clinic's website.

system, thus serving as a gatekeeper for specialists in hospitals and private clinics. The GP is often responsible for initial diagnostics, routine interventions, prescription of medicine, managing chronic conditions, providing preventive care, and referring patients to specialized treatment. GPs are, e.g., responsible for around 85% of all outpatient prescriptions.

Patients in hospitals receive medicine free of charge while hospitalized. When discharged from the hospital, patients need to collect their medicine at a pharmacy. While there is an out-of-pocket cost associated with purchasing medicine, prescription drugs sold in pharmacies are highly subsidized.

2.2 Register Data

We obtain data on AMIs from the hospital register, containing all hospitalizations and outpatient hospital contacts in Denmark since 1977. We use data from 1995 onwards to align with the drug database (see below). We merge the hospital register with population registers to present evidence on full population (diagnosed) prevalence. This is combined with outpatient care data on GP and specialist visits, and with the prescription drug database from 1995 until 2019. This data provides the Anatomical Therapeutic Chemical Classification System grouping code (ATC-code) of medications picked up. We focus on lipid-lowering drugs (ATC-C10) since they have a clear connection to mortality through cholesterol.[8] We also construct female usage rates for lipid-lowering drugs on the clinic level. Lastly, this data is supplemented with information on individuals' labor market status.

2.3 Copenhagen City Heart Study (CCHS)

We complement the register data with objectively and independently measured health from the Copenhagen City Heart Study (*Østerbroundersøgelsen*). This enables investigating the role of diagnostics and gender differences in care-seeking conditional on objective health for the *prevalence-mortality puzzle*.

The Copenhagen City Heart Study is a cardiovascular population study with examinations conducted in Copenhagen between 1976 and 2015, in five waves and with an ongoing follow-up. We focus on waves 3-5 since most of the register data starts around wave 3. The study goal was to learn about the prevention of coronary heart disease and stroke. Each wave consisted of two parts: a survey about respondents' background information, health behavior, and health history, and a medical examination in which several key health parameters were measured. Most importantly, the CCHS measured respondents' cholesterol levels from a blood sample. The results of the measurements were sent to the patient directly. The measurements from various tests were written into a report card with clear markers for values outside the normal range (see Figure A2 in the appendix). Respondents were invited to the study through a random draw from the Copenhagen population register, stratified by age, if they lived within the ten city wards surrounding the hospital in which the study was conducted. This means that the CCHS study population is regionally selected. The response

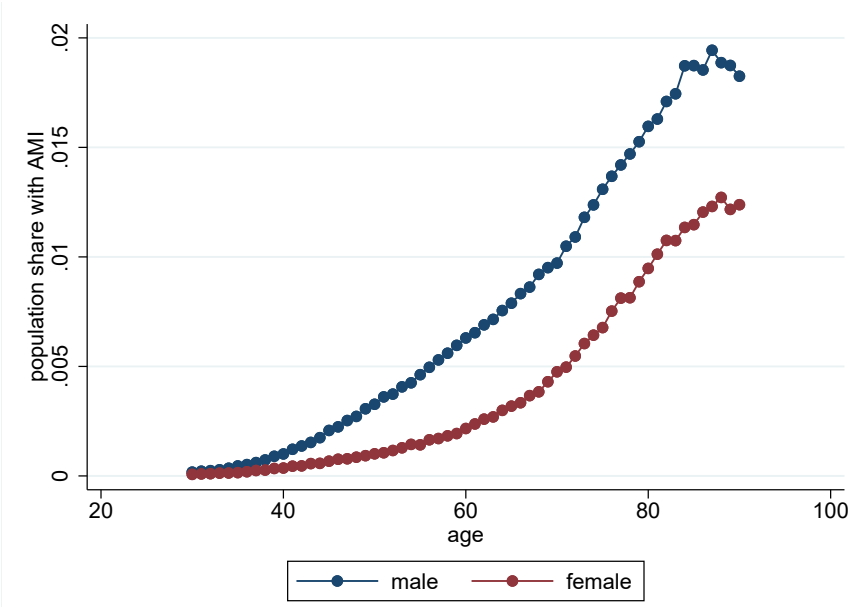
[8] See Table A1 for an explanation of the different types of drugs.

rate ranged between 50 and 75% across waves (Schnohr, 2009). Table A2 in the appendix presents some general demographic descriptives of the invited and participating population. It shows that those who participate are overall advantaged from a health perspective: they are younger, more likely to be married, use more care, have fewer comorbidities, have higher labor income, and have more education. Issues such as undertreatment are likely less severe in such an advantaged population, suggesting that the results of this paper likely present a lower bound of effects for the entire population.

3 The Prevalence-Mortality Puzzle

Figure 1 plots the prevalence of first hospitalizations with AMI in the Danish population for the ages 30 to 90. Over the entire age range, men are more likely to be diagnosed with AMI, with an average prevalence of 0.4% compared to 0.2% for women.[9] The gender gap is quite large, with the share of men with AMI being up to 0.63 percentage points higher than the share of women, equivalent to a 2.5-fold higher prevalence. This is in accordance with evidence from many other developed countries (Tan et al., 2016).

Figure 1: Prevalence of AMI - over age and gender

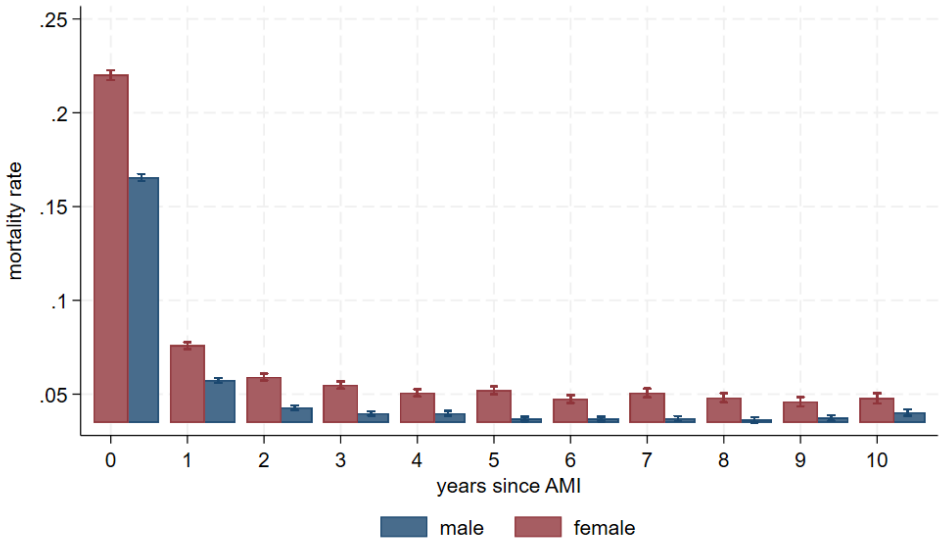


Note: Figure shows the prevalence of AMI over age, split by gender for the entire Danish population from 1995 to 2018. Restricted to ages 30-90.

When we turn to post-AMI mortality, we would expect that men are more likely to die since they are more often diagnosed and thus likely less healthy. Figure 2, however, shows the opposite: in the first 10 years after AMI, women are more likely to die, between 0.7 and 5.5 percentage points. This is equivalent to 11-79% of the average mortality rate over this period (6.9%). The gap is largest in the year where AMI occurs, both in absolute and relative terms, with a 33% higher mortality rate for women. The mortality rate decreases substantially after year zero, suggesting that either those who are relatively healthier survive or that those who survive can be treated effectively.

[9] While prevalence grows steadily over age, there is a dip around age 90 where the curve flattens. This is because around age 90, many individuals do not make it to the hospital anymore when they have a first AMI, but die right away at home/in a nursing home. Such deaths are not counted here since individuals are never diagnosed in the hospital.

Figure 2: Gender gap in mortality after AMI



Notes: Figure shows the mortality rate after a first AMI for 10 years following AMI, split by gender. Restricted to ages 30-90.

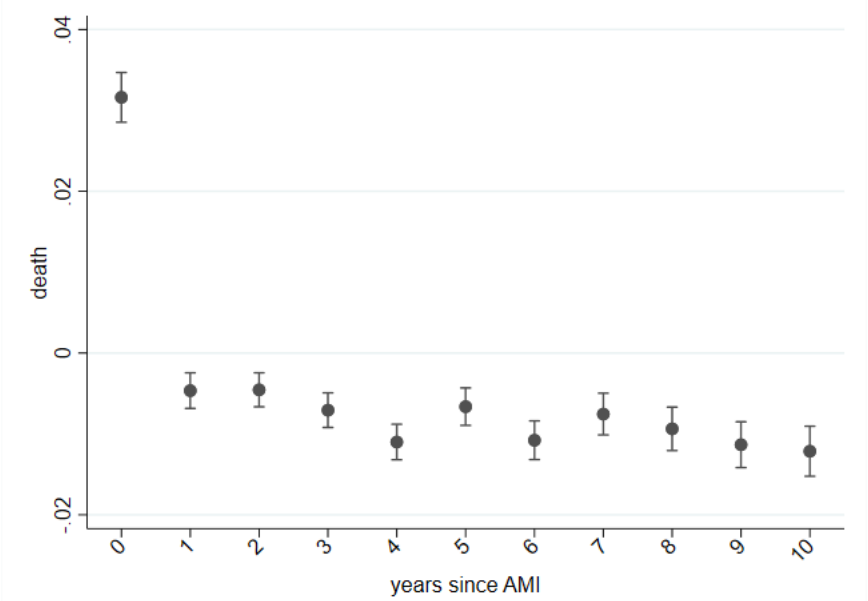
One potential explanation for the *prevalence-mortality puzzle* is that women are just older and/or sicker when they experience AMI due to their higher overall life expectancy. Figure 3 plots coefficients from a regression of death post-AMI on gender, where age-fixed effects and comorbidities are taken into account. Comorbidities are measured using the well-established Charlson comorbidity index.[10] Figure 3 shows that the differences in the year of AMI shrink somewhat when controlling for age-fixed effects and comorbidities, suggesting a 3.1 percentage points higher mortality rate for women. After year zero, the gap reverses, and women experience a lower mortality risk. This is, on the one hand, consistent with an interpretation of underdiagnosis of women and therapy effectiveness, where those women who survive are finally adequately treated. It is, on the other hand, also consistent with more unhealthy men surviving due to earlier treatment compared to unhealthy women who die immediately.[11]

4 What drives the prevalence-mortality puzzle?

As mentioned above, underdiagnosis has been discussed as a potential driver for the *prevalence-mortality puzzle*. If women are underdiagnosed, they cannot receive the necessary care

[10] The Charlson comorbidity index predicts 1-year mortality on the basis of pre-existing health conditions. We use data on hospitalizations for the year prior to AMI. We use the weights provided in Quan et al. (2011) and use the procedure for administrative data by Quan et al. (2005).
[11] Similar results are obtained when only controlling for age.

Figure 3: Gender gap in mortality after AMI - controlling for age and comorbidities



Notes: Figure shows coefficients from regressing an indicator for death on the interaction $yrs\ since\ AMI \times female$. Controlling for age-fixed effects ($\lambda_{i,t}$), year-fixed effects (μ_t), and comorbidities in the year before using the Charlson comorbidity index. $death_{i,t} = yrs\ since\ AMI \times female + yrs\ since\ AMI + charlson_{i,t-1} + \lambda_{i,t} + \mu_t + \epsilon_{i,t}$.

in the form of check-ups or medication. Underdiagnosis seems to even occur in the acute case, where women with AMI are more likely to be sent away from the hospital instead of being admitted (Pope et al., 2000), incur much longer waiting times than men, and receive less thorough examinations (Banco et al., 2022). Potential reasons for this and higher female mortality are differences in pre-existing diagnoses and treatment. In the Danish setting, we can test directly whether those women who have been treated with medication against heart disease face different mortality rates compared to women who have not been treated and compared to men. We focus on cholesterol-lowering medication. High cholesterol is, next to high blood pressure, the largest driver of heart disease. Compared to high blood pressure, the relationship between cholesterol levels and mortality is unambiguous, and according to WHO (2019), the same for men and women. There also exists a clear medication treatment corridor in the form of lipid-lowering drugs.[12]

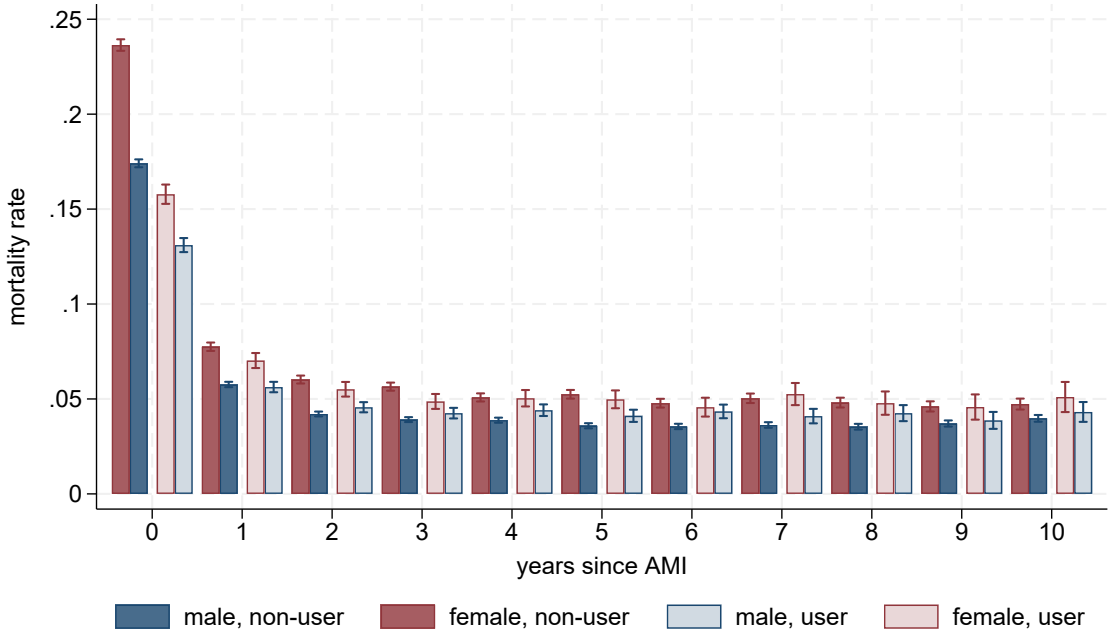
Figure 4 investigates the role of previous lipid-lowering medication descriptively. It shows the mortality rate after AMI split by gender and whether the individual has ever used lipid-

[12] Lipid-lowering drugs lower the level of total cholesterol and low-density lipoprotein (LDL) cholesterol in the blood. They are often referred to as "statins" since these are the most commonly used drugs. Risk and treatment indications are less clear for high blood pressure, the second driver of heart disease. There exists a range of blood-pressure-lowering medications that are often used in combination, such that indications are not as clear as for high cholesterol.

lowering drugs before.[13] Mortality in the group treated with lipid-lowering drugs is overall lower. However, also the gender gap in mortality is smaller in the population treated with lipid-lowering drugs (year 0: 2.68 p.p., 20%) than in the untreated population (year 0: 6.22 p.p., 36%), both in absolute and relative terms. This suggests that medication can reduce the gender gap in mortality.

