# Heterogeneity in mortality, morbidity, and health behaviors: Covid-19 and beyond

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## Sammanfattning

Ett flertal studier från både Sverige och internationellt har visat att pandemin drabbar vissa grupper särskilt hårt. Det är inte bara äldre populationer som löpt högre risk att drabbas av allvarlig sjukdom och dödlighet, utan även etniska minoriteter och personer med lägre utbildningsnivå eller inkomst. Vi vet ännu inte mycket om orsakerna till dessa socioekonomiska gradienter i pandemins effekter, men i forskningen diskuteras framförallt tre tänkbara förklaringar. För det första är det sannolikt att personer med lägre utbildningsnivå eller inkomst och personer som invandrat löpt högre risk att bli smittade av viruset, på grund av att de i lägre utsträckning har yrken som går att bedriva hemifrån; är trångbodda i högre utsträckning, eller av andra anledningar haft svårare att beakta fysisk distansering. För det andra kan det vara så att de medicinska riskfaktorer som associerats med svår Covid-19 sjukdom förekommer mer i populationer med lägre utbildning eller inkomst, eller bland invandrade. För det tredje är det möjligt att hälsobeteenden samt bemötande i sjukvården samvarierar med utbildningsnivå, inkomst, och andra sociodemografiska faktorer. Exempel på relevanta hälsobeteenden är testning och huruvida man söker vård tidigt i sjukdomsförloppet om man får svåra symtom, vilka kan påverkas av både tillgänglighet, kunskap, och bemötande.

Denna rapport studerar huruvida det, bland de som insjuknat i Covid-19, återstår socioekonomiska skillnader i morbiditet och dödlighet efter att man kontrollerat för att populationer med olika utbildning, inkomst, och födelseland skiljer sig åt i termer av underliggande hälsa. Genom att studera skillnader i utfall bland de som faktiskt blivit sjuka i Covid-19 kontrollerar man även för skillnader i risken att bli smittad. Därmed är syftet med rapporten att undersöka i vilken utsträckning faktorer utöver smittorisk och hälsa skulle kunna förklara varför personer med sämre socioekonomiska förutsättningar haft sämre utfall i pandemin. Rapporten studerar de drygt 62,000 personer som lagts in för slutenvård på grund av Covid-19 under 2020 fram till och med maj 2021, och använder registerinformation (på individnivå) om bakgrundsvariabler (ex. inkomst, familjesituation, ålder, utbildning, bostadsort, födelseland), underliggande medicinska hälsotillstånd (via patientregister), testning, öppenvårdsbesök, sjukhusinläggningar, intensivvård och mortalitet, samt månatlig information om förvärvsinkomster och sjukpenning. Det unika datamaterialet innebär att man kan följa individer genom hela vårdkedjan, från inläggning till överlevnad/död, samt vårdbesök och arbetsförmåga bland de som skrivits ut vid liv.

Studien når fyra huvudsakliga slutsatser. Till att börja med visar resultaten att svår Covid-19 som krävt sjukhusvård har långsiktigt negativa konsekvenser för individers hälsa och arbetsmarknadsutfall.

Så länge som elva månader efter sjukhusinläggningen hade de individer som lagts in 20 procent lägre förvärvsinkomster relativt månaden innan de lades in, och avsevärt högre uttag av sjukpenning. Bland de som skrivits ut från sjukhuset och uppsökt läkarvård inom 90 dagar var en oproportionerligt hög andel diagnostiserade med besvär i andningsorganen och med symtom och sjukdomstecken som inte är lätta att klassificera. För det andra finner studien att morbiditet och dödlighet i Covid-19, bland de som slutenvårdats, var negativt korrelerat med utbildningsnivå, inkomst, och att vara gift/sambo, även med hänsyn tagna till skillnader i underliggande hälsa, ålder, kön, bostadskommun, och inläggningsvecka. Individer med lägre utbildning/inkomst och ensamstående hade en högre sannolikhet att ha blivit inlagda på IVA och att ha avlidit till följd av Covid-19 relativt individer med högre utbildning/inkomst respektive gifta eller sambor. Det kan visserligen inte uteslutas att det finns kvarstående – icke observerbara - skillnader i hälsa mellan grupperna, som studien inte kunnat kontrollera för, som driver dessa återstående skillnader, men sådana antas vara mindre i den population som alla blivit inlagda i slutenvården. Sammantaget tyder resultaten på att risk för smitta och skillnader i underliggande hälsa inte ensamt kan förklara de tidigare dokumenterade socioekonomiska skillnaderna i Covid-19-utfall.

För det tredje tyder resultaten på att de med lägre utbildning, inkomst, ensamstående, och utlandsfödda blev inlagda direkt på IVA i högre utsträckning än de med högre utbildning, inkomst, sambo/make eller maka respektive än de födda i Sverige. Det fanns även likadana skillnader i sannolikheten att ha lagts in på sjukhus utan ett test med bekräftad Covid-19 innan sjukhusinläggningen. Detta indikerar att vissa grupper eventuellt söker vård i ett sent skede av sjukdomsförloppet, och att testbeteende skiljer sig åt, alternativt att vård- och testtillgängligheten är olika för de olika grupperna. Det är även så att de med högre utbildning/inkomst och de födda i Sverige har en högre sjukvårdskonsumtion efter att de blivit utskrivna – i termer av öppenvårdsbesök – men ingen högre sannolikhet att återinläggas på sjukhus. Sammantaget tyder resultaten på att sjukvårdskonsumtion eller vårdkontakter är mer förekommande bland de med en högre socioekonomisk status, medan dödligheten är lägre relativt de med lägre socioekonomisk status, även betingat på hälsa och andra bakgrundsfaktorer. En potentiell förklaring till detta skulle kunna vara att kunskap om hälsa och hur man effektivt navigerar sjukvårdssystemet är relaterat till utbildningsnivå eller invandringsstatus.

Studien visar även att de socioekonomiska gradienterna i utfall efter insjuknande i Covid-19 ser likadana ut som de socioekonomiska gradienterna i sjuklighet och dödlighet efter andra vanliga folksjukdomar före pandemin, inklusive andra infektionssjukdomar och influensa. Personer med högre utbildning/inkomst, som inte är ensamstående, och som inte är utlandsfödda har en högre sjukfrånvaro än personer med lägre utbildning/inkomst, ensamstående respektive utlandsfödda, för samma typ av hälsochock (infektionssjukdomar, tumörer, eller hjärt- och kärlsjukdomar). Samtidigt har dock personer med högre utbildning/inkomst, eller med en make/maka/sambo lägre dödlighet efter en sådan hälsochock jämfört med deras lägre utbildade/ensamstående motparter med samma hälsa, ålder, och andra bakgrundsvariabler. Med andra ord verkar den så kallade morbiditets-mortalitetsparadoxen – där vissa grupper har högre sjukvårdskonsumtion men lägre dödlighet – inte unikt för pandemin, utan följer de mönster som ses för andra sjukdomar i avsaknad av en global pandemi.

Den fjärde slutsatsen är dock att det för en särskild grupp, nämligen utlandsfödda, tycks finnas mekanismer för utfall efter insjuknande i Covid-19 som inte stämmer överens med denna grupps utfall efter andra vanliga folksjukdomar. Tidigare studier har visat att invandrade personer i genomsnitt har bättre underliggande hälsa än populationen i övrigt, en så kallad ”healthy migrant advantage”. Resultaten i denna studie är i linje med denna hypotes när det gäller hälsochocker före pandemin. Invandrare födda i framförallt Asien tycks ha en lägre sjukfrånvaro, men också lägre dödlighet, efter en infektionssjukdom, tumör, eller hjärt-kärlsjukdom jämfört med svenskfödda med motsvarande ålder och andra bakgrundsvariabler. Kontrollerat för utbildningsnivå och inkomst är denna underdödlighet relativt svenskfödda ännu mer framträdande. Sammantaget är överdödligheten i Covid-19 bland utlandsfödda relativt de födda i Sverige högre än förväntat baserat på relativa utfall för andra vanliga folksjukdomar, inklusive andra infektionssjukdomar. Vidare forskning behövs därför för att klarlägga de specifika trösklar eller mekanismer som försvårat utfallen efter insjuknande i Covid-19 bland utlandsfödda.