Figure 5 repeats this exercise, controlling for age-fixed effects. Similar conclusions to those from Figure 4 can be drawn here. Note that after the year of the AMI, gender differences are no longer significantly different for users and non-users.

Figure 4: Gender gap in mortality after AMI - previous use of lipid-lowering drugs

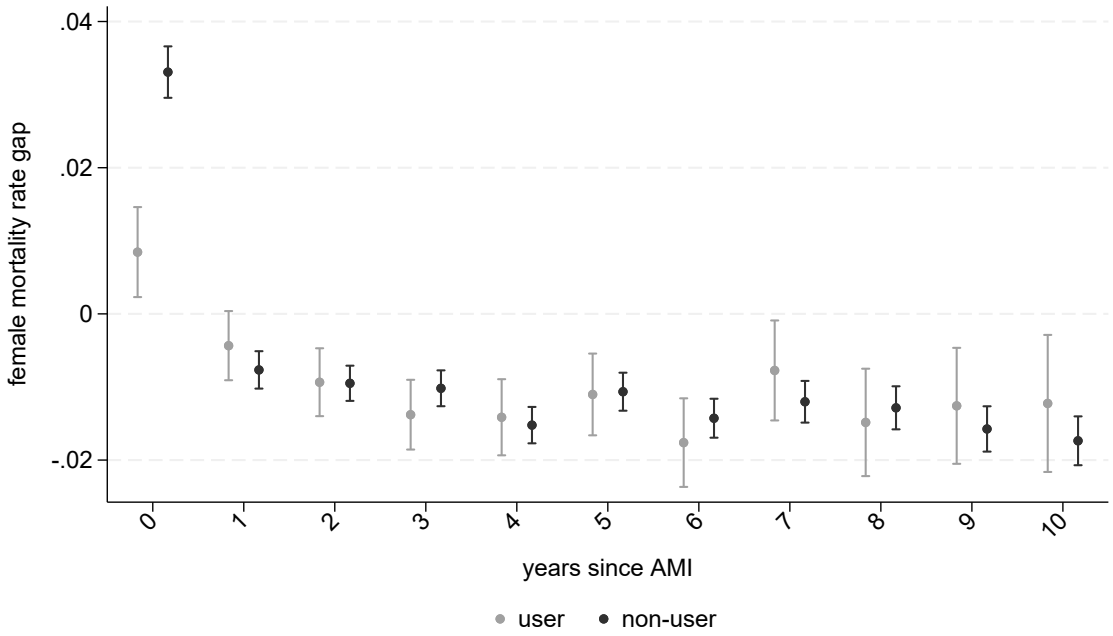


Notes: Figure shows the mortality rate after AMI for 10 years, split by gender and previous use of lipid-lowering drugs.

Now the question arises whether women do not use these medications to the same extent as men. Figure 6 below suggests so. It plots the share of the population between ages 30 and 90 using lipid-lowering drugs. It shows that men have substantially larger usage rates of lipid-lowering drugs.[14] This is surprising as studies have shown that lipid-lowering drugs in the form of statins are equally effective in women as they are in men for secondary prevention - i.e., when heart disease has already manifested (Sever et al., 2003; Group et al., 2002; Collins, 2003). There is furthermore no evidence that statins are less safe in men than in women

[13] We use the term "using" instead of "picking up" medication despite the data coming from prescription pick up. We elaborate on this assumption in Section 4.2.1.
[14] Men have a higher usage share for most other ATC-C code drugs. The patterns regarding mortality and previous use also hold for the other ATC-C codes; results available on request.

Figure 5: Gender gap in mortality after AMI - previous use of lipid-lowering drugs - controlling for age



Notes: Figure shows coefficients from regressing an indicator for death on the $yrs\ since\ AMI \times female$, separately for users, and non-users of lipid-lowering drugs. Controlling for age-fixed effects ($\lambda_{i,t}$) and year-fixed effects (μ_t). Estimated separately for previous users and non-users of lipid-lowering drugs: $death_{i,t} = yrs\ since\ AMI \times female + yrs\ since\ AMI + + \lambda_{i,t} + \mu_t + \epsilon_{i,t}$.

(Gulati and Merz, 2015). Guidelines also do not make different recommendations regarding critical cholesterol levels or treatment with statins for men versus women for secondary prevention (Grundy et al., 2019). Once initiated, lipid-lowering drugs are typically taken for the rest of life (Wu et al., 2022), meaning that gender disparities in use are likely accentuated over the life cycle. Figure A1 in the appendix furthermore shows that the out-of-pocket price patients face is quite low, with around US$150 per year before the patent of the most popular statin (*Simvastatin*) ran out in 2002, and around US$45 per year afterward.[15]

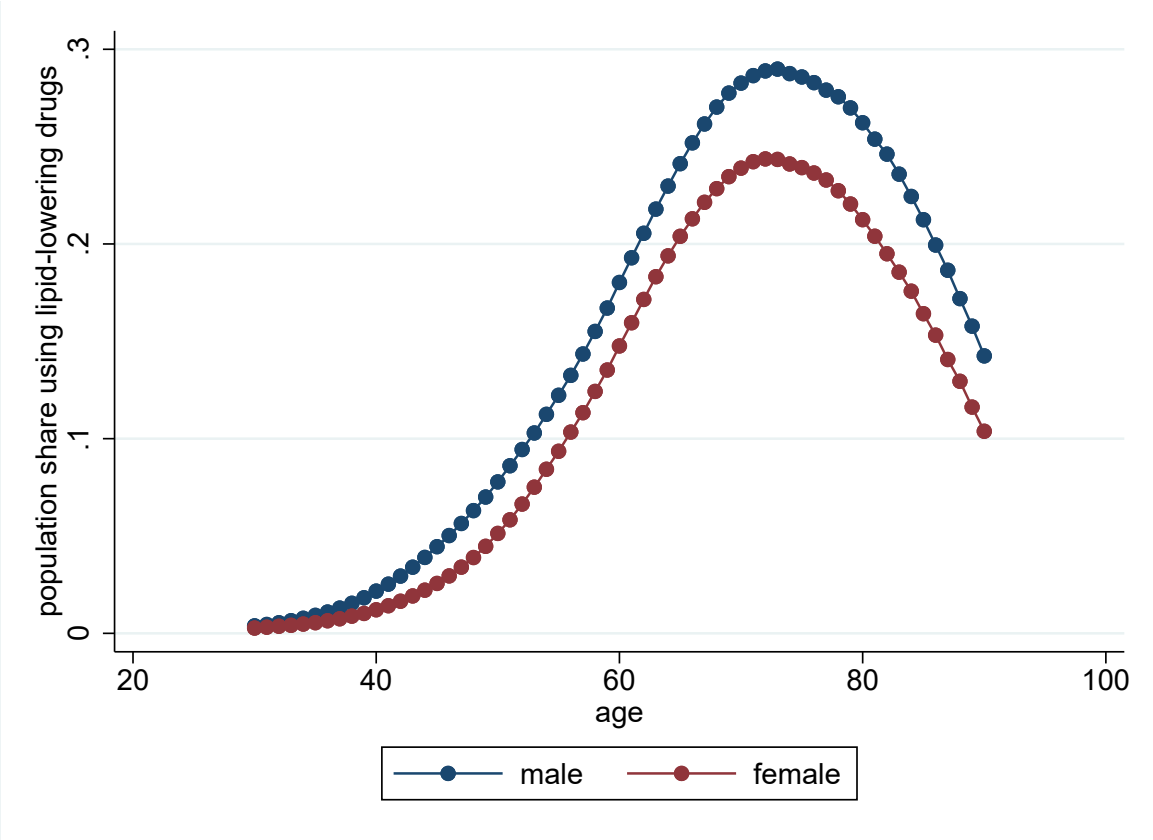
The overall lower usage of lipid-lowering drugs for women could stem from the patient or the provider side: Women could go to the doctor less, not pick up their prescription (so they do not show up in the data), or providers could prescribe less to women.[16] The next

[15] Usage of lipid-lowering drugs generally increases over age and often follows a hump shape at older ages, suggesting that those using lipid-lowering drugs potentially die earlier thus reducing the share of users in later age groups.

[16] We use the term provider when we refer to all possible physicians such as general practitioners, specialists, and doctors in the hospital. We use the term GP whenever we use explicit information about an individual's GP.

sub-section explores reasons rooted in individual behavior, sub-section 4.2 explores provider behavior, and sub-section 4.3 delves more into mechanisms.

Figure 6: Gender differences in usage of lipid-lowering drugs



Notes: Figure shows usage rates for lipid-lowering drugs in the whole population over age, split by gender. Restricted to ages 30-90.

4.1 Gender gaps in mortality: individual behavior

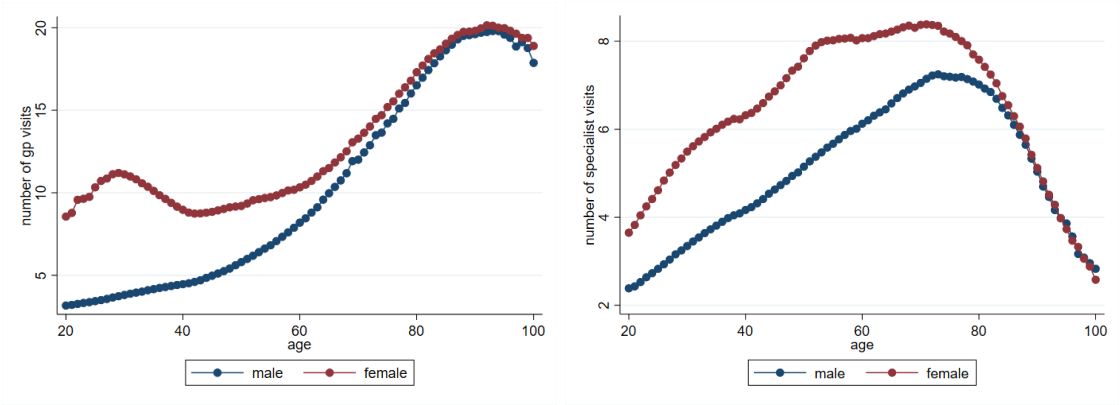
In this section, we explore the role of gender differences in healthcare-seeking behavior for the *prevalence-mortality puzzle*. We assess whether women are less likely to seek care and, therefore, less likely to obtain medication for heart disease. We first present descriptive evidence on healthcare usage of the entire Danish population from the registers and then zoom in on more detailed data on health behavior and self-assessed health from the CCHS.

4.1.1 Descriptive evidence on gender differences in health behavior

Figure 7 shows average visits to GPs and specialists for men versus women. Overall, women visit GPs and specialists more often. Especially at younger ages, women visit GPs and

specialists up to twice as much, the number of visits then converges at later ages.[17]

Figure 7: Gender differences in healthcare use



(a) GP visits

(b) Specialist visits

Notes: Figure shows averages over age. Excludes visits related to pregnancy and childbirth. For a definition of specialist visits, see footnote 13.

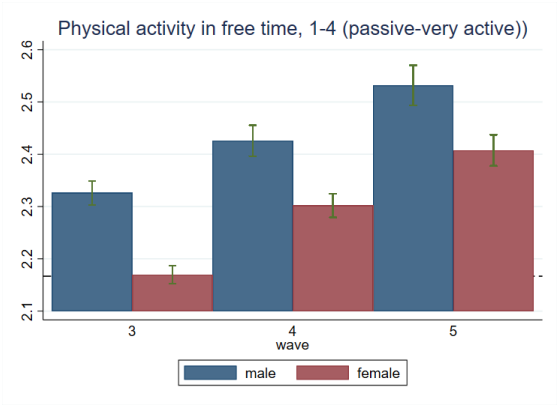
The fact that women visit GPs and specialists so much more often but are still less likely to use lipid-lowering drugs suggests that the content of those visits for men and women must be very different. One possible explanation is that providers may perceive men and women differently due to their health behaviors. Figure 8 uses data from the CCHS on self-reported health behaviors to shed some light on this. Figure 8 shows that women overall have very different risk profiles compared to men: they smoke and drink substantially less. However, they also exercise slightly less and report worse health. These gender differences also hold conditional on objective health and age, see Table A3. This suggests that women might be perceived differently than men by their providers, due to differences in lifestyle. However, differences go in both directions: women might be perceived as healthier due to them reporting less smoking and drinking, but also as less healthy due to worse self-assessed health and lower physical activity.

4.1.2 The role of objective health for gender differences in healthcare-seeking

In this subsection, we investigate whether the higher care-seeking of women shown above is explained by poorer health or different health behaviors. Table 1 below estimates the role of gender for care-seeking in a simple OLS model with the number of GP and specialist visits as the dependent variables, using varying controls. Columns (1) and (5) show the raw

[17] Note that GP and specialist visits exclude visits related to pregnancy and childbirth and children's care. Specialist visits contain visits to different doctors, e.g., radiologists, internists, neurologists, psychiatrists, etc. Excludes physiotherapy, chiropractors, and gynecologists. Note that in Denmark, cardiologists do not operate in private practices but only in hospitals and will thus not show up in our measure of specialist visits.

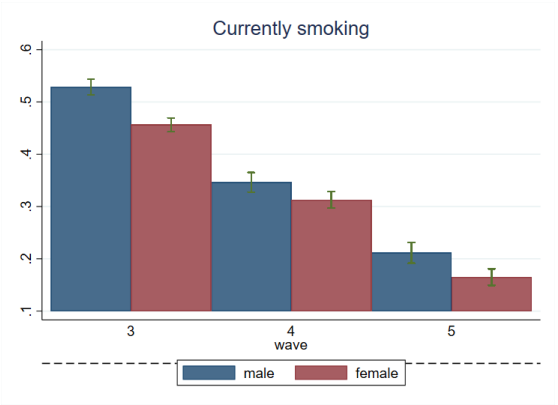
Figure 8: Gender differences in health behaviors



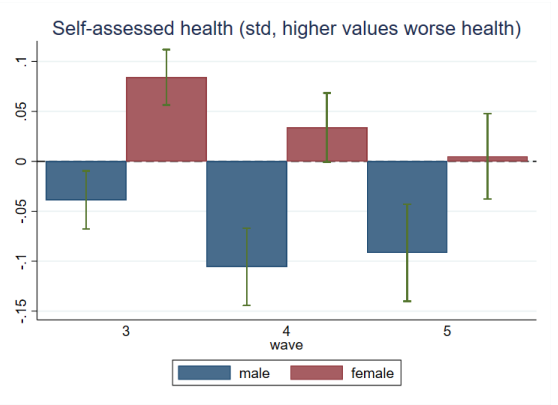
(a) Phys. activity 1-4 (passive-very active)



(b) Alcohol freq. 1-4 (never-daily)



(c) Share current smoker



(d) Self-assessed health (standardized)

gender gap in visits, accounting for year and age-fixed effects. Women have three more visits to the GP per year and 2.4 more visits to a specialist than men. Relative to the means, this suggests that women go to the GP 37% and the specialist 32% more. Columns (2) and (6) add controls for objective health, in the form of systolic and diastolic blood pressure, total cholesterol, and body mass index (BMI). The coefficients change very little and remain statistically significant. This means that, also conditional on objective health, women go to the doctor more often. In the next step, instead of objective health, we include measures of self-reported health behavior (smoking, the frequency with which alcohol is consumed, the frequency of physical activity) and self-assessed health. Compared to the baseline without controls, coefficients become smaller but remain statistically significant. In the last step, we control for both, measures of objective health and health behaviors (columns (4) and (8). Even then, the coefficients of the female dummy remain significant and still suggest 34% (of the mean) more GP visits and 30% (of the mean) more specialist visits for women

compared to men. This suggests that women consistently seek more care, regardless of their objective health and health behavior.

The evidence presented in this section suggests that a lack of women's healthcare-seeking is not the driving factor behind their lower usage of lipid-lowering drugs. We, however, find that women might be perceived very differently by the provider due to gender differences in reported health behaviors and self-assessed health, conditional on objective health. The next section, therefore, focuses on the role of the provider.

Table 1: Associations between gender and care-seeking, conditional on objective and subjective health

	Number of GP contacts				*Number of specialist contacts*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mean:			*8.17*				*7.61*	
Female	3.033***	3.170***	2.644***	2.810***	2.419***	2.414***	2.316***	2.247***
	[0.124]	[0.127]	[0.129]	[0.132]	[0.145]	[0.150]	[0.155]	[0.161]
Objective health								
Systolic BP		-0.011***		-0.009**		-0.020***		-0.020***
		[0.004]		[0.004]		[0.005]		[0.005]
Diastolic BP		-0.008		-0.003		0.005		0.005
		[0.007]		[0.007]		[0.009]		[0.009]
Total cholesterol		-0.265***		-0.220***		-0.285***		-0.253***
		[0.056]		[0.055]		[0.066]		[0.067]
BMI		0.170***		0.112***		-0.029		-0.060***
		[0.016]		[0.016]		[0.018]		[0.019]
Health Behaviors								
Current smoker			-0.044	0.129			-0.833***	-0.907***
			[0.129]	[0.130]			[0.155]	[0.158]
Alcohol freq. (1-4)			-0.231***	-0.168*			0.019	0.001
			[0.086]	[0.087]			[0.104]	[0.106]
Phys. activity (1-4)			-0.224**	-0.142			0.363***	0.269**
			[0.088]	[0.088]			[0.106]	[0.108]
Self-assessed health			1.913***	1.839***			0.752***	0.793***
			[0.063]	[0.063]			[0.076]	[0.077]
Constant	4.063	3.227	6.156**	5.309*	-3.221	0.952	-3.030	2.056
	[3.213]	[3.226]	[3.104]	[3.130]	[3.747]	[3.816]	[3.741]	[3.816]
R-squared	0.071	0.078	0.129	0.130	0.075	0.079	0.082	0.087
Observations	15,726	15,516	15,330	15,128	15,726	15,516	15,330	15,128

Standard errors clustered on the individual level in brackets; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Controls for age ($\lambda_{i,t}$) and year-fixed (μ_t) effects in all columns. Physical activity ranges from 1-4 (passive-very active), and alcohol frequency ranges from 1-4 (never-daily) as well. $\#contacts_{i,t} = female_i + \lambda_{i,t} + i.year + controls_{i,t} + \epsilon_{i,t}$

4.2 Provider Behavior

4.2.1 Variation in provider usage rates of lipid-lowering drugs

To study provider behavior, we focus on the medication usage of patients. The prescribing of medication is not only one of the key tasks of GPs but also an important dimension of the treatment of heart disease, as suggested by Figures 4 and 5. There are two important assumptions related to the data. The prescription database only records medication picked up at the pharmacy and does not record prescriptions that were written but never picked up. First of all, we need to assume that those medications that are picked up are also used. Data from the CCHS reveals that around 91% of those who have picked up a prescription for lipid-lowering drugs in the month before the examination also indicate using these drugs in the survey. Only 1.6% say they do not use them, and 7.4% do not respond. Proxying medication usage with medication pick-up is a common assumption made in this setting. We will therefore use the term medication usage instead of prescription pick-up. Second, we need to assume that the pick-up of medication also reflects the prescription behavior of providers. A study from 2014 (Pottegård et al., 2014) suggests that about 9.3% of first prescriptions are not picked up, with very little differences across genders. For statins, this number drops to 6.2%. However, in the most extreme scenario, there might be selection of those patients who never pick up statins to specific GPs, and we would largely overestimate the role of the GPs. We, therefore, exploit in the next subsection that individuals are exposed to new GPs when their clinic closes.

We first provide descriptive evidence on the variation of medication usage according to gender across GPs. We document the variation in the GP-specific rates of male and female usage of lipid-lowering drugs. The share of male patients using lipid-lowering drugs is on average higher, with around 7.1% (sd 0.07) compared to women with around 5.6% (sd 0.06) of female patients. Panel (a) of Figure 9 below plots the distribution of the share of female and male patient user shares of lipid-lowering drugs. The figure shows that there are more GPs with low female usage shares and high male user shares. Another way to depict gender differences in usage is to plot the gap, i.e., the difference between male and female usage share for each GP. Panel (b) of Figure 9 below shows that the distribution of this gap is clearly right-skewed, reflecting more GPs with higher male than female usage shares. The size of the gaps is also relatively large compared to the usage shares over age presented in Figure 6. The descriptives above suggest substantial variation in usage shares across GPs, with large gaps between men and women.

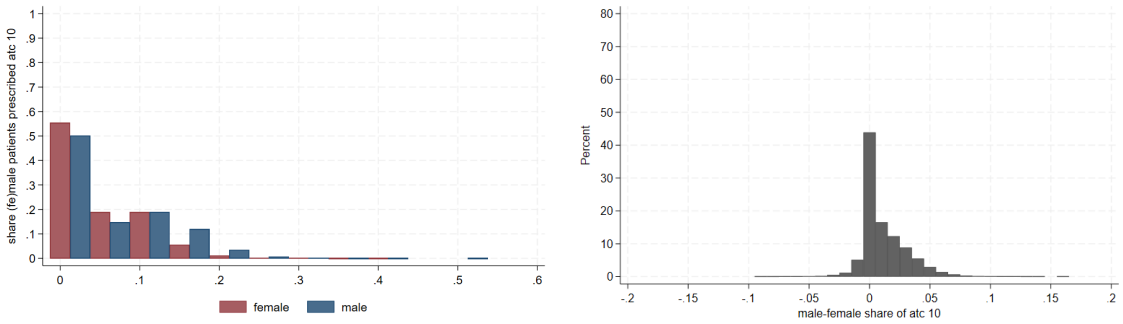
4.2.2 The effect of provider-usage rates on uptake of lipid-lowering drugs and mortality

In order to show that medication usage is indeed a good proxy for provider prescription behavior, we exploit that patients face new providers when their old clinic closes. If a provider's prescription behavior is relatively unrelated to individual medication use, we should not find any effect of changing to a new provider on subsequent medication use. We

exploit the difference in female usage rates of lipid-lowering drugs between the old (closing) and the new GP. We focus on female user rates as a proxy of a GP's prescription behavior towards females. We do, however, also consider outcomes of males to understand whether higher female usage rates reflect a general or a patient-gender-specific behavior.

Figure A3 in the appendix plots the distribution of the difference in female usage rates between the old and the new GP when a clinic closes. The figure shows that individuals experience different types of changes: they change to GPs with the same, lower, or higher female usage rates.[18]

Figure 9: Differences in male and female usage rates of lipid-lowering drugs



(a) Distribution of GP-level male and female usage rates of lipid-lowering drugs

(b) GP-level gap between male and female usage rates of lipid-lowering drugs

We investigate the role of switching GPs by documenting how the difference in female usage rates of lipid-lowering drugs between the new and the old GP is related to the probability of picking up a prescription for lipid-lowering drugs relative to those individuals who switch to a GP with (roughly) the same female usage rate. Importantly, we control for the individual's 1-year lagged prescription usage. Figure 10 shows that if the difference is negative, i.e., the new provider has a lower usage rate, then the probability of picking up lipid-lowering drugs is reduced. Vice versa, if the difference is positive, i.e., the new provider has a higher female usage rate, then the probability of picking up a prescription is increased. It also seems that those effects are weakly linearly increasing in the size of the difference. The patterns are similar for men and women.

We then use an alternative specification where we compare the effect of closure-induced switching to a GP with a lower or higher female usage rate of lipid-lowering drugs on the change in the prescription pick-up instead of using the entire range of changes. Figure 11 shows that switching to a GP with a lower female usage share of lipid-lowering drugs reduces the probability of picking up a prescription. Switching to a higher female share

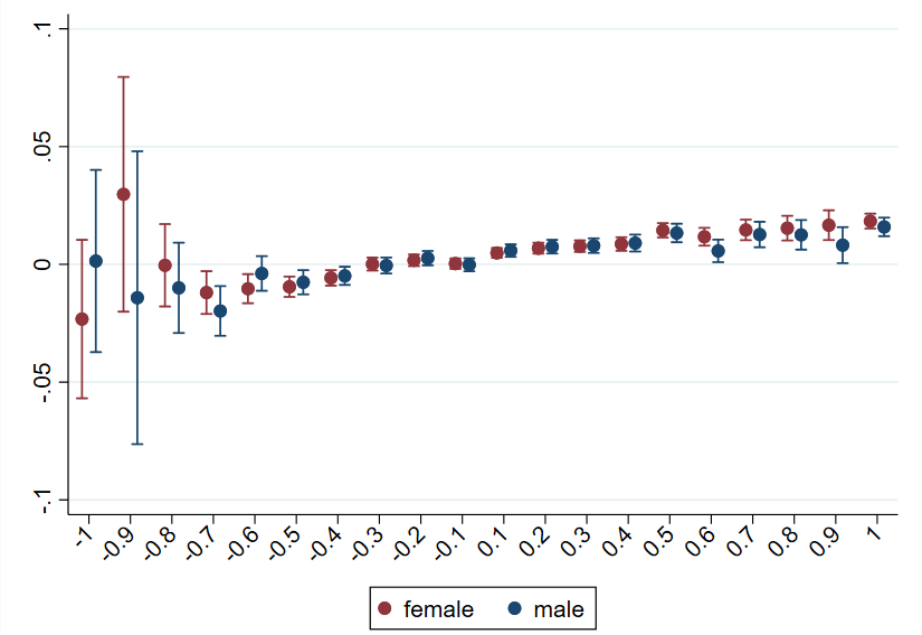
[18] Note that there is mass at 1, indicating there is a large share of individuals who experience more than a doubling of the prescription rates. This might reflect time trends due to the increasing usage of medication over time. Such time trends will be accounted for in the estimations.

GP increases the probability of picking up a prescription. The effects for men are again very similar. This points to the importance of general and not necessarily gender-specific prescription behavior.

In these estimations, we control for the difference in GP practice age and gender composition, as these characteristics are observed by potential patients and thus can be selected into. The effect sizes are large compared to average usage rates, ranging up to 30%. This suggests that GPs exert a substantial influence over the medication usage of their patients. One threat to this conclusion is selection. That means we need to show that after a closure, women do not select to lower-female usage-rate GPs and therefore receive less medication. Figure 12 below shows that the opposite holds true. The figure depicts relative risk ratios from a multinomial logit model for the effect of the female indicator on the probability of choosing a lower or a higher female usage rate GP after a closure, relative to a similar female usage rate GP. Women have a lower relative risk ratio of choosing a new provider with a lower female usage rate than men. The female indicator is also associated with a higher relative risk ratio of choosing a GP that has a higher usage rate.