# 1 Introduction

Since the emergence of the SARS-CoV-2 pandemic in late 2019, researchers and public health authorities have continuously monitored the incidence and clinical outcomes of individuals diagnosed with Covid-19. This work has resulted in the identification of several risk factors associated with Covid-19 severity, including age, male gender, and certain chronic health conditions and comorbidities.[1] In addition, recent evidence suggests that ethnic minorities and individuals with lower income or education (or more broadly – individuals with lower socioeconomic status, SES) are disproportionately affected by the pandemic. In the US, and the UK, Black or Hispanic, and ethnic minority populations, respectively, have been observed to be more likely to be infected with SARS-CoV-2; have higher hospitalization rates, and higher mortality rates due to Covid-19 relative to those of white ethnicity (see e.g. de Lusignan et al., 2020; Aldridge et al., 2020; Williamson et al., 2020). Drefahl et al. (2020) made similar observations for Sweden: males, low-income earners, lower educated, immigrants from low- and middle income countries, and not-married individuals had higher Covid-19 mortality risks in the early phase of the pandemic.

The unequal burden of the pandemic with respect to ethnicity and SES is thus relatively well documented. However, we know much less about the causes of these differences. Broadly speaking, the literature discusses three main explanations (see e.g. Burström and Tao, 2020). First, low SES and ethnic minority populations likely face higher risk of infection, due to holding jobs that cannot be performed from home; crowded housing conditions; and exposure to other potential transmission paths (such as public transportation). Second, the prevalence of risk factors (underlying chronic conditions and comorbidities) is inversely associated with socioeconomic status. Thus, conditional on infection, low SES populations may have worse outcomes because they are more likely to have poor underlying health. Third, health care seeking behaviors are associated with health literacy, which is generally lower in populations with low SES than in groups with higher education and earnings. Thus, individuals in disadvantaged groups may delay seeking care for Covid-19, have more restricted access to health care, or may receive different treatments in the health care system; all potential mechanisms for more severe outcomes.

While this third group of explanations is not likely to be quantitatively as predictive of the documented gradients in Covid-19 outcomes as the type of occupation held or underlying health, they are nevertheless important to quantify. An unequal distribution of access to information, knowledge, or

[1]Specifically, the clinical literature has identified that individuals diagnosed with obesity, diabetes, hypertension or coronary artery disease experience worse outcomes conditional on being infected (see e.g. Du et al., 2020; de Lusignan et al., 2020; Li et al., 2020; Williamson et al., 2020).

medical care based on SES may further exacerbate the unequal burden of the pandemic. These channels also require other policy tools than those that address the risk of contracting the virus in the first place.

The purpose of this report is to examine the relevance of this third group of explanations for the observed differences in outcomes between groups of individuals defined by their SES, and by country of birth. The idea is to test whether any of the documented differences in mortality or Covid-19 severity remain, once we adjust for differences in the risk of contracting the virus and for differences in age and underlying health. Any remaining differences could arguably be attributed to health seeking behaviors or treatments, or point towards other channels that warrant further examination.

In order to account for potentially different exposures to infection, the study examines heterogeneity in outcomes among individuals who received inpatient care due to Covid-19, controlling for that low- and high SES groups may differ systematically with respect to underlying health and other characteristics that are predictive for morbidity and mortality. The study also examines whether individuals exhibit different health seeking behaviors depending on SES, ethnicity, and marital status. Finally, the study compares any potential differences in outcomes by income, education, country of birth, and marital status to those observed for other common health shocks in the population, before the pandemic. This analysis is informative on whether the unequal burden of the pandemic with respect to SES is specific to the conditions during a pandemic, or whether it simply mirrors the SES gradients in health in general.

The analyses are based on exceptionally rich individual-level population-wide data from multiple administrative registers in Sweden. The data spans the first, second, and third waves of the SARS-CoV-2 transmission in Sweden (from January 2020 through May 2021), with matched health records (inpatient and outpatient care) and socioeconomic data for the full population between 2015 and 2021. Thus, it is possible to follow the entire chain of events, from infection, potential hospitalization, intensive care, and death. The data also allows studying individuals' health- and labor market outcomes up to almost a year after the hospitalization. Thus, these data will also generate novel insights about the recovery from severe Covid-19, both in terms of diagnoses that accompany Covid-19 patients after they have been discharged from hospital, and to what extent the ability to work is affected in the medium-run (measured by labor earnings and sickness absence).

The study yields several novel findings. First, individuals that were hospitalized for Covid-19 have long-term health issues, indicated by the probability of re-admission to hospital after discharge (conditional on surviving) and post discharge outpatient care visits. The study informs on the causes of such re-admissions and the specific health issues that follow severe Covid-19, through detailed diagnosis codes. With respect to re-admissions, (former) Covid-19 patients are disproportionately (re-)admitted for diseases of the respiratory system. With respect to post-discharge outpatient care, individuals who experienced severe Covid-19 disproportionately seek care for symptoms and signs of illness that are not easily classified or diagnosed. Following their sickness absenteeism and labor earnings, these health issues seem to reduce their work capacity, indicated by substantially higher sickness benefits and substantially (20 percent) lower labor earnings in the 11-month follow-up horizon after hospital admission that the data allows.

Second, substantial differences in the probability of ICU admission and mortality between groups defined by SES remain after including extensive controls for health, age, and other personal characteristics. In particular, the top 25 percent of earners are 2.2 percentage points less likely to have died relative to those in the bottom 25 percent of the income distribution, in a sample where 16 percent died. Similarly, those with post-secondary schooling were 1.8 percentage points less likely to have died relative to those with only compulsory schooling. Finally, mortality was also correlated with marital status: married/cohabiting individuals were almost 1 percentage point less likely to have died compared to their single counterparts. Similar gradients were found with respect to the probability of receiving intensive care.

Third, while mortality risks were lower in socioeconomically advantaged groups, health care consumption was higher: individuals with higher income or education were more likely to have at least one outpatient care visit after being discharged, relative to their lower earning or lower educated counterparts. This gradient is not likely driven by higher earning/educated being of worse health, as indicated by their lower hospital re-admission probability (and lower mortality).

Fourth, results suggest that health care seeking behaviors differ by SES. In particular, individuals with higher income and education were less likely to have been admitted directly to the ICU, compared to those with lower income or education, which indicates that the latter group may have delayed seeking care for their symptoms. Moreover, even when testing capacity had been vastly expanded, those with lower income or education were substantially more likely to have been admitted to the hospital without having been tested for Covid-19 prior to hospital admission relative to those with higher earnings or education. The same is true with respect to marital status, where singles were more likely to have been admitted to hospital without having been tested prior. In the case of education or income, the differences in testing behavior could potentially be explained by health literacy, or different constraints in obtaining a test between the groups. With respect to marital status, it is possible that having a partner or spouse monitoring your health reduces the risk of delaying seeking health care or getting tested, although the data does not allow to test the specific mechanisms. Taken together, these results are in line with those for health care consumption after being discharged, where high SES groups were observed to make more use of the health care system.

Fifth, even conditional on health and other characteristics, there were remaining differences in the probability of ICU admission and death by country of birth. Specifically, individuals born in an African, Asian, or South American country were 3.5, 1.2, and 3 percentage points more likely, respectively to have been admitted to an ICU compared to natives. Moreover, individuals born in African country were 1.5 percentage points more likely to have died from Covid-19, compared to natives. Individuals born in Africa and Asia were also more likely to have been admitted to hospital without being tested for Covid-19 prior, compared to natives. Finally, individuals born in Asia, South America, and European countries were significantly less likely to have received outpatient care post discharge compared to natives, while there were no statistically significant differences in re-admission rate.