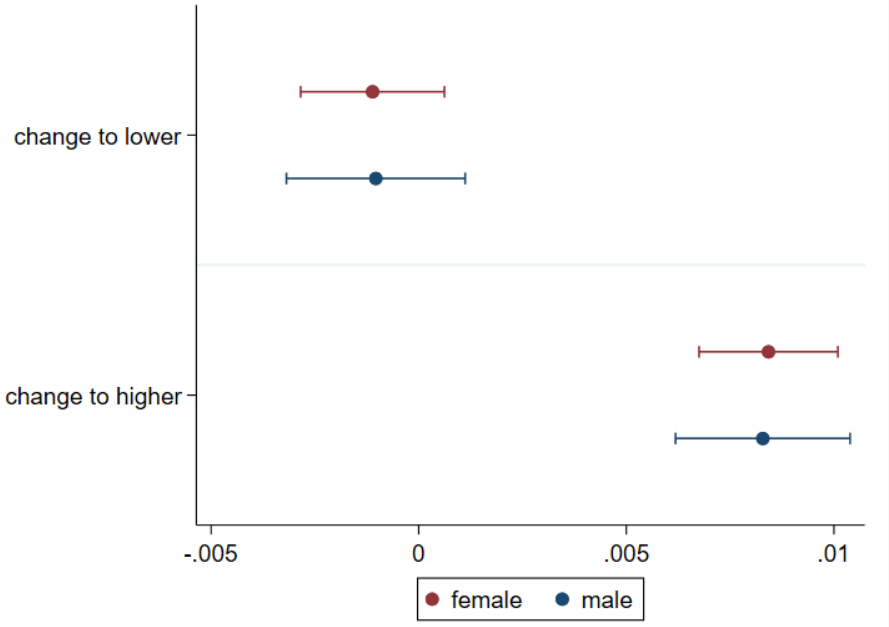
Lastly, we investigate whether the switch to a higher or lower-usage-rate GP also affects mortality. Figure 13 provides suggestive evidence that the change to a lower/higher usage rate GP affects the mortality risk in the first five years after the GP change. Switching to a GP with a higher usage rate of lipid-lowering drugs is associated with a small reduction in the probability of dying in the first five years after the change. This suggests that the increase in lipid-lowering drugs induced by the doctor can be life-saving.

Figure 10: Effect of change in female usage rate on own usage of lipid-lowering drugs



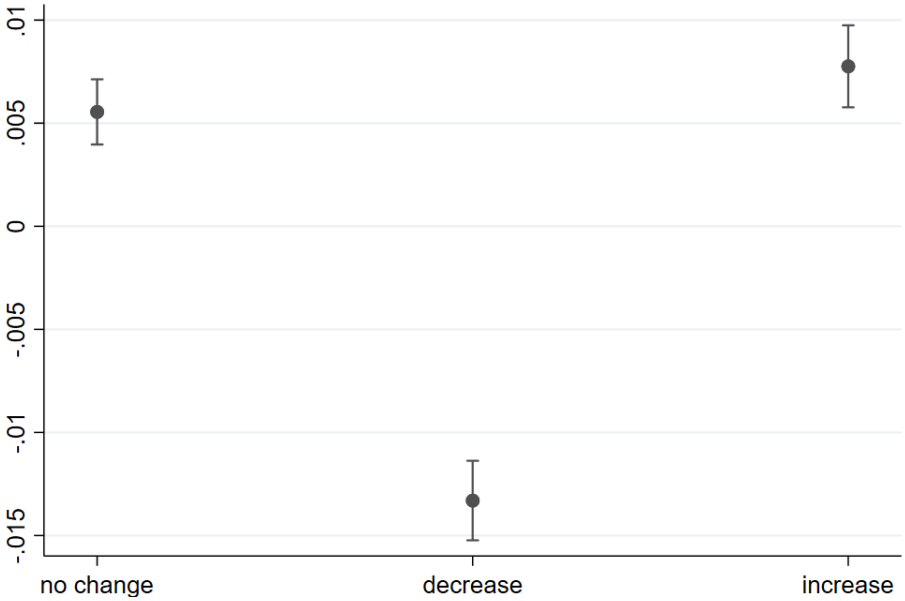
Notes: Figure shows the effect of the change in female usage rates after closure on the probability of receiving medication. Controls for age ($\lambda_{i,t}$) and year-fixed (μ_t) effects as well as the change in age and gender composition between the closing and the new clinic. $P(ATC10_{i,t}) = changerate_ATC10_{i,t} + ATC10_{i,t-1} + change\ docgender_{i,t} + change\ docage_{i,t} + \lambda_{i,t} + \mu_t + \epsilon_{i,t}$.

Figure 11: Effect of change in female usage rates on change in probability to use lipid-lowering drugs



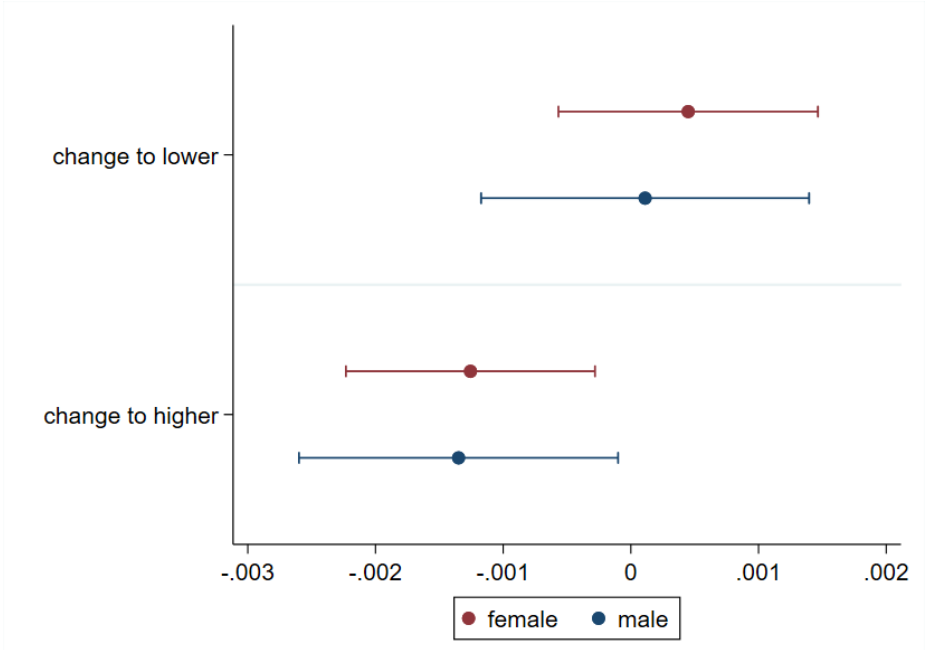
Notes: Figure shows the effect of the change in female usage rates after closure on the probability of receiving medication. Controls for age ($\lambda_{i,t}$) and year-fixed (μ_t) effects as well as the change in age and gender composition between the closing and the new clinic. $ATC10_{i,t} = negchange_ATC10_{i,t} \times closure + poschange_ATC10_{i,t} \times closure + closure + ATC10_{i,t-1} + change\ docgender_{i,t} + change\ docage_{i,t} + \lambda_{i,t} + \mu_t + \epsilon_{i,t}$.

Figure 12: Selection into provider with different female usage rates of lipid-lowering drugs, relative risk ratios



Notes: Figure shows relative risk ratios for the type of change in female usage rate individuals experience after a closure. Controls for age ($\lambda_{i,t}$) and year-fixed (μ_t) effects as well as the change in age and gender composition between the closing and the new clinic. $changecat_ATC10_{i,t} = female + change\ docgender_{i,t} + change\ docage_{i,t} + \lambda_{i,t} + \mu_t + \epsilon_{i,t}$.

Figure 13: Effect of change in female usage rates on probability of death



Notes: Figure shows the effect of the change in female usage rates after closure on the probability of death during the first five years after closure. Controls for age ($\lambda_{i,t}$) and year-fixed (μ_t) effects as well as the change in age and gender composition between the closing and the new clinic. $death_{i,t} = negchange_ATC10_{i,t} \times closure + poschange_ATC10_{i,t} \times closure + closure + change\ docgender_{i,t} + change\ docage_{i,t} + \lambda_{i,t} + \mu_t + \epsilon_{i,t}$.

4.3 Mechanisms

The previous section demonstrated the substantial influence of GPs on medication usage. This suggests that the low female usage rates of medications, to some extent, reflect GP prescription behavior. However, it remains unclear why women are prescribed less than men. There is a multitude of potential reasons. We will discuss diagnostics as the most prominent explanation here, but acknowledge that there might be many more. With diagnostics, we mean that GPs could have difficulties in assessing women's symptoms, given that many guidelines and clinical trials are based on men (Mauvais-Jarvis et al., 2020). Also, women might report the same symptoms differently than men or have other symptoms than men (Roeters van Lennep et al., 2023). It is challenging to investigate this when health is often latent or measured by the (potentially biased) GP.

We therefore combine the register data with cholesterol measurements from the CCHS. This enables us to rely on objectively and independently measured health outcomes since GPs are only presented with the results of the measurements from the CCHS and cannot influence whether the tests are carried out. The measurements were sent to the respondents with the advice to consult their GP if any of the measurements exceeded a threshold value defined in the survey. The report card sent to patients contained both values of cholesterol and the markers for values outside the normal range, see Figure A2.

Since results were only sent to patients, this means that any potential prescription behavior by the GP is largely affected by whether the respondent visited their GP and informed them of their results. While we do not know whether this happened, we try our best to open this black box. We will be able to rule out some mechanisms, but not all. We focus on the measurement of total cholesterol and use thresholds of high cholesterol as defined in the CCHS.[19] In a robustness check, we consider an alternative threshold reflecting general guidelines by the expert panel of the National Cholesterol Education Program in 1988 (Waters, 2019).[20]

Table 2 provides an overview of the cholesterol measurements. In total, around 16,000 measurements were taken throughout the three waves. Total cholesterol is quite high in wave 3, with 22% of the sample being classified as high cholesterol. The reason is that during wave 3, lipid-lowering drugs were just introduced in Denmark, and usage was still quite low. Therefore, the share of those with high cholesterol drops substantially in wave 4. In wave 5, another measure is applied that now also considers low-density-lipoprotein cholesterol (LDL-cholesterol). The shares of high-cholesterol individuals are also much higher when considering the more conservative guideline threshold.[21] We will particularly exploit the first measurement of high cholesterol. This is defined as a respondent having

[19] See Table note of Table 2.

[20] The National Cholesterol Education Program in 1988 (Waters, 2019) defines high cholesterol as cholesterol exceeding a threshold of 6.2 millimoles per liter (mmol/L), a threshold suggested also used in Arni et al. (2021).

[21] Note that we do not define high cholesterol for those who already use lipid-lowering drugs as their cholesterol levels cannot be taken at face value since they are affected by the medication.

high cholesterol measured for the first time in the study and not having used any ATC-code C medication before or having reported a hospital contact related to heart disease. We use this definition to ensure that the high cholesterol measurement is likely new information, based on the data available.

Table 2: CCHS cholesterol measurements

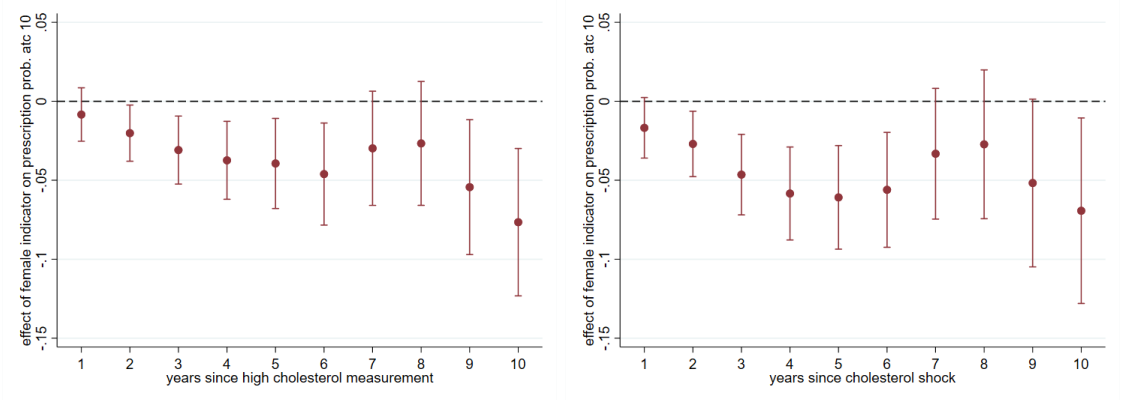
wave	3 (1991-94)	4 (2001-03)	5 (2011-15)
# measurements	8,698	4,686	2,484
mean (mmol/L)	6.10	5.50	5.62
CCHS thresholds			
% high cholesterol	21.81	9.43	9.86
% first high cholesterol		3.18	5.27
Guideline threshold			
% high cholesterol	42.30	24.93	26.97
% first high cholesterol		4.25	7.29

Note: CCHS thresholds: Individuals were classified as having high cholesterol if total cholesterol was above 7 mmol/L for waves 3 and 4 and in wave 5 if total cholesterol was above 6 mmol/L and LDL-cholesterol was above 4 mmol/L. Note that respondents using lipid-lowering drugs or anti-hypertensives are excluded here. Guideline: High cholesterol is defined as total cholesterol > 6.2 mmol/L.

This (likely) new information about high cholesterol enables us to study one potential mechanism of the low usage rates among women. If GPs merely do not recognize women's symptoms and do not test for cholesterol, receiving a first measurement of high cholesterol from the CCHS should lead to similar uptake in lipid-lowering drugs across genders. Figure A4 in the appendix investigates the average response to (first) high cholesterol measurements jointly for both genders. It shows that both a high cholesterol measurement and a first cholesterol measurement are associated with an increase in the usage of lipid-lowering drugs over the next 10 years. Note that the effect is a little smaller for the information shocks, potentially due to the fact that a repeated high cholesterol measure indicates a real need for medication. Figure 14 turns to gender differences: Panel (a) shows the effect of being female on the probability of using ATC-code C10 medication, i.e., lipid-lowering drugs, in the 10 years after a high cholesterol measurement. Women with a high cholesterol measurement have an up to 7.5 percentage points lower probability of using lipid-lowering drugs than men with a high cholesterol measurement. Noteworthy, the difference only arises in the second year after the measurement. This might be due to measurement error, but also because in the first years, we lack information on prescriptions for those measurements in wave three, because they took place before the prescription register started in 1995.