Based on these results, the study draws four main conclusions. First, severe Covid-19 has long-term negative health consequences, affecting individuals' ability to return to market work. Second, there are substantial differences in morbidity and mortality due to Covid-19 between groups defined by their socioeconomic status, even after adjusting for differences in underlying health and a large set of other characteristics. While one cannot rule out that the remaining gaps in mortality and morbidity could be accounted for by unobserved differences in health, for example body mass index, the individuals studied are all severely affected by Covid-19, and thus such differences should arguably be smaller than in the population at large. Thus, differences in the risk of becoming infected, and differences in underlying health are not likely to be the sole explanations for why disadvantaged groups have higher Covid-19 mortality. The evidence also suggests that health behaviors differ between high- and low earnings/educated individuals. In particular, individuals with more favorable socioeconomic status consume more health care than do those with lower socioeconomic status, but have lower mortality. This so-called morbidity-mortality paradox suggests that health literacy, which is key to navigating the health care system effectively, is systematically related to SES and may contribute to the outcomes of a given health shock. Why health behaviors differ across groups, and how much they can explain differences in mortality remain open questions.

Third, the documented gradients in morbidity and mortality due to Covid-19 largely mirror those of other common health shocks in non-pandemic years. The study documents that observationally equivalent (in terms of medical history, age, gender, and municipality of residence) individuals experiencing an infectious disease, tumor, or disease of the circulatory system have widely different outcomes depending on their level of education, income, or marital status in ways that consistent with those for Covid-19. In particular, individuals of higher socioeconomic status have higher health care consumption – as measured by their sickness absence – following such health shocks, but significantly lower mortality relative to their lower socioeconomic counterparts. Addressing the inequalities in health outcomes in future pandemics thus likely requires an understanding of-, and addressing the causes of the overall health inequalities in the population. Fourth, while the results from the Covid-19 pandemic largely mirror those for other common health shocks, foreign-born – specifically those born in an African country - have higher mortality risk (relative to natives) due to Covid-19 than what should be expected based on how they fare (in relative terms) after other severe health events, including other infectious diseases and influenza. This warrants future research focusing on the specific causes by which this group is particularly affected by the pandemic.

## 2 Data sources

The analyses presented in this report are based on data provided through a research program at Stockholm University, initiated by the Corona Commission: *Ett forskningsprogram om Covid-19 i Sverige: Smittspridning, bekämpning, och effecter på individer och samhälle*.[2] The purpose of the research program is to evaluate the consequences of Covid-19 for public health, in terms of morbidity and mortality, and mental and physical health broadly, as well as the consequences of policy actions taken to curb transmission and minimize negative effects on society, for key social and economic outcomes. The results from the research program serves as independent scientific basis for policy discussion.

The data used in this report consists of a combination of multiple individual level register data sets. From Statistics Sweden, the Longitudinal Integration database for Sickness insurance- and Labor Market Studies (LISA) provides individual level data on labor income, governmental transfers, education level, gender, municipality or residence, age, civil status, and housing/living conditions covering the years 2015-2019. Information about family links (married or cohabiting couples) come from the register of the total population (Registret över Totalbefolkningen), and links between parents and children from the Multigenerational register. Information about confirmed Covid-19 cases based on PCR tests come

[2]The research program is lead by Torsten Persson (member of the commission), and coordinated by Adam Altmejd, Evelina Björkegren, and Olof Östergren (employed at the commission).

from the SmiNet database, which is administered by the Public Health Agency of Sweden (Folkhälsomyndigheten). This data covers January 2020 – March 2021, and includes 787 225 observations (787 219 individuals). The register contains information about test date (although test dates are missing in 90 959 cases.

Data on health outcomes is provided by the National Board of Health's (Socialstyrelsen) inpatient- and outpatient registries.[3] The registries contain date of admission, date of discharge, date of outpatient visit, as well as detailed diagnosis codes according to the International Classification of Diseases (ICD). From the inpatient registry, I extract all hospitalizations where Covid-19 is recorded as the main or secondary diagnosis (all cases with ICD-codes U071 and U072). The same individual can be recorded with multiple hospital admissions if they are moved from one clinic to another; if an admission is recorded on the same day as a discharge, I consider the two admissions as one consecutive hospitalization spell.[4]

From the outpatient registry, I obtain information on all outpatient care visits with Covid-19 recorded as the main or secondary diagnosis, as well as for all other causes. In addition, individual level data on intensive care is provided by the Intensive Care Registry (Svenska intensivvårdsregistret, SIR). Thus, any person who received ICU due to Covid-19 is identified in the data. Finally, to study mortality I rely on the Cause of Death Registry (Dödsorsaksregistret), which provides information on the date and cause of death (ICD-codes). The inpatient-, outpatient-, and Cause of Death registries all cover the period January 2015–May 2021, and the ICU register January 2020–May 2021.

## 2.1 Population of interest

The datasets described above covers all individuals who had been registers as residents in Sweden during 2015 – 2019. The study group of interest in this paper is the full subset of the population that received inpatient care for Covid-19, sometime during January 2020 – May 2021, which is comprised by 62,527 individuals.

[3]Outpatient care includes day-surgeries and specialized care, but does not include primary care visits to a GP.

[4]Multiple admissions for the same person with several days, weeks, or months between admissions, I consider separate spells.

# 3 Descriptive statistics: who was hospitalized, and how did they fair?

## 3.1 Context

Since the first confirmed case in Sweden on January 31, 2020 until the end of March 2021, Sweden had recorded 787,222 confirmed Covid-19 cases in SmiNet Figure A.1. By the first week of June 2021, a total of 63,984 individuals had received inpatient hospital care with Covid-19 as the main or secondary diagnosis (Panel B of Figure A.1), and a total of 7,503 individuals had received intensive care (Panel A, Figure A.2). Finally, a total of 15,537 individuals had died by the first week of June 2021 (Panel B of Figure A.2). A large share of the deceased were not hospitalized prior to death, due to old age (many individuals of older age living in nursing homes died without being hospitalized, due to being too frail for invasive hospital care). In the hospitalized group, 9,021 individuals had died due to Covid-19 by the first week of June, 2021.

## 3.2 Summary statistics

The population-wide data in Sweden allows an in-depth examination of which groups that bear the brunt of the pandemic, and how infected individuals fair in their post-infection morbidity and health care consumption. While we know from previous studies that Covid-19 mortality is linked to ethnicity and sociodemographic and economic factors, and to neighborhood characteristics such as population density or average income, most of the existing literature is based on short time periods in the early stages of the pandemic; samples of patients at particular hospitals; and with limited information on individuals' income, education, family- or housing situation. The data used here spans the first, second, and third waves of the SARS-CoV-2 transmission in Sweden (from January 2020 through May 2021), with matched health records and socioeconomic data for the full population between 2015 and 2021. Thus, we can follow the entire chain of events, from infection, potential hospitalization and death, as well as study surviving individuals' health- and labor market outcomes up to a year after they were discharged or ended up in hospital. This chapter therefore starts by analyzing how the risk of hospitalization for Covid-19 varied with a wide range of socioeconomic and demographic characteristics. Subsequently, I analyze how individuals who were hospitalized faired; what proportion received intensive care or died; how long did they remain at hospital? Finally, for those discharged alive, what was their health status after discharge: what proportion were re-admitted to the hospital a second time, and for what cause; and how many received outpatient care, and for what cause? These analyses will inform on the longer-term consequences of severe Covid-19, of which we still know very little.

Figure 1 shows how the risk of hospitalization varies with socioeconomic characteristics. The graph illustrates how the group admitted to inpatient hospital care due to Covid-19 differs from the overall population: the figure reports differences in proportions of the hospitalized group and the full population that exhibit a certain characteristic (along with 95% confidence intervals).[5]

As expected based on a wide range of evidence linking old age to severe outcomes from Covid-19, the youngest age group (30-49) is heavily under-represented in the hospitalized group relative to the population at large, while the oldest age group (70 and older) is heavily over-represented. Moreover, women are under-represented among the hospitalized. We can also note that the group that have underlying health conditions which are considered risk factors for severe Covid-19 (medical risk group) is heavily over-represented among the hospitalized relative to the population at large.

To study potential differences in the rate of hospitalizations by socioeconomic status (SES), the figure reports differences between the hospitalized and the full population that belong to different education groups (compulsory school, high school, college or more) and income quartiles.[6] In addition, the graph reports the difference in the proportions living in deprived/vulnerable neighborhoods ("utsatta områden"), and the fractions that live alone or without a partner, and in marriage/cohabitation unions, respectively. Taken together, the results suggest that individuals with lower SES are disproportionately affected by the pandemic: individuals belonging to the first (fourth) income quartile are over-represented (under-represented), the low (highly) educated are over-represented (under-represented), married- or cohabiting individuals are under-represented, while individuals without a spouse or partner are disproportionately affected. Moreover, residents born in Asian countries are strongly over-represented among the hospitalized.

The figure also reports how occupation type – characterized by potential exposure to the virus – is distributed in the hospitalized group vis-à-vis the population. In particular, individuals with occupations that allow working from home, or otherwise are subjected to few or moderate social interactions in their jobs are under-represented in the hospitalized groups, whereas workers with high degree of social interaction in their occupations are over-represented. These findings are in line with the narrative that workers holding so called "essential jobs" are at greater risk of being infected and, therefore, also face

[5]Table A.1 in the Appendix reports the means of the same characteristics in the population as a whole and the hospitalized, respectively.

[6]Individuals are ranked by their average income over the years 2015-2019 in their respective birth-cohorts, and then divided into four equally sized groups based on that ranking. Thus, individuals in the first quartile refers to belonging to the bottom 25 percent of their cohort-specific income distribution, and individuals in the fourth quartile belongs to the top 25 percent of their cohort-specific income distribution.

greater risks of becoming hospitalized. However, the results could also be driven by how underlying health is distributed in the groups holding different types of jobs.

Table 1 displays summary statistics for the population hospitalized because of Covid-19 since the start of the pandemic until (and including) March 2021 (although inpatient data exists until May 2021, I exclude individuals admitted in April – May to allow at least a two month follow-up horizon for all patients). The three columns report summary statistics for waves one (first half of 2020), two (second half of 2020), and three (first three months of 2021), respectively.

First, we can note that around 17 percent of those hospitalized in the first and second waves, respectively, died from Covid-19, while the corresponding number for the third wave was 13.4 percent. The lower mortality rate in wave three could be due to that the censoring of the data, i.e. that some of those hospitalized during the first three months of 2021 died after the data ends. However, the average duration between hospital admission and death (conditional on death) was around 18 days, on average, in the first wave, which could mean that a two-month follow-up horizon is sufficient. This would imply instead, that mortality declined because of different groups of individuals being infected or hospitalized over time, or that medical treatments were improved over time. As data from the full first half of 2021 is made available, it would be prudent to revisit these statistics.

One particularly notable summary statistic is the fraction of patients that were hospitalized without a PCR test confirming infection prior to hospitalization (tested at hospital): the majority (78 percent) were admitted to hospital for Covid-19 without being tested prior to hospital admission in the first wave, which is in line with the testing policy at the time when supply was low. In the third wave, however, a substantially lower – but still large – fraction, 39 percent, received a positive test only after being admitted to the hospital. Thus, despite that the testing capacity had been substantially expanded by the beginning of 2021, a large fraction of the individuals who were hospitalized in early 2021 had still not obtained a test for infection before they were hospitalized. In later sections, the study examines how testing behavior differs across groups.

How did Covid-19 patients fair after they were discharged from hospital, conditional on survival? The results presented in the lower panel of Table 1 shows that that as many as 18-20 percent were re-admitted to the hospital within 90 days of discharge, while a majority – 52-55 percent – had at least one outpatient care visit within 90 days from discharge. While it is difficult to speak to the magnitudes of these estimates without comparison to hospitalization- and outpatient care visits in a normal year, they point to potentially long-term negative health consequences of severe Covid-19. Later in the study, I will provide analyses of the effect of being hospitalized for Covid-19 on sickness absence up to a year after hospitalization, to inform on this issue in more detail.

What were the main causes of re-admission and outpatient care visits after being discharged from hospital? Table 2 shows the most common diagnosis type for each individual who were either re-admitted or received outpatient care at least once within 90 days from discharge. For re-admissions, the most common diagnoses were Covid-19 (26 percent), and diseases of the circulatory system (13 percent). For patients who received outpatient care, the most common causes include the diagnoses categories "symptoms and clinical findings not elsewhere classified" (18 percent), "factors influencing health statu" (13 percent), and diseases of the circulatory system (9 percent). The first two diagnose categories are interesting considering the numerous reports of long-term post-Covid-19 symptoms. To get a better sense of what types of health issues are contained in these two diagnoses categories, Table 3 looks at the distribution of sub-diagnoses contained each category, for those individuals who had an outpatient care visit with these diagnoses within 90 days from discharge. The upper panel reports the distribution of cases diagnosed as "symptoms and clinical findings not elsewhere classified" (chapter "R" of the ICD-10) over the sub-categories contained. The most common sub-category is symptoms and signs of illnesses of the circulatory or respiratory system. The second most common sub-category is "general symptoms of illness", suggesting that the post-Covid-19 symptoms are not easily diagnosed.

The lower panel of Table 3 looks at the distribution of cases diagnosed with "factors influencing health status" (chapter "Z" of the ICD-10) over the sub-categories contained. The majority of cases, 53 percent, consists of the sub-category "contact with health care for examination and investigation of signs of illness". The second most common sub-category consists of health care visits related to a patients medical history or the medical history in the patient's family.

In order to draw any conclusions on whether these types of diagnoses and symptoms are related to Covid-19, we need to compare the frequency with which they occur in the sample of those hospitalized for Covid-19 with health care visits in a normal year. To do so, Table 4 reports differences in the distribution of inpatient and outpatient causes between the group hospitalized for Covid-19 (re-admission causes and post-Covid-19 outpatient care) and an age-matched sample of the population who were not hospitalized for Covid-19. For the latter group, data on hospital- and outpatient care from 2019 are used.

Starting with inpatient care, individuals who were re-admitted to inpatient care after being discharged from Covid-19 inpatient care were 5.5 percentage points more likely to seek care for diseases of the respiratory system compared to the age-matched sample of 2019. Moreover, they were 6.8 percentage points less likely to be admitted to hospital due to musculoskeletal diseases, and 4 percentage points less likely to have suffered injuries or accidents. Admissions due to mental/behavioral problems are also higher after Covid-19 relative to the age-matched sample (1.7 percentage points).

Turning to outpatient care, post-Covid-19 outpatient care visits were 8.3 percentage points more likely to have been diagnosed with “symptoms and signs of illness not classified elsewhere” compared to an age-matched sample seeking outpatient care in 2019, and 6.2 percentage points more likely to be diagnosed with “factors influencing health status” compared to the same group. Thus, this suggests that Covid-19 may cause longer-term health issues that are not easily defined or diagnosed.