When we then turn to those who have received a high cholesterol measurement for the first time in the study examination, we would expect that this information leads to similar usage shares of men and women if GPs were merely not recognizing symptoms or not administering blood tests. Strikingly, in Panel (b) of Figure 14, however, we also see a large gender gap arising here. Women with a high cholesterol shock are up to 6.5 percentage points less likely to use lipid-lowering drugs compared to men who incur the same shock. So while both men and women increase their uptake of lipid-lowering drugs following a (first) high cholesterol measurement, women do so less than men. The size of this gap is quite large, as it is of similar size to average usage rates across the entire CCHS population. The gap is also much larger than the gap in use of lipid-lowering drugs for those without high cholesterol (shocks), but this difference becomes smaller over time, likely because some of those without high cholesterol (shocks) also become diagnosed and get treated.

Figure 14: Gender differences in usage of lipid-lowering drugs after (first) high cholesterol measurement



(a) high cholesterol measurement

(b) first high cholesterol measurement

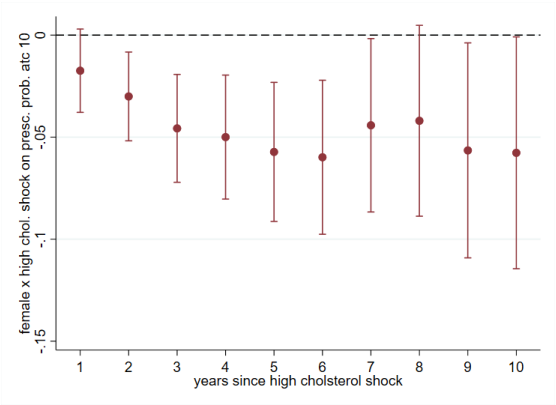
Notes: Figure shows the effect of $female$ on the usage of lipid-lowering drugs after receiving (a) a high cholesterol measurement and (b) a first high cholesterol measurement. Controls for age ($\lambda_{i,t}$) and year-fixed (μ_t) effects. $ATC10_{i,t} = female_i + \lambda_{i,t} + \mu_t + \epsilon_{i,t}$

Another way of investigating the differential uptake by gender after a first high cholesterol measurement is to use an interaction specification in the full sample of measurements. Figure 15 plots the coefficients of the interaction between the female indicator and an indicator for a first high-cholesterol shock. This coefficient should be interpreted as indicating the gender difference in the effect of obtaining a high cholesterol shock on uptake. The coefficients are negative and thus confirm the picture above.

In a robustness test, we repeat this exercise with the guideline thresholds for high cholesterol of 6.2 mmoL/L. Figures A5 and A6 show similar patterns as Figures 14 and 15.[22]

[22] Our results are also robust to excluding individuals with a cholesterol laboratory test in the register data - a population for which high cholesterol might not be new information.

Figure 15: Effect of high cholesterol shock on prescription usage probability



(a) first high cholesterol measurement

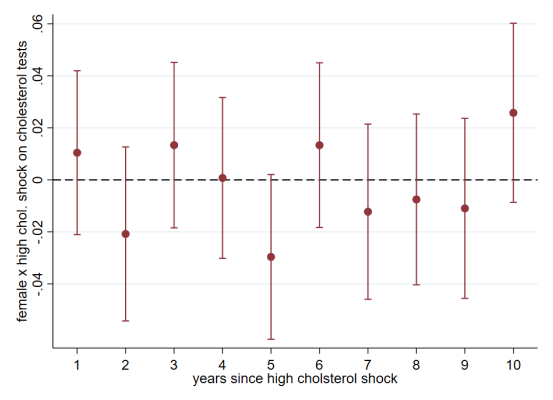
Notes: Figure shows the effect of $female \times high\ cholesterol\ shock$ on the usage of lipid-lowering drugs. Controls for age ($\lambda_{i,t}$), and year-fixed (μ_t) effects, and female-specific age ($\phi_{i,t}$) and time trends ($\eta_{i,t}$). $ATC10_{i,t} = female_i + high\ cholesterol\ shock_i + female_i \times high\ cholesterol\ shock_i + \lambda_i + \mu_t + \phi_{i,t} + \eta_{i,t} + \epsilon_{i,t}$

The remaining gender gap thus excludes one major channel in our setting, namely that women willing to use lipid-lowering drugs visit their GP, who does not recognize their symptoms and thus does not treat them. What we can not exclude with this are other mechanisms: First of all, the remaining gender gap may be caused by GPs not responding to the information provided, either because they do not trust it or because, for some other reason, they do not want to prescribe statins. On the other hand, women could also be reluctant to react to the information by not seeing their GP, not sharing information, or not taking up lipid-lowering drugs when recommended by their GP.

We investigate the role of the GP in several ways: First, we test whether GPs administer more testing or revert to treating other symptoms in women. Then we investigate heterogeneity in the gender gap of uptake according to a set of GP characteristics. We start by considering additional cholesterol tests. If the GPs do not believe the information from the CCHS, it could be that they order laboratory tests themselves. If they are disproportionately less likely to believe women, we could see gender differences in cholesterol tests. Figure 16 below suggests that this is not necessarily the case. Women with a high cholesterol shock are not systematically more or less like to get a cholesterol laboratory test; coefficients vary in sign and are also mostly statistically insignificant. We then investigate whether, instead of prescribing lipid-lowering drugs, GPs initiate other forms of treatment. One prime candidate is hormone replacement therapy (HRT), which treats symptoms of menopause. Around menopause, women's risk of heart disease increases dramatically, so GPs might focus on HRT medication instead of the relevant lipid-lowering drugs. Figure

17, however, shows a lower use of HR for those with a (first) high cholesterol measurement. One reason could be the uptake of lipid-lowering drugs, or those women in menopause, being exactly those who have higher cholesterol levels.

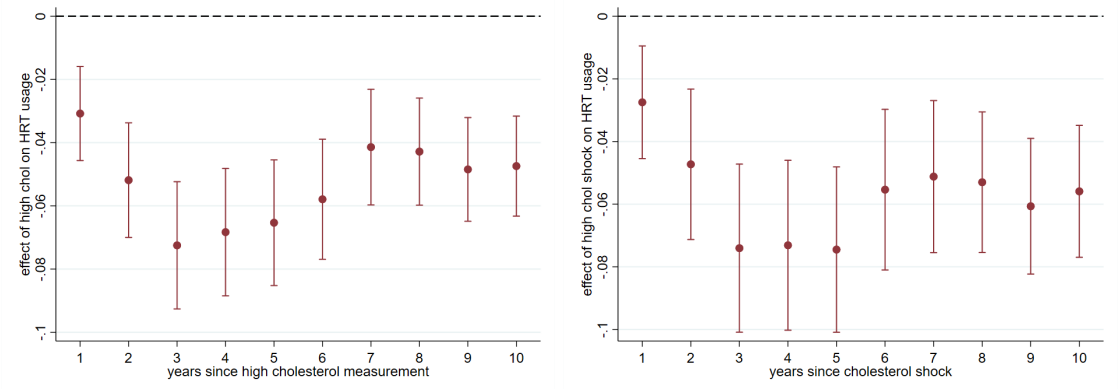
Figure 16: Effect of high cholesterol shock on cholesterol tests



(a) first high cholesterol measurement

Notes: Figure shows the effect of $female \times high\ cholesterol\ shock$ on the probability of having a cholesterol laboratory test. Controls for age ($\lambda_{i,t}$) and year-fixed (μ_t) effects, and female-specific age ($\phi_{i,t}$) and time trends ($\eta_{i,t}$). $cholesterol\ test_{i,t} = female_i + high\ cholesterol\ shock + female \times high\ cholesterol\ shock + \lambda_{i,t} + \mu_t + \phi_{i,t} + \eta_{i,t} + \epsilon_{i,t}$

Figure 17: Effect of (first) high cholesterol on usage of HRT medication



(a) first high cholesterol measurement

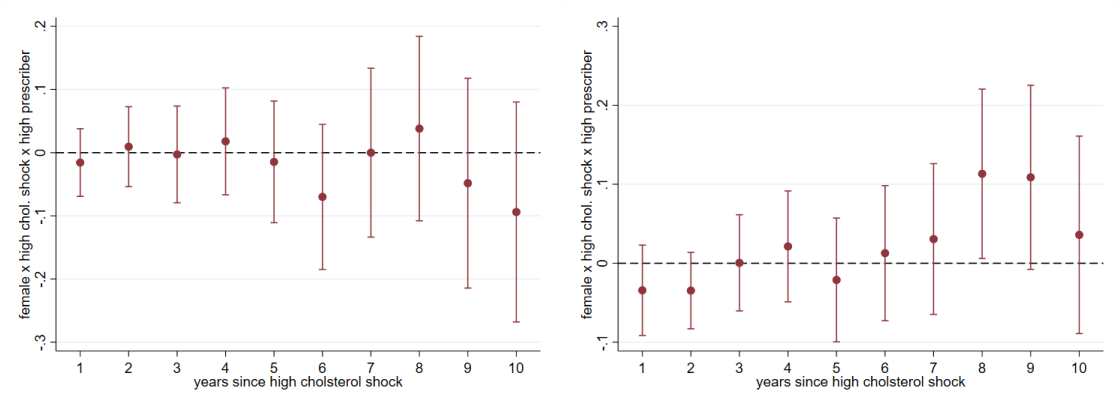
(b) first high cholesterol measurement

Notes: Figure shows the effect of $female \times high\ cholesterol\ shock$ on the probability of having a cholesterol laboratory test. Controls for age ($\lambda_{i,t}$) and year-fixed (μ_t) effects, for the female sample. (a): $HRT_{i,t} = high\ cholesterol + \lambda_{i,t} + \mu_t + \epsilon_{i,t}$; (b): $HRT_{i,t} = high\ cholesterol\ shock + \lambda_{i,t} + \mu_t + \epsilon_{i,t}$

We now test whether heterogeneity along the GP behavior and characteristics can explain

the gender gap in uptake of lipid-lowering drugs. We start out by using information on female usage rates of lipid-lowering drugs, as also used in subsections 4.2.1 and 4.2.2. We use two different measures of female usage rates of lipid-lowering drugs. We use the female-usage-rate of the GP visited in the year before receiving the cholesterol measurement in the CCHS, and we also use the female-usage-rate of the current GP. We present results from a triple-interaction, reflecting the effect of being a woman with a high cholesterol shock visiting a high female-usage-rate GP. Figure 18 shows that there is no difference when visiting a high female-usage rate GP, except for a small increase eight to nine years after the measurement when considering the current GP. Figure A8 shows average uptake rates according to GP female-usage-rates. This shows that despite the gender gap not varying, men and women with a high female-usage- rate GP are more likely to use those drugs, but men are always more likely than women. I.e., the gender gap remains at high and low levels of usage. That means that it is beneficial for women to visit a high female-usage-rate GP, since they have a larger uptake than those women who visit a low female-usage-rate GP, just not as high as men. The graphs also show that women with high female-usage-rate GPs at least reach a usage as high as men visiting a low female-usage-rate GPs.

Figure 18: Effect of high cholesterol shock on prescription usage probability - triple interaction, high female-usage-rate GP



(a) GP visited before measurement

(b) current GP

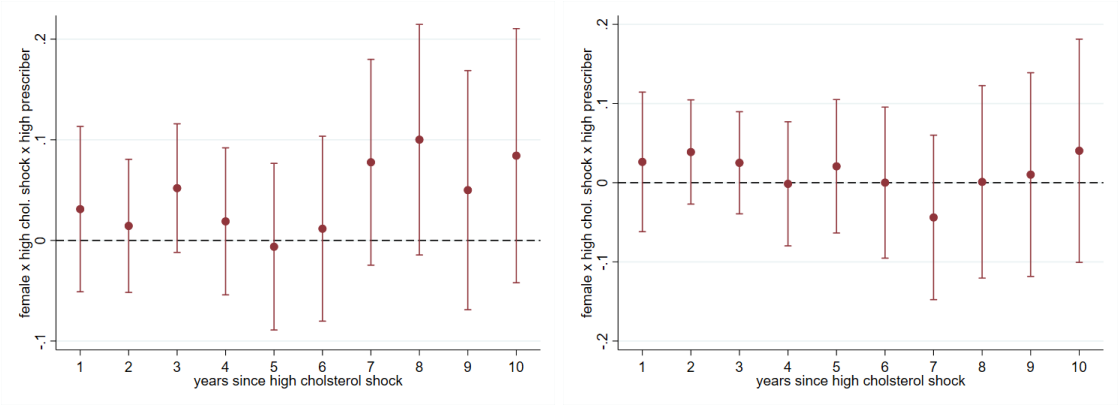
Notes: Figure shows the effect of $female \times high\ cholesterol\ shock \times high\ female\ usage\ rate$ on the usage of lipid-lowering drugs. Controls for age ($\lambda_{i,t}$) and year-fixed (μ_t) effects, and female-specific age ($\phi_{i,t}$) and time trends ($\eta_{i,t}$). $ATC10_{i,t} = female_i + high\ cholesterol\ shock + female \times high\ cholesterol\ shock + high\ cholesterol\ shock \times high\ prescriber + female \times high\ prescriber + female \times high\ cholesterol\ shock \times high\ prescriber + \lambda_{i,t} + \mu_t + \phi_{i,t} + \eta_{i,t} + \epsilon_{i,t}$

We then look at GP's demographic characteristics, namely age and gender. We use a similar specification as above where we use a triple-interaction of being female and having a high cholesterol shock with currently a) likely having a) male GP (visiting a GP clinic with more male GPs), and having b) a young GP (visiting a GP clinic with average GP age below 45). Panel (a) of Figure 19 shows that there is a slightly but statistically insignificant

higher probability of lipid-lowering drug usage for women with a high cholesterol shock if the GP is likely male. Panel (b) of Figure 19 shows that there is essentially no differential effect of visiting a rather young doctor. Currie et al. (2016) find that young, male heart surgeons treat more aggressively and obtain better patient outcomes. The lack of impact of age on the gender gap might stem from a conservative age definition (defining young as an average age below 45), but also from the fact that, compared to invasive procedures, the prescription of lipid-lowering drugs has changed less over time and thus across generations of GPs.

The gender gap in usage of lipid-lowering drugs after a high cholesterol is overall rather unresponsive to a variety of doctor characteristics, suggesting that either GPs do not have an influence as large as we expected or that we capture the wrong dimensions of heterogeneity.

Figure 19: Effect of high cholesterol shock on prescription usage probability - triple interaction, GP demographics



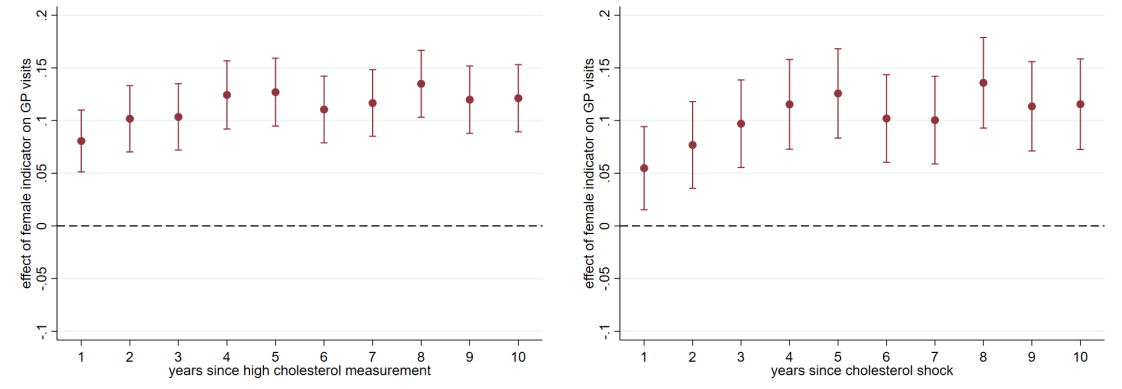
(a) likely male GP

(b) likely young GP

Notes: Figure shows the effect of $female \times high\ cholesterol\ shock \times likely\ male\ GP\ rate$ on the usage of lipid-lowering drugs. Controls for age ($\lambda_{i,t}$) and year-fixed (μ_t) effects, and female-specific age ($\phi_{i,t}$) and time trends ($\eta_{i,t}$). (a): $ATC10_{i,t} = female_i + high\ cholesterol\ shock + female \times high\ cholesterol\ shock + high\ cholesterol\ shock \times male\ GP + female \times male\ GP + female \times high\ cholesterol\ shock \times male\ GP + \lambda_{i,t} + \mu_t + \phi_{i,t} + \eta_{i,t} + \epsilon_{i,t}$; (b): $ATC10_{i,t} = female_i + high\ cholesterol\ shock + female \times high\ cholesterol\ shock + high\ cholesterol\ shock \times young\ GP + female \times young\ GP + female \times high\ cholesterol\ shock \times young\ GP + \lambda_{i,t} + \mu_t + \phi_{i,t} + \eta_{i,t} + \epsilon_{i,t}$

We then turn to the role of individuals. We first test whether care-seeking can explain the observed gender gap. If women go to the doctor less than men after receiving a (first) high cholesterol measurement, this would explain why they are less likely to use lipid-lowering drugs. Figure 20 investigates the role of being female for visiting the GP in a given year when having received a (first) high cholesterol measurement. The figure shows that even after a (first) high cholesterol measurement, women visit the GP more often than men. This is in line with results from Section 4.1 However, using the interaction specification, Figure 21 shows that even though women see the doctor more often than men, if they receive a cholesterol shock, they do not proportionally do so: In the year after the measurement, the increase in the probability to visit the GP is smaller for women with a high cholesterol shock than for men with the same shock. This suggests that women might be hesitant to share the new information they have received. We can also show that this relatively lower increase in the probability of a GP visit is not driven by increased visits to specialists. Figure A7 in the appendix focuses on visits to the cardiologist but does not show a gender difference that might explain the relative reduction in GP visits. It might, however, be possible that women are already at the capacity limit, and just cannot raise GP visits further. Given this lower propensity to visit the GP, Figure A9 in the appendix investigates whether the gender gap is purely driven by women with a shock visiting their GP less. Figure A9, however, shows a gap of a similar size as the unconditional gap, so this does not seem to be the case.

Figure 20: Gender differences in GP visits after (first) high cholesterol measurement

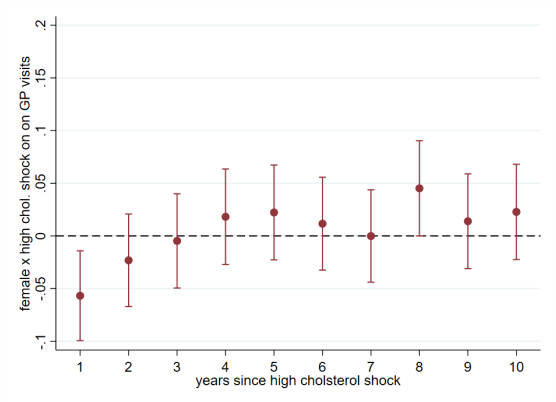


(a) high cholesterol measurement

(b) first high cholesterol measurement

Notes: Figure shows the effect of $female$ on the probability of visiting a GP visit after receiving (a) a high cholesterol measurement and (b) a first high cholesterol measurement. Controls for age ($\lambda_{i,t}$) and year-fixed (μ_t) effects. $GP\ visit_{i,t} = female_i + \lambda_{i,t} + \mu_t + \epsilon_{i,t}$.

Figure 21: Effect of high cholesterol shock on GP visits

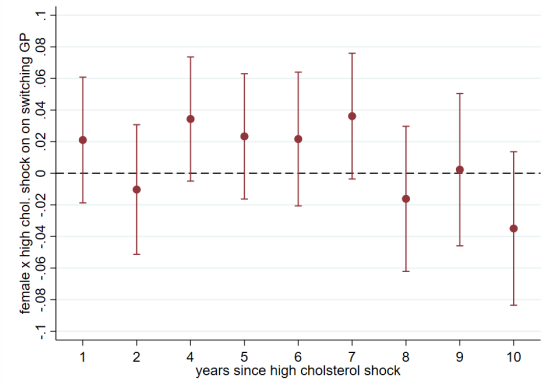


(a) first high cholesterol measurement

Notes: Figure shows the effect of $female \times high\ cholesterol\ shock$ on the probability of visiting a GP. Controls for age ($\lambda_{i,t}$) and year-fixed (μ_t) effects, and female-specific age and time trends. $GP\ visit_{i,t} = female_i + high\ cholesterol\ shock + female \times high\ cholesterol\ shock + \lambda_{i,t} + \mu_t + \epsilon_{i,t}$

Given women's lower propensity to visit their GP, we investigate whether women are more likely to switch their doctor after receiving a (first) high cholesterol measurement. Figure 22 shows that there is indeed a slight – albeit often insignificant – increase in switches for women with a high cholesterol shock.

Figure 22: Effect of high cholesterol shock on GP switching

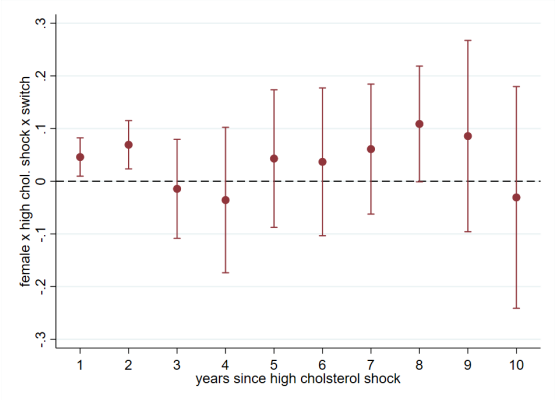


(a) first high cholesterol measurement

Notes: Figure shows the effect of $female \times high\ cholesterol\ shock$ on the probability of switching the GP. Controls for age ($\lambda_{i,t}$) and year-fixed (μ_t) effects, and female-specific age ($\phi_{i,t}$) and time trends ($\eta_{i,t}$). $switch\ GP_{i,t} = female_i + high\ cholesterol\ shock + female \times high\ cholesterol\ shock + \lambda_{i,t} + \mu_t + \phi_{i,t} + \eta_{i,t} + \epsilon_{i,t}$

We then investigate whether, for those who switch GPs, the gender gap in uptake of lipid-lowering drugs is affected. Since only a fraction of our sample switches GP, the following result needs to be interpreted with caution as they reflect responses of a small proportion of the sample. Figure 23 shows that for women with a high cholesterol shock who switch their GP, the gap in usage of lipid-lowering drugs is reduced. Thus, it seems that while the gender gap is not responsive to a range of GP characteristics, it seems that only switching the GP affects this gap.

Figure 23: Effect of high cholesterol shock on prescription usage probability - triple interaction, switching



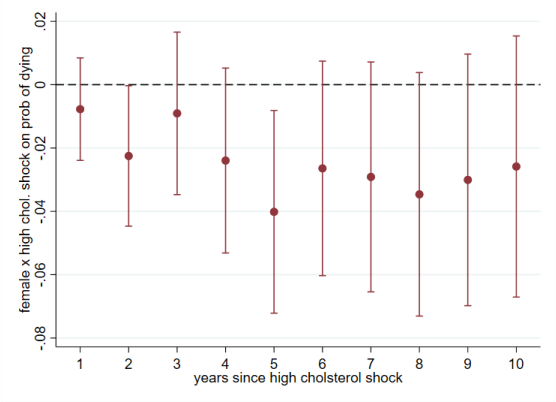
(a) first high cholesterol measurement

Notes: Figure shows the effect of $female \times high\ cholesterol\ shock \times switching$ on the usage of lipid-lowering drugs. Controls for age ($\lambda_{i,t}$) and year-fixed (μ_t) effects, and female-specific age ($\phi_{i,t}$) and time trends ($\eta_{i,t}$). $ATC10_{i,t} = female_i + high\ cholesterol\ shock + female \times high\ cholesterol\ shock + switch + high\ cholesterol\ shock \times switch + female \times switch + female \times high\ cholesterol\ shock \times switch + \lambda_{i,t} + \mu_t + \phi_{i,t} + \eta_{i,t} + \epsilon_{i,t}$

While we can successfully rule out many of the most prominent explanations for the gender gap in prescriptions, we cannot fully tackle it. The fact that women do not increase visits as much as men but then switch GPs and consequently increase usage, suggests that there is a substantial role for physician behavior that can only be broken by switching doctors.

Lastly, we step back and consider mortality as an outcome. Despite the remaining gender gap in the uptake of lipid-lowering drugs, usage has increased for both genders through testing during the CCHS. We see a substantial but mostly borderline significant/insignificant negative coefficient, indicating that having a high cholesterol shock might have served as a protection from dying for women, likely through the increase in uptake of lipid-lowering drugs.

Figure 24: Effect of high cholesterol shock on probability of dying



(a) first high cholesterol measurement

Notes: Figure shows the effect of $female \times high\ cholesterol\ shock$ on death. Controls for age ($\lambda_{i,t}$) and year-fixed (μ_t) effects, and female-specific age ($\phi_{i,t}$) and time trends ($\eta_{i,t}$). $death_{i,t} = female_i + high\ cholesterol\ shock + female \times high\ cholesterol\ shock + \lambda_{i,t} + \mu_t + \phi_{i,t} + \eta_{i,t} + \epsilon_{i,t}$

5 Labor market outcomes

The effects of undertreatment are likely to extend beyond health. Women with undiagnosed heart disease likely spend more time in debilitating health (Case and Paxson, 2005; World Economic Forum, 2024). This potentially has important consequences for economic productivity, such as labor market outcomes. As Figure 2 shows, not everyone with AMI dies right away, and many may return to work. We, therefore, investigate whether health inequalities also spill over to the labor market. More precisely, we investigate whether having AMI has differential effects on the labor market outcomes of women versus men. We test the differential role of experiencing AMI on general labor supply and disability benefit receipt.

Table 3 uses cross-sectional data to show that women indeed face stronger labor market penalties than men when suffering from AMI.[23] While having AMI reduces labor supply and increases disability benefit receipt, it does so more strongly for women than for men. This result also holds true if we control for comorbidities in the year before AMI, suggesting that the larger AMI penalty for women is not driven by women suffering from additional diseases. Table A5 shows similar results when conditioning on survival for the first ten years after AMI.

In addition to cross-sectional evidence, Figure 25 presents results from event studies using the imputation estimator by Borusyak et al. (2024), estimated separately for men and women. Panel (a) of Figure 25 shows two key features: First, the reduction in women's labor supply is larger than that of men. Second, before AMI, women already have larger negative pre-trends than men. That means in the years before AMI, they already reduce labor supply more than men. Panel (b) of Figure 25 shows similar patterns for disability benefits: long before AMI, women have a higher likelihood of being on disability benefits than men, and then have a substantial upward jump afterward, leading to even higher levels of disability benefit receipt. This supports the claim that before AMI, women likely lived in more debilitating health than men. The findings of this section are in line with evidence of inequities in health spilling over to economic decisions and conditions (De Nardi et al., 2024).

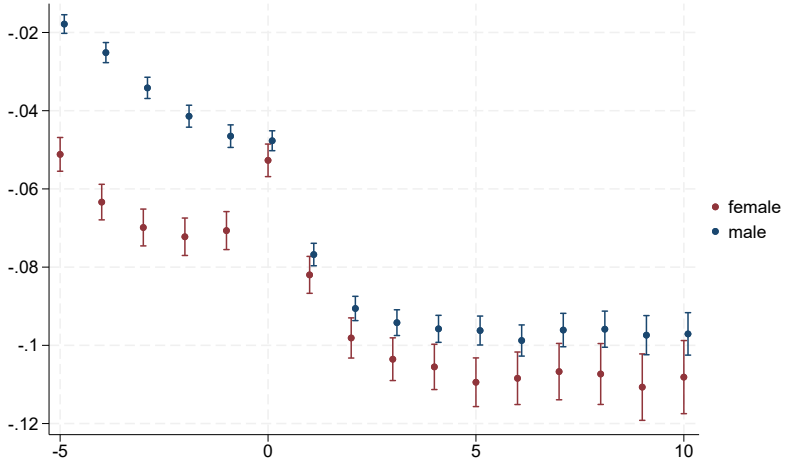
[23] Note that this focuses on all AMIs. Results for first AMIs can be found in the appendix in Table A4.