We can also zoom in which of the sub-categories of these, rather loosely defined, diagnosis categories that are most common within the category. Table Table 5 compares those in the population of interest that received outpatient care for “symptoms not classified elsewhere” and compares the distribution of sub-categories contained in that diagnosis category with an age-matched sample who received outpatient care for the same diagnosis category in 2019. The results show that the Covid-19 patients are disproportionately diagnosed with symptoms and signs of the circulatory or respiratory system (12.9 percentage points more likely), mainly at the expense of symptoms of illness of intellectual and emotional functions (4.3 percentage points less likely). Moreover, Covid-19 patients diagnosed with “symptoms and signs not classified elsewhere” are 4.3 percentage points more likely to have been diagnosed with “general symptoms of illness” relative to the age-matched sample who received outpatient care for the same diagnosis category in 2019.

### 3.3 Labor earnings and sickness benefits after Covid-19 hospitalization

The results in the previous section suggested that individuals who experienced severe Covid-19 experience longer-term health issues. Another way to study morbidity in the longer term is to study labor market outcomes: how are earnings and sickness absence affected after a Covid-19 hospitalization.[7] To answer these questions, I use monthly data on labor earnings and sickness benefits from Statistics Sweden, and estimate the percentage change in both variables in each month since becoming hospitalized, compared to the month before hospitalization. Since this analysis focuses on labor market outcomes, it only includes individuals who were employed before becoming hospitalized due to Covid-19.

The results are displayed in Figure 2. The horizontal axis in each figure displays months since hospitalization, where $time = 0$ is the month of hospitalization, $time = 1$ is one month after, and so forth.

[7] See Kleven et al. (2019) for details on the econometric method used.

Panel A shows the percentage change in labor income, and panel B the percentage change in sickness benefit received. Panel A shows that there were no differences in the income earned in the 5 months before being hospitalized relative to the month before, but in the month of hospitalization, labor earnings dropped by almost 10 percent, on average, and in the second and third months earnings dropped by around 30 and 27 percent, respectively. From the third month onwards, the earnings reduction stabilizes at around 20 percent. However, even 11 months after the hospitalization event, earnings were still around 15 percent lower, on average, relative to the month before hospitalization. Panel B shows that this reduction in labor supply is likely driven by long-term sickness absence: one and two months after being hospitalized, sickness benefits are more than 300 percent higher for these individuals, relative to the month before hospitalization. Moreover, as long as 11 months after the hospitalization, individuals receive almost 50 percent higher more in sickness benefits compared to the month before they were admitted to the hospital.

Thus, these results point to substantial negative effects of severe Covid-19 on individuals' work capacity, which appear to be long-lasting.

## 4 Heterogeneous effects of severe Covid-19

This chapter documents heterogeneity in the outcomes of patients hospitalized for Covid-19 by income, education, marital status, and country of birth. The interest lies in studying whether differences in outcomes between individuals with high- or low income/education; between those living with or without a partner; and between natives and foreign-born which have been documented in earlier studies remain, once we adjust for systematic differences in pre-existing conditions, age, gender, and municipality of residence between the groups.

The analysis consists of estimating morbidity and mortality outcomes as functions of different socioeconomic factors, conditional on characteristics and health. Health is controlled for in two ways: having any of the pre-existing conditions identified as risk factors for severe Covid-19 (medical risk group), and secondly, through indicators for any hospitalizations for all different diagnosis categories of the ICD-10 in the five years prior to the start of the pandemic (2015-2019), as well as the number of days spent in hospital for all causes during those years. The estimations also control the week of hospital admission for Covid-19.

### 4.1 Subsequent health and mortality

Table 6 reports how mortality (columns 1-4) and ICU admission (columns 5-8) varied with socioeconomic background factors of interest, holding constant health, age, municipality of residence, and time effects. The results reported in column (1) show that, after adjusting for differences in health and other characteristics, Covid-19 patients with earnings in the third and fourth quartiles of their cohort-specific income distributions are 1.1 and 2.2 percentage points less likely, respectively, to have died from Covid-19 relative to patients with earnings in the bottom 25 percent of the income distribution. These estimates are sizeable considering the mean mortality rate of 16 percent in the sample.

The results reported in column (2) indicate that patients with a high school degree and a college degree are 0.7 and 1.8 percentage points less likely, respectively, to have died relative to patients with at most compulsory schooling. Finally, column (3) shows that also marital status mattered for mortality: those with a cohabiting partner or a spouse were 0.7 percentage points less likely to have died relative to their single counterparts. Entering all socioeconomic characteristics jointly (column 4), the point estimates decline somewhat – which is expected since they are correlated – but all socioeconomic indicators remain to be individually predictive of mortality.

Columns 5-8 show the corresponding results with respect to ICU admissions, conditional on hospitalization. As for mortality, ICU admission is inversely associated with the level of income and level of education. Individuals with earnings in the second, third, and fourth quartiles of their cohort-specific income distribution are 1.2, 1.8, and 2.1 percentage points less likely, respectively to have been admitted to the ICU relative to their counterparts in the bottom 25 percent of the income distribution. Moreover, individuals with a high school degree and with a college degree are 0.7 and 1.7 percentage points, respectively, less likely to have required intensive care compared to individuals with at most compulsory schooling. There was no difference, however, in the risk of ICU admission by marital status. Entering all characteristics jointly does not qualitatively affect the results (column 8). Again, relative to the mean ICU admission rate in the sample – 10.5 percent – these differences are sizeable.

Table A.2 in the Appendix reports results from estimating the joint regressions (corresponding to columns 4 and 8 of Table 6) separately for the three waves of the pandemic in Sweden. Patients with a college degree are less likely to die from Covid-19 compared to low educated patients, in all three waves. The income gradient in mortality, however, is predominantly driven by the hospitalizations in the first wave, although the difference between the highest and the lowest income quartiles is marginally significant also in the second and third waves. In contrast, the education- and income gradients in ICU admissions are predominantly driven by the second and third waves of the pandemic.

How do does the health of individuals evolve after severe Covid-19? Conditional on having survived and discharged from hospital, the results presented in Table 7 show an estimated lower risk of re-admission among individuals with higher earnings (compared to patients with lower earnings). At the same time, there a positive relationship between the level of income and outpatient care incidence, and between the level of education and outpatient care incidence.[8] Specifically, individuals in the third and fourth quartiles of their cohort-specific income distributions are 1.8 and 1.6 percentage points more likely to have had an outpatient care visit within 60 days from discharge, respectively, compared to their counterparts in the bottom 25 percent of the income distribution. Relative to the mean outcome in the sample (45 percent had at least one post-discharge outpatient care visit), these estimates correspond to a 4 and 3.5 percent higher probability, respectively. Similar point estimates are revealed with respect to the level of education. These results suggest that while higher SES individuals have better post-discharge health, they consume more outpatient care than do lower SES individuals, which could potentially be related to their health literacy or health investment behavior. The next section discusses the possible interpretation of the results reported in Table 6 and Table 7 in more detail.

#### 4.1.1 Interpretation of results

While a large share of the unconditional differences in ICU admission and mortality (not shown) between the groups studied above can be explained by the variation in pre-existing conditions and other covariates, the remaining differences are indeed sizeable. In order to interpret the remaining heterogeneity across groups as driven by behavioral factors or differences in treatments/access to care, we would have to assume that low- and high SES individuals have the same average level of objective health prior to the hospitalization, conditional on the control variables. In other words, it would require assuming that we have adequately controlled for the difference in health between groups. This is a rather strong assumption, as there may be unobserved differences across the groups that are predictive for the outcomes under study. In particular, obesity has been identified as a risk factor for severe Covid-19, and the health registries used in this report do not include information on BMI (see e.g. Townsend et al., 2020, for a discussion on disparities in Covid-10 outcomes and obesity). To the extent that obesity is systematically more prevalent in low SES groups, controlling for BMI may attenuate the remaining gaps documented here. However, one can note that the sample studied all experience severe Covid-19 that re-

[8] Outpatient care here refers to specialist care that requires a remittance from a GP. Thus, primary care visits are not observed in the data.

quired hospitalization, which arguably removes a meaningful portion of the differences in health across the groups, in addition to what the extensive set of controls achieve.

Moreover, even though hospital admission can be viewed as an objective measure of a change in health, one cannot rule out that there are systematic differences in the propensity to be admitted to the hospital for severe Covid-19 depending on SES. If, for example, low SES individuals have a higher threshold to being admitted to hospital or delay seeking hospital care, this could potentially account for their higher mortality rate, if early intervention and treatment is important for survival. Thus, differing thresholds to hospitalization can be viewed as one of the mechanisms of interest (discussed in more detail in the next section).

Finally, the finding that high SES individuals are more likely to receive outpatient care conditional on survival (and hospital discharge) can be interpreted in two ways. First, taken at face value, the results suggest that individuals with a more favorable SES consume more health care, due to more preventive behavior or because they can more easily navigate the health care system, or have better access. On the other hand, because low SES individuals are observed to die at a higher rate than high SES individuals, this could mean that survivors in the former group are more positively selected on (unobserved) health relative to their high SES counterparts. This could potentially account for the high SES group's higher health care consumption post discharge. However, the fact that there appears to exist reversed SES gradients in re-admission to inpatient care among the survivors (columns 5-8 of Table 7) supports the first interpretation, namely that health behaviors drive the documented differences in outpatient care. The next section explores potential indicators for health behaviors in more detail.

### 4.2 Heterogeneity in health behaviors?

The analyses presented in the previous chapter suggest that other factors than health or the risk of becoming infected may also explain part of the SES gradient in Covid-19 outcomes. This section explores other possible channels. In particular, the interest lies in whether there are differing thresholds to hospital admission for Covid-19 by SES and marital status.

Two indicators for health behaviors related to Covid-19 are used. First, an indicator for whether the hospitalized individual was admitted to an intensive care unit on the day of hospital admission. The idea is that an immediate ICU admission may indicate that the individual did not seek or obtain care for their symptoms until they require acute intensive care. The second proxy for search behavior used is an indicator for whether a PCR test for SARS-CoV-2 infection was obtained only once hospitalized. While tests were not widely supplied during the first wave of the transmission in Sweden, the testing capacity was substantially increased by the second and third waves, with tests then being offered universally, and available through drive-in, home-testing, and other facilities. Thus, not having been tested for infection prior to being hospitalized for severe Covid-19 could be indicative of not taking preventive measures or otherwise not having easy access to a testing facility.

Table 8 reports the estimated differences between groups in the probability of having been admitted immediately to the ICU (columns 1-4), and having been tested at the hospital (columns 5-8). Column (1) shows that there is a decreasing relationship between the level of income and the probability of being directly admitted to the ICU: those with earnings in the second, third, and fourth quartiles of the income distribution are 0.5, 0.8, and 0.9 percentage points less likely, respectively, to have been admitted to an ICU on the same day of hospitalization, compared to those in the bottom 25 percent of the income distribution. These differences are sizeable relative to the mean outcome of 3.3 percent. Moreover, having a college or university degree (column 2) decreases the same probability by 0.8 percentage points relative to having at most compulsory schooling, and having a partner (column 3) decreases the likelihood by 0.4 percentage points relative to being single. Entering all these characteristics jointly (column 4) does not qualitatively or quantitatively alter the results notably.

Columns 5–8 report the corresponding results for not having been tested for Covid-19 prior to hospitalization. Those with earnings in the second, third, and fourth quartiles of the income distribution are 4.4, 5.3, and 9.6 percentage points, respectively, less likely to have been admitted to the hospital without confirmed infection before the hospitalization. The sample average of being tested at the hospital is high; 53 percent averaged over the entire sample period. Nevertheless, the point estimates are large and in relative terms, they imply differences ranging between eight and 18 percent. Column (6) shows that there is also an educational gradient in the likelihood of not having been tested prior to hospitalization (2.2 and 6.2 percentage points lower probability for those having a high school degree and a college degree, respectively, compared to those with at most compulsory schooling). Finally, having a partner decreases the likelihood of not being tested prior to hospital admission by 3.8 percentage points, relative to singles (column 7). Entering all characteristics jointly does not alter the results qualitatively, but the point estimates are somewhat smaller for education levels in particular.

Table A.3 in the Appendix shows that the observed differences in testing behavior between the groups are predominantly driven by those hospitalized during the second- and third waves of the transmission, i.e., when testing was offered on broad scale to the population. (Regarding ICU admissions, the coefficients on the level of education, income, and partnership status are negative during all three waves, but less precisely estimated compared to when data from all three waves are pooled).

Overall, these results suggest that individuals with poorer socioeconomic status, and individuals who live on their own delayed seeking care, or otherwise had more restricted access to tests or health care compared to individuals with higher SES. Previous research based on Swedish register data shows that health literacy is possibly related to health outcomes. For example, Wångdahl et al. (2018) study health literacy among refugees in Sweden and find, using survey evidence, that refugees had limited health literacy, and that about four in ten respondents reported having refrained from seeking health care. They also conclude that health literacy was related to seeking health care, and to health outcomes. Moreover, Chen et al. (2019) test for health literacy as a potential channel for the SES gradient in health, using population-wide administrative data in Sweden. In particular, they find that having a family member who were admitted to medical school (through admission lotteries in over-subscribed programs) had a positive causal effect on health, suggesting that access to medical expertise matters for health outcomes. They conclude that a substantial share of the SES gradient in health can be accounted for the fact that access to health care professionals in the family is unequally distributed across SES.

In light of these previous studies, it is interesting to analyze whether having access to a health professional in the family is predictive of testing behavior. If such a correlation exists, it would point towards one particular channel through which access to medical expertise in the family affects health as documented by Chen et al. (2019), and – in the current context – inform on the extent to which health literacy matters for health behaviors related to Covid-19.

To identify health professionals in the family, I use the multigenerational register combined with data on field of education from the LISA register, and identify whether the individuals in the sample hospitalized for Covid-19 have a parent, sibling, spouse, or adult child with a medical degree or a nursing degree. Because the sample studied (hospitalized for Covid-19) is older than the population at large, there are missing observations for parents' occupation for a large part of the sample. With regards to siblings, spouses, and children, the sample attrition is smaller, but it is still important to note that this analysis should be interpreted with some caution.

Table 9 shows the estimated relationship between having been admitted to hospital without having been tested for infection prior to admission and one's father, mother, sibling, spouse, or adult child being a trained medical professional (doctor or nurse). As seen, having a father-, spouse-, or adult child trained in a medical profession decreases the probability of not being tested prior to admission by 7.8, 3.1, and 1.2 percentage points, respectively. While these correlations may reflect unobserved differences in health or other characteristics between families with and without doctors or nurses in the family, it is interesting to note that having a lawyer in the family is not significantly related to having been tested before hospital admission, apart from a weakly significant (at the 10% level) “effect” of having an adult child trained as a lawyer (see Table A.4 in the Appendix).

Taken together, the results presented here suggests the need for a better understanding of the extent to which access to information about medical treatments and interventions differ across groups.

### 4.3 Heterogeneity in outcomes and health behaviors by region of birth

Several previous studies from Sweden and abroad have documented that ethnic minority populations are disproportionately affected by Covid-19 (see e.g. Drefahl et al., 2020). Table 10 reports heterogeneity in outcomes by region of birth (compared to those born in Sweden), controlling for age, gender, health, municipality of residence, and week of hospitalization. Individuals born in an African, Asian, or South American country are 3.5, 1.2, and 3 percentage points more likely, respectively to have been admitted to an ICU compared to natives. There is also a marginally significant difference of 0.8 percentage points between individuals born in a European country other than Sweden and natives, in the probability of ICU admission. Moreover, column (1) shows that even conditional on health, individuals born in African country are 1.5 percentage points more likely to have died from Covid-19 in the hospitalized population, compared to natives. There are no significant differences in mortality between those born in Asia, South America, or Europe compared to natives. Thus, the ethnic gradient in mortality can be entirely accounted for by health and other covariates, except for the difference between those born in an African country, which exhibit a starkly higher mortality risk.