Table 3: Labor market effects of AMI

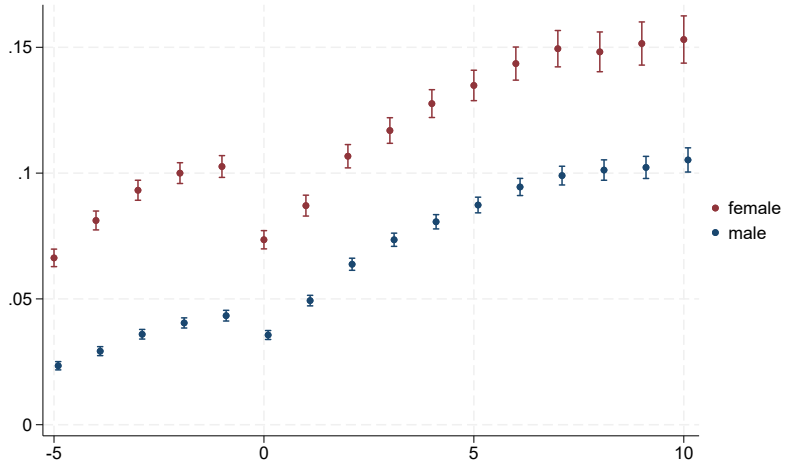
	(1) Working	(2) Disability benefits
AMI_{t-1}	-0.129***	0.073***
	[0.001]	[0.001]
Female	-0.076***	0.015***
	[0.000]	[0.000]
$AMI_{t-1} \times female$	-0.076***	0.104***
	[0.003]	[0.002]
R-squared	0.163	0.054
Observations	121,879,463	121,797,561
Controlling for comorbidity		
AMI_{t-1}	-0.015***	-0.023***
	[0.001]	[0.001]
Female	-0.076***	0.015***
	[0.000]	[0.000]
$AMI_{t-1} \times female$	-0.071***	0.100***
	[0.003]	[0.002]
R-squared	0.165	0.061
Observations	121,879,463	121,797,561

Standard errors clustered on the individual level in brackets; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Controls for age and year-fixed effects in all columns. *labor supply*$_{i,t} = AMI_{i,t-1} + female + AMI_{i,t-1} \times female + \lambda_{i,t} + \mu_t + \epsilon_{i,t}$ The lower panel additionally controls for the Charlson Comorbidity Index.

Figure 25: Effect of AMI on labor market outcomes - event study



(a) Working



(b) Disability benefits

Notes: Figure shows event study results, estimated separately for men and women using the did_imputation estimator, using individual (ξi), year ($\lambda_{i,t}$), and age (μ_t) fixed effects. $labor\ supply_{i,t} = distanceAMI_{i,t} + \lambda_{i,t} + \mu_t + \xi_i + \epsilon_{i,t}$

6 Conclusion

This paper studies gender differences in health using the case of heart disease. It investigates the role of individual and provider behavior for the *prevalence-mortality puzzle* - the higher female mortality after AMI despite the higher lifetime (diagnosed) prevalence of heart disease for men. We first document the existence of a substantial mortality disadvantage for women post-AMI, confirming existing evidence. We then show that previous usage of lipid-lowering medication substantially reduces the gender gap. We investigate why women use less medication against heart disease than men. While women on average seek more healthcare and have a healthier lifestyle (less smoking and alcohol), they exercise less and are more pessimistic about their own health. Thus, we turn to the role of the provider. We first document substantial variation in GP-level medication usage rates, and that there are many more GPs with lower female usage rates. We then show that these usage rates are largely driven by GPs' prescription behavior by using information about clinic closures and changes to a new GP. We then test whether difficulties in diagnostics are a mechanism causing the low female usage rates of lipid-lowering drugs. For this, we use objective health measurements from the CCHS. On average, even after receiving a first high cholesterol measurement, women are less likely to use lipid-lowering drugs than men with high cholesterol. We then provide suggestive evidence that women are somewhat less reactive in visiting their GP, and that the gap in prescription is not sensitive to GP characteristics. It is, however, affected by women switching GPs. Lastly, we show large spillovers of these health inequalities to the labor market with larger anticipation and AMI penalties for women than for men.

These results are not only important from a healthcare perspective but also in general. While population welfare is of key importance, reducing female mortality will have important general economic consequences. Whereas treatment in terms of higher medication is relatively cheap, surviving women will likely incur further health and general care costs. However, early treatment can avoid the full development of diseases. Those women who die at a higher rate after AMI are likely in worse health in the years before. A report by the World Economic Forum (2024) suggests that women spend "25% more of their lives in debilitating health" than men. Despite women in developed countries living longer than men (Goldin and Lleras-Muney, 2019), women have worse self-rated health and more hospitalization episodes than men over the life course (Case and Paxson, 2005). In addition, costs are not restricted to the health sector care but also spill over to the labor market, in the form of reduced labor market participation and higher reliance on social assistance.

Our results show that testing overall increases usage of lipid-lowering drugs, despite the gender gap in that increase. Thus, policies encouraging regular testing of cholesterol might seem promising. It also seems crucial to better understand variation in prescription usage. Encouraging women to visit high-prescribing GPs, for example, would raise their uptake. Furthermore, focusing on the high efficacy of lipid-lowering drugs in women, through information campaigns or in medical training/education, seems to be a tool of first-order

importance to close the gender-mortality gap in heart disease. For example, guidelines advocating for more cholesterol testing would mitigate the impact of the providers potentially having difficulties in interpreting female symptoms.

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Appendix

Table A1: ATC-codes category C (cardiovascular system drugs)

Code	Medical term	Layman's term
C01	Cardiac therapy	Treats cardiac arrhythmia angina pectoris
C03	Diuretics	Increases diuresis (increase in urine passed by the body), reduces fluid accumulation in the body
C02	Antihypertensives	Lowers blood-pressure
C04	Peripheral vasodilators	Causes dilation of peripheral arteries re-distributing blood from central arteries to peripheral arteries relieving and protecting the heart from the excess pressure of blood
C05	Vasoprotectives	Stabilising venous vessels
C08	Calcium channel blockers	Lower blood pressure by stopping calcium from entering the cells of the heart and arteries
C07	Beta-blocking agents	Lowers blood pressure and heart rate by blocking receptors normally used for increasing blood pressure and heart rate
C09	Agents acting on the renin-angiotensin system	Act on a hormone system that helps to control blood pressure and the amount of fluid in the body.
C10	Lipid modifying agents	Lower the level of total cholesterol and low-density lipoprotein (LDL) cholesterol in the blood. Often referred to as statins as this is the most commonly used drug.

Table A2: CCHS population - demographics

	invited	participating	p-value
Age	59.13	55.82	0.000
	(16.67)	(13.93)	
Married	0.52	0.70	0.000
	(0.50)	(0.46)	
Number of GP visits	6.17	7.09	0.000
	(10.14)	(8.71)	
Number of specialist visits	3.65	6.86	0.000
	(8.53)	(10.14)	
Charlson Comorbidity Index	0.19	0.09	0.000
	(0.66)	(0.45)	
Income (DKK)	56,013.52	85,348.280	0.000
	(115,241.650)	(123,807.10)	
Education (1-6,	2.30	2.54	0.000
primary-Master/PhD)	(1.64)	(1.63)	

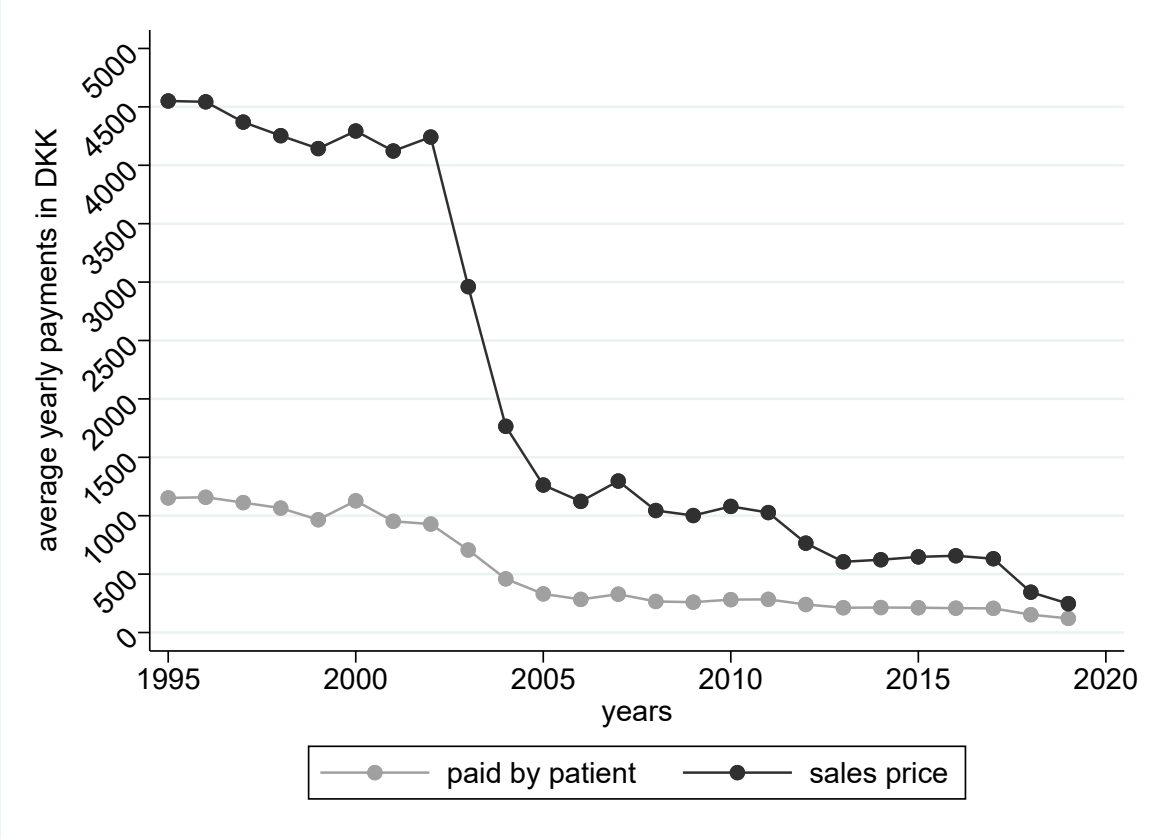
Note: Table shows means and standard deviations (in brackets). Based on waves 1-4 of CCHS. We exclude wave 5 due to insufficient information about invitations. Note that information on marital status is only available from wave 3 onwards, and that information on HP and specialist visits is available from wave 4 onwards. Information on the Charlson comorbidity index and income is available from wave 2 onwards.

Table A3: Health behavior differences across gender - conditional on objective health

	(1) Current Smoker	(2) Alcohol freq	(3) Phys. activity	(4) Self-assessed health
Female	-0.075***	-0.492***	-0.146***	0.121***
	[0.008]	[0.012]	[0.012]	[0.016]
Constant	1.251***	2.066***	2.619***	-0.827**
	[0.199]	[0.295]	[0.296]	[0.414]
R-squared	0.094	0.365	0.077	0.050
Observations	15,513	15,508	15,427	15,325

Standard errors clustered on the individual level in brackets; $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Controls for age and year-fixed effects in all columns. Includes controls for objective health: systolic and diastolic blood pressure, total cholesterol, and BMI. $current\ smoker = female + i.age + i.year + objective\ health_i + \epsilon_i$

Figure A1: Payment for lipid-lowering drugs over time



Note: Figure shows average yearly payments by the patient and average yearly sales prices of lipid-lowering drugs. The payments paid by patients are much lower than sales prices due to the generous subsidies.

Figure A2: CCHS measurements report card

Østerbroundersøgelsen
Bispebjerg og Frederiksberg Hospital
Nordre Fasanvej 57-59
Hovedvejen, Indgang 5 st
2000 Frederiksberg
Mail: Oebus6@regionh.dk
Telefon: 38 16 36 70

ØBUS 6 nr. Hermed sender vi dine resultater fra d. . . . .. . / . . . . . .