The table also shows that individuals born in Africa and Asia are 10 and 3.5 percentage points more likely, respectively, to have been admitted to hospital without being tested for Covid-19 prior, compared to natives (column 4). Finally, columns (6)-(7) shows that individuals born in Asia, South America, and European countries are significantly less likely to have received outpatient care post discharge compared to natives, while there are no statistically significant differences in re-admission rate, except for that Asians are 1 percentage points less likely to have been re-admitted compared to native Swedes.

Table A.5 in the Appendix reports the corresponding results separately for the first wave of the transmission, and Table A.6 shows the heterogeneity in outcomes by country of birth in the second- and third waves (pooled). The higher mortality risk among individuals born in African countries is entirely driven by the first wave, i.e., among those hospitalized in the first half of 2020, when mortality was 2.3 percentage points higher compared to natives. Similarly, the higher risk of ICU admission among foreign-born is driven by the first wave, as are the differences in outpatient care conditional on discharge. However, the higher probability of not having been tested prior to hospitalization is mainly driven by those hospitalized in the second and third waves.

Because immigrants, on average, have lower earnings and education compared to natives, one question that arises is whether some of the higher mortality risk among those born in an African country is driven by their lower socioeconomic status, which is positively correlated to Covid-19 mortality as we have seen. In Table A.7, the probability of death and ICU admission for foreign-born is revisited, but now including controls for income, education, and marital status (using data only from the first wave). The results show that the higher probability of death among African immigrants is accounted for by their socioeconomic status, but the risk of ICU admission is unaffected by controls for socioeconomic status. Thus, even after including extensive controls, immigrants from Africa, Asia, and South America run higher risks of requiring intensive care compared to natives.

It is also important to note that, while SES explains – in a statistical sense – the mortality gap between immigrants and natives, other research has shown that immigrants generally have a health advantage over natives (the "healthy migrant" phenomenon, discussed in e.g. Drefahl et al. (2020)). Thus, for other health shocks, immigrants typically have lower mortality than do natives. The last section of this report revisits this phenomenon, and documents the native-immigrant mortality gap for other common health shocks, before the pandemic.

### 4.4 Subsequent earnings and sickness benefit take-up

To study heterogeneity in the consequences of severe Covid-19 on individuals' labor market outcomes, I again use monthly data on labor earnings and sickness benefits. I restrict the sample to those hospitalized for Covid-19 that had positive earnings in at least one of the six months prior to their hospitalization.[9]

I then estimate the change in earnings and sickness benefits received in each month before and after being hospitalized for Covid-19, relative to the month before hospitalization, separately for each of the groups of interest. The estimations include the same control variables as previous analyses: age, female gender, municipality of residence, week of hospital admission, indicator for having pre-existing conditions identified as risk factors for severe Covid-19, and indicators for inpatient care received during

[9] The sample includes individuals who died from Covid-19, until they died.

2015-2019.

First, Figure 3 shows the estimated changes in the likelihood of having positive labor income (income $>$ 0 SEK), before and after the hospitalization event. For all groups, there is a substantial decline in the probability of earning positive income, ranging between 10-20 percentage points reduction. Moreover, the reduction in labor supply is relatively constant over the 11 month long follow-up horizon after the hospitalization event, pointing to a potentially long lasting effect of severe Covid-19 on labor supply.

With respect to the level of education, the labor supply reduction is monotonically decreasing with the level of education. With respect to the pre-pandemic level of income, the largest drop in labor supply is observed for workers in the lowest 25 percent of the income distribution. Moreover, workers born in African countries experience larger drops in employment compared to workers born in Asia, Europe, or Sweden. Finally, there are no statistically significant differences between singles and those with a spouse/cohabiting partner.

Figure 4 displays the corresponding results for the percentage change in labor earnings. As zero earnings are included, this outcome variable measures a combination of working/not working and hours of work conditional on working. There are significant reductions in earnings after the hospitalization: one month after the event, earnings drop by around 30 percent, and do not recover fully even 11 months after the hospitalization event (point estimates stabilize at around -10 percent after three months). However, there are no significant differences by education level, region of birth, nor marital status, and no clear-cut conclusions regarding differences between low- and high-earning workers. In combination with the results on whether individuals work at all (Figure 3), this suggests that conditional on returning to work, low SES groups may work more hours compared to high SES groups.

Figure 5 shows the percentage change in sickness benefit receipt in each month before and after the hospitalization, relative to the month before. For all groups considered, there are substantial and long-lasting increases in sickness benefit receipt after the hospitalization event. There are no sizeable or statistically significant differences in these effects across the comparison groups, however.

There are two main conclusions from this analysis. First, conditional on surviving severe Covid-19, the time to recovery appears long. As long as 11 months after the hospitalization, earnings are substantially lower relative to the pre-hospitalization levels, and sickness benefits substantially higher. Second, low SES groups appear to experience more adverse effects mainly in terms of extensive margin labor supply responses: they are more likely to not work at all compared to high SES groups, but conditional on returning to work, they likely work more hours than their higher SES counterparts do.

# 5 Heterogenous effects of other health shocks in pre-pandemic years

Is the unequal burden of Covid-19 particular to the pandemic, or do the differences in outcomes compare to how individuals fare after other common health shocks? Studying the SES gradients in morbidity and mortality in common diseases in the population can be informative of whether the mechanisms for the differences in outcomes documented here and elsewhere are specific to the pandemic situation or whether insights on how to address them can be gained by understanding the causes of health inequalities in general.

This chapter therefore explores the same SES gradients as in the previous chapter, but from common health shocks before the pandemic. The analyses are based on the full population of Swedish residents who had a hospitalization episode (i.e., experienced a health shock) at least once during the years 2016-2018, due to infections/influenza, tumors, or circulatory diseases (such as acute myocardial infarctions), and who were at most 65 years of age at the time of the health shock. Data on such health shocks is provided by the inpatient register, where the date of hospital admission is also recorded. I match these data to individual level information on sickness absence spells, provided by the National Social Insurance Board (Försäkringskassan). The sickness absence data includes spells of sick leave, from which monthly days on sickness absence were calculated for the time-period 2015-2019. Thus, sickness absence is observed at least 12 months prior to, and up to 48 months after the health shock for each individual. Moreover, from the cause of death register, mortality data was matched (at the monthly level) for all months including the month of hospital admission up to 48 months after. Finally, all control variables used in the analysis of the effect of Covid-19 on morbidity/mortality (with the exception of the medical risk factors for severe Covid-19) were used in this analysis (measured in the calendar year before the health shock).

I start by analyzing the "raw" data, i.e., without adjusting for any pre-determined characteristics, and study mean sickness absence days per month before and after a health shock, for individuals with and without a college degree; for individuals belonging to the first, second, third, and fourth quartiles of their cohort-specific income distributions; for married/cohabiting vs. singles; and for individuals born in Sweden, Europe, Asia, and Africa, respectively. The analyses are performed for each type health shock separately, and are displayed in Figure 6–Figure 8.

For all three types of health shocks, individuals with lower earnings appear to have a smaller increase in take-up of sickness absence after a health shock than individuals with higher earnings, while the reverse is true for mortality. The same pattern of heterogeneity is found with respect to marital status, where married/cohabiting individuals are observed with larger increases in sickness absence after a given health shock relative to their single counterparts, even while they have lower mortality rates after the health shock compared to singles. With respect to education, the differences in sickness benefit take-up seem small, but there are, again, substantial differences in mortality (low educated have higher mortality rate). These results are in line with the so-called morbidity-mortality paradox, that refers to the phenomenon that certain groups have higher health care consumption or absenteeism but at the same time have longer longevity, compared to other groups.