Ikke fastende blodprøver		Normal	Bør kontrolleres hos egen læge indenfor 1 måned	Ej udført
Hæmoglobin (blodprocent)	. . . . . mMol/L	☐	☐	☐
TSH (stofskifte)	. . . . . mIU/L	☐	☐	☐
ALAT (leverfunktion)	. . . . . U/L	☐	☐	☐
Kolesterol	. . . . . mMol/L	☐	☐	☐
LDL-kolesterol	. . . . . mMol/L	☐	☐	☐
Kreatinin (nyre funktion)	. . . . µMol/L	☐	☐	☐
Blodsukker	. . . . . mMol/L	☐	☐	☐
Triglycerid	. . . . . mMol/L	☐	☐	☐

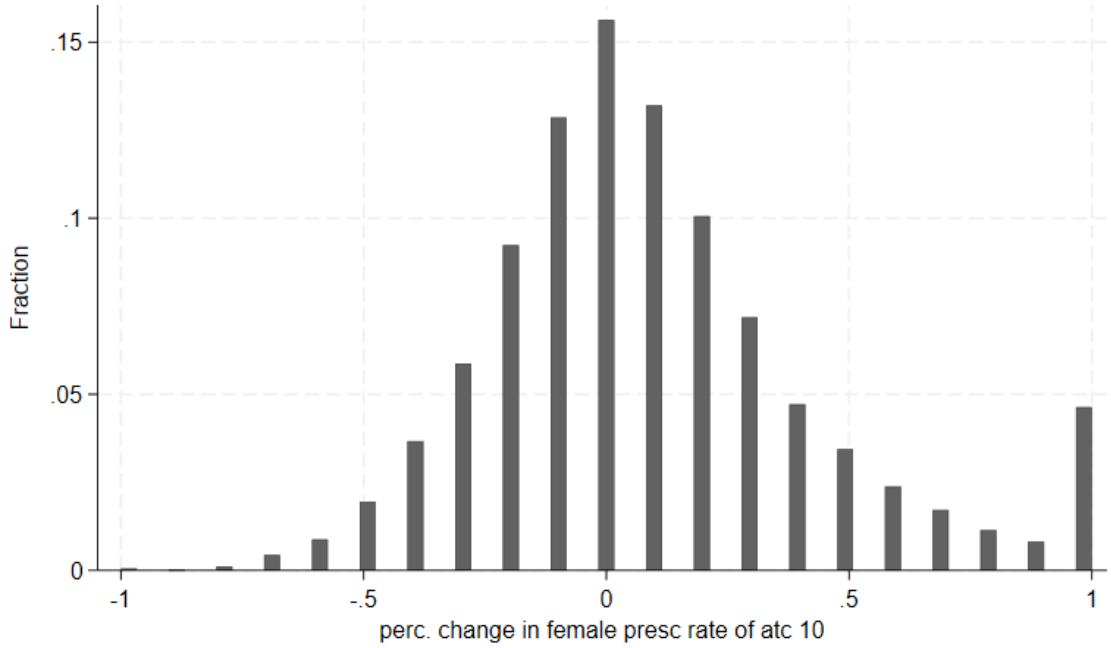
Hjerte og kredsløb				
Blodtryk	. . . . . / . . . . mmHg	☐	☐	☐
EKG		☐	☐	☐

Lungefunktion	Normal	Let nedsat	Kontroller hos læge	Ej udført
	☐	☐	☐	☐

Med venlig hilsen og tak fordi du deltog
Østerbroundersøgelsen

D.16.11.2021 Version 1

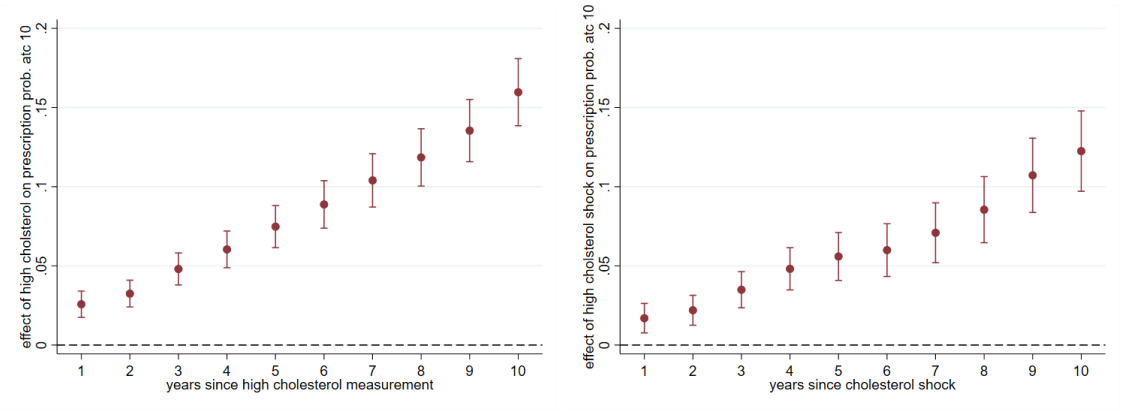
Figure A3: Distribution of change in female usage rates after closure



(a) C10 (lipid-lowering agents)

Note: Figure shows the distribution of the change in female usage rates after a closure.

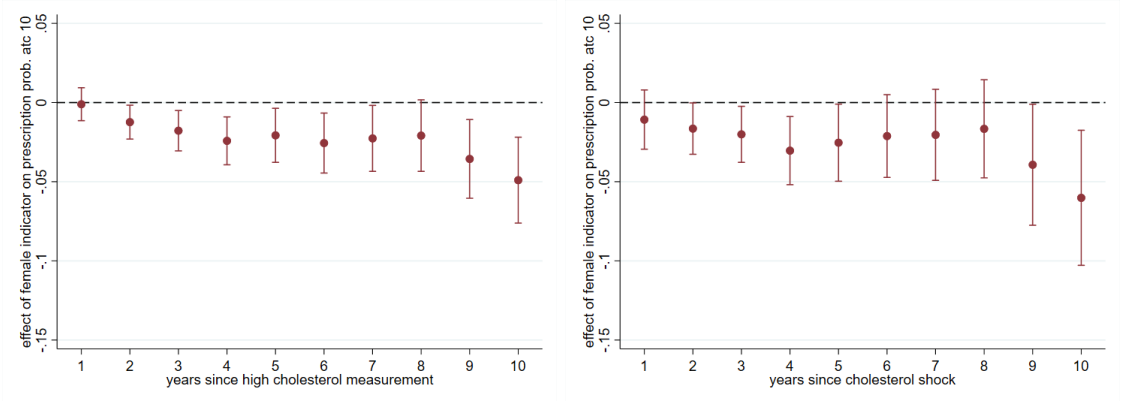
Figure A4: Usage of lipid-lowering drugs after (first) high cholesterol measurement



(a) high cholesterol measurement (b) first high cholesterol measurement

Notes: Figure shows the effect of receiving a (first) high cholesterol measurement on the probability of using lipid-lowering drugs. Controls for age ($\lambda_{i,t}$) and year-fixed (μ_t) effects. (a) $ATC_{i,t} = high\ cholesterol_{i,t} + \lambda_{i,t} + \mu_t + \epsilon_{i,t}$ (b) $ATC_{i,t} = high\ cholesterolshock_{i,t} + \lambda_{i,t} + \mu_t + \epsilon_{i,t}$

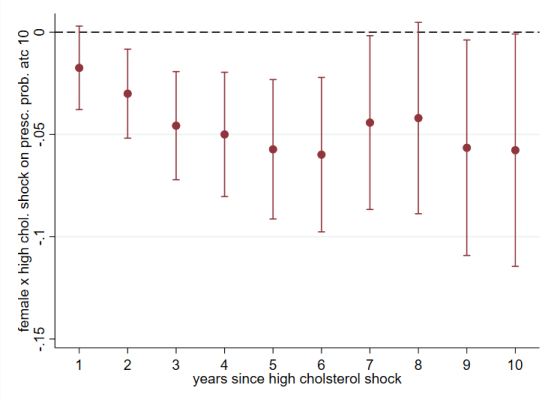
Figure A5: Gender differences in usage of lipid-lowering drugs after (first) high cholesterol measurement, CCHS thresholds



(a) high cholesterol measurement (b) first high cholesterol measurement

Notes: Figure shows the effect of $female$ on the usage of lipid-lowering drugs after receiving (a) a high cholesterol measurement and (b) a first high cholesterol measurement. Controls for age ($\lambda_{i,t}$) and year-fixed (μ_t) effects. $ATC10_{i,t} = female_i + \lambda_{i,t} + \mu_t + \epsilon_{i,t}$

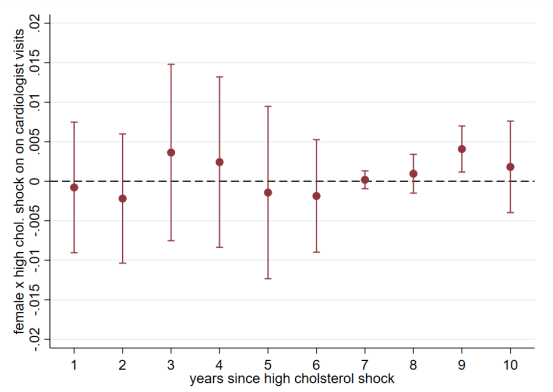
Figure A6: Effect of high cholesterol shock on prescription usage probability, CCHS thresholds



(a) first high cholesterol measurement

Notes: Figure shows the effect of $female \times high\ cholesterol\ shock$ on the usage of lipid-lowering drugs. Controls for age ($\lambda_{i,t}$) and year-fixed (μ_t) effects, and female-specific age ($\phi_{i,t}$) and time trends ($\eta_{i,t}$). $ATC10_{i,t} = female_i + high\ cholesterol\ shock + female \times high\ cholesterol\ shock + \lambda_{i,t} + \mu_t + \phi_{i,t} + \eta_{i,t} + \epsilon_{i,t}$

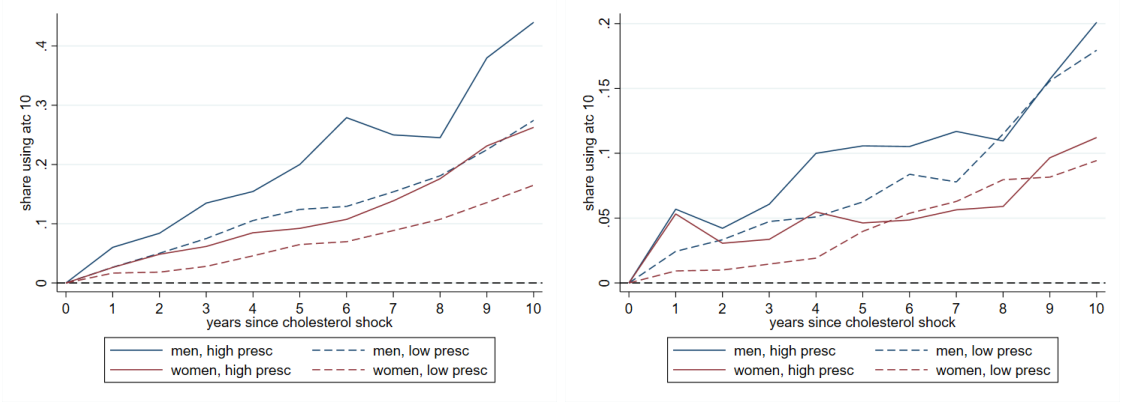
Figure A7: Effect of high cholesterol shock on cardiologist visits



(a) first high cholesterol measurement

Notes: Figure shows the effect of $female \times high\ cholesterol\ shock$ on the probability of visiting a cardiologist. Controls for age ($\lambda_{i,t}$) and year-fixed (μ_t) effects, and female-specific age ($\phi_{i,t}$) and time trends ($\eta_{i,t}$). $cardiologist\ visit_i, t = female_i + high\ cholesterol\ shock + female \times high\ cholesterol\ shock + \lambda_{i,t} + \mu_t + \phi_{i,t} + \eta_{i,t} + \epsilon_{i,t}$

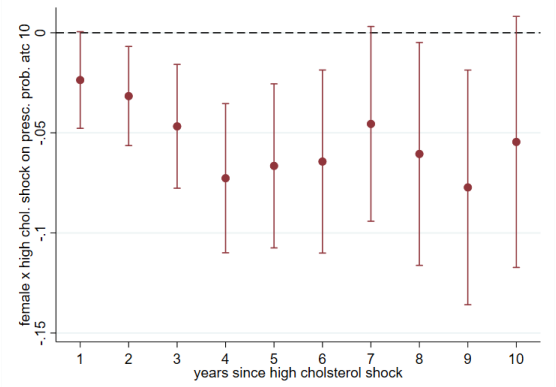
Figure A8: Average usage shares of lipid-lowering drugs, according to GP female-usage rates



(a) usage rate of GP visited before measurement

(b) usage rate of current GP

Figure A9: Effect of high cholesterol shock on lipid-lowering drugs - conditional on GP visit



(a) first high cholesterol measurement

Notes: Figure shows the effect of $female \times high\ cholesterol\ shock$ on the usage of lipid-lowering drugs - for a sample that visited their GP in the respective year. Controls for age ($\lambda_{i,t}$) and year-fixed (μ_t) effects, and female-specific age ($\phi_{i,t}$) and time trends ($\eta_{i,t}$). $GP\ visit_i,t = female_i + high\ cholesterol\ shock + female \times high\ cholesterol\ shock + \lambda_{i,t} + \mu_t + \phi_{i,t} + \eta_{i,t} + \epsilon_{i,t}$

Table A4: Labor market effects of AMI - first AMI

	(1) Working	(2) Disability Benefits
AMI_{t-1}	-0.112***	0.058***
	[0.002]	[0.001]
Female	-0.076***	0.015***
	[0.000]	[0.000]
$AMI_{t-1} \times female$	-0.084***	0.106***
	[0.003]	[0.002]
R-squared	0.162	0.054
Observations	121,709,196	121,627,573
Controlling for comorbidity		
AMI_{t-1}	-0.002	-0.036***
	[0.002]	[0.001]
Female	-0.076***	0.015***
	[0.000]	[0.000]
$AMI_{t-1} \times female$	-0.079***	0.102***
	[0.003]	[0.002]
R-squared	0.165	0.060
Observations	121,709,196	121,627,573

Standard errors clustered on the individual level in brackets; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Controls for age and year-fixed effects in all columns. $labor\ supply_{i,t} = heart_attack_{i,t-1} + female + heart_attack_{i,t-1} \times female + i.age + i.year + \epsilon_i$ Lower panel additionally controls for Charlson Comorbidity Index.

Table A5: Labor market effects of AMI - conditional on survival

	(1)	(2)
	Working	Disability Benefits
AMI_{t-1}	-0.124***	0.070***
	[0.001]	[0.001]
Female	-0.077***	0.015***
	[0.000]	[0.000]
$AMI_{t-1} \times female$	-0.074***	0.102***
	[0.003]	[0.002]
R-squared	0.160	0.051
Observations	119,453,841	119,453,841
first AMI		
AMI_{t-1}	-0.106***	0.054***
	[0.002]	[0.001]
Female	-0.077***	0.015***
	[0.000]	[0.000]
$AMI_{t-1} \times female$	-0.082***	0.103***
	[0.003]	[0.002]
R-squared	0.159	0.051
Observations	119,284,434	119,284,434

Standard errors clustered on the individual level in brackets; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Controls for age and year-fixed effects in all columns. $labor\ supply_{i,t} = heart_attack_{i,t-1} + female + heart_attack_{i,t-1} \times female + i.age + i.year + \epsilon_i$