With respect to region of birth, the results instead suggest that immigrants from low- or middle income countries (Africa or Asia) generally have both smaller increases in morbidity, and lower mortality after a given health shock relative to those born in Sweden or Europe. This has previously been labelled the "healthy migrant" phenomenon, where migrants are observed to have smaller all-cause mortality compared to natives.

Taken at face value, the results thus suggest that people with lower SES are more likely to die following a given health shock compared to high SES individuals. At the same time, and consistent with the results for Covid-19, high SES individuals have higher health care consumption than do individuals of low SES, possibly due to differences in health behaviors, or different treatment received in the health care system. However, these first sets of results should be interpreted with caution since the distribution of age and other characteristics (mainly pre-shock health) is not likely to be the same in the different groups. Figure 9–Figure 11 instead show estimated differences in the change in sickness absence in each month before and after the health shock, relative to the month before, between the different groups, controlling for age, month of hospitalization, municipality of residence, and level of health before the hospitalization.

For health shocks due to infectious diseases (Figure 9), the results show that high educated, high earners, married/cohabiting, have larger increases in sickness absence compared to their low-educated, lower earning-, and single counterparts, respectively. With respect to region of birth, individuals born in Sweden or other European countries also have larger increases in sickness absence following a health shock compared to their counterparts born in Asia or Africa. The same patterns hold true also for tumors (Figure 10), and for diseases of the circulatory system (Figure 11). For the latter two health shocks, the morbidity gradients are long lasting (typically lasting up to 12 months after the health shock).

Finally, Table 12 shows the estimated differences in mortality risk after a health shock (data is pooled for infectious diseases, tumors, and diseases of the circulatory system), controlling for health shock type, pre-existing health conditions, age, and other personal characteristics.

Interestingly, the relationships between the socioeconomic indicators (income, education, and marital status) and mortality for these common health shocks are completely in line with those seen for Covid-19 mortality. Specifically, higher earnings is monotonically negatively related with mortality: individuals in the second, third, and fourth quartiles of the income distribution are 2.1, 3.1 and 3.6 percentage points less likely, respectively, to die from a given health shock compared to their counterparts in the bottom 25 percent of the income distribution. Similarly, individuals with a high school degree and college degree, respectively, are 0.7 and 2 percentage points less likely to die compared to those with only compulsory schooling. Individuals with a spouse or cohabiting partner are 1.7 percent less likely to die, relative to their single counterparts. Entering all these characteristics jointly (column 4) does not alter the conclusions qualitatively.

Column (5) reports the difference in mortality between foreign-born and natives. Individuals born in European countries are 0.4 percentage points more likely to die from a given health shock compared to natives, but individuals of Asian descent are 0.9 percentage points *less* likely to die from the same health shock compared to natives, and there is no difference in mortality between natives and those of African descent. These results are starkly different compared to the case of Covid-19, where conditional on health, those of African descent were more than 2 percentage points more likely to die compared to natives. Interestingly, controlling for income, education, and marital status, the results are also different compared to Covid-19: the risk of dying from a given health shock is then 1.4 and 1.8 percentage points lower for those born in Africa and Asia, respectively, compared to natives (recall that in the Covid-19 case, these variables "explained" the difference in mortality between natives and those of African descent). The lower mortality risk in immigrants from these other health shocks is in line with the so-called healthy migrant advantage. Specifically, income is negatively correlated with mortality risk, and immigrants generally have lower income. So if controlling for income and education yields an even lower probability of death in immigrants relative to natives, it implies that their health is on average better.

How do these results inform on the gaps found with respect to Covid-19? In a nutshell, immigrants fair worse (relative to natives) in the case of Covid-19 than they do in other common health events. One potential explanation could be that viral infections simply hit different in different groups, so comparing how different groups fair due to SARS-CoV-2 with other adverse health events would be uninformative.

However, if we study the heterogeneity in mortality due to infectious diseases and influenza (in a non-pandemic year), the conclusions are the same: Table 12 shows that the income- and education gradients in mortality due to infections/influenza are consistent with those found for Covid-19, while immigrants either have no excess mortality (Africans) or lower mortality (Asians) than natives. Thus, immigrants have a higher mortality relative to natives in Covid-19 than what we should expect based on the mortality gap observed for other common health shocks, including other infectious diseases and influenza. This of course raises the question of what is particular when it comes to Covid-19, which should be an interesting avenue for further research.

Another take-away from the analyses is that the key to understanding why the pandemic has so widely different effects on individuals' health outcomes depending on their level of income or education may lie in understanding how health behaviors differ across the groups. The results suggest that individuals with higher SES consume more health care, and take up more sickness absence after a given health shock, compared to individuals with lower SES. At the same time, their mortality is lower. Why health behaviors differ across groups, and how much they can explain differences in mortality remain open questions.

## 6 Conclusions

Previous research on Covid-19 incidence has documented that the risk of hospitalization and death due to Covid-19 is higher in ethnic minority populations and in groups with lower socioeconomic status. However, we know much less about the causes of such differences. The purpose of this study is to test whether any of the documented differences remain, once we adjust for differences in the risk of contracting the virus and for differences in age and underlying health, which may be unequally distributed in the population with respect to socioeconomic status and ethnicity/immigration status. Any remaining differences could arguably be attributed to health care seeking behaviors, the treatment received by the health care system; or to unobserved differences in health that are not accounted for in the data.

In order to account for potentially different exposures to infection, the study examines heterogeneity in outcomes among individuals who received inpatient care due to Covid-19, controlling for that low- and high SES groups may differ systematically with respect to underlying health and other characteristics that are predictive for morbidity and mortality. The study also examines whether individuals exhibit different health care seeking behaviors depending on SES, ethnicity, and marital status. Finally, the study compares any potential differences in outcomes by income, education, country of birth, and marital status to those observed for other common health shocks in the population, before the pandemic, including infectious diseases and influenza. This analysis is informative on whether the unequal burden of the pandemic with respect to SES and country of birth is specific to the conditions during the pandemic, or whether it simply mirrors the SES gradients in health in general.

Four main conclusions are drawn from the analyses. First, severe Covid-19 has long-term negative health consequences, which negatively affecting individuals' ability to return to market work. Labor earnings decline substantially at the time of hospitalization, while sickness absence increases. Eleven months after being hospitalized, earnings are still 20 percent lower compared to the month before hospitalization. The study provides some detail into the specific health issues that Covid-19 patients experience after being discharged from hospital, through data on outpatient care visits with detailed diagnosis codes. These results suggest that individuals with severe Covid-19 experience symptoms that are not easily classified or diagnosed, after being discharged from hospital.

Second, there are substantial differences in morbidity and mortality due to Covid-19 between groups defined by their socioeconomic status, even after adjusting for differences in underlying health and a large set of other characteristics. While one cannot rule out that the remaining gaps in mortality could be accounted for by unobserved differences in health, for example body mass index, the individuals studied are all severely affected by Covid-19, and thus such differences should arguably be smaller than in the population at large. Thus, differences in the risk of becoming infected, and differences in underlying health are not likely to be the sole explanations for why disadvantaged groups have higher Covid-19 mortality. The evidence also suggests that health behaviors differ between high- and low earnings/educated individuals. In particular, individuals with more favorable socioeconomic status consume more health care than do those with lower socioeconomic status, but have lower mortality. This so-called morbidity-mortality paradox could potentially be explained by health literacy, which is key to navigating the health care system effectively, being systematically related to SES. Why health behaviors differ across groups, and how much they can explain differences in mortality remain open questions. Third, the documented gradients in morbidity and mortality due to Covid-19 largely mirror those of other common health shocks in non-pandemic years. Observationally equivalent (in terms of medical history, age, gender, and municipality of residence) individuals experiencing an infectious disease, tumor, or diseases of the circulatory system have widely different outcomes depending on their level of education, income, or marital status in ways that closely resemble those for Covid-19. In particular, individuals of higher socioeconomic status have higher health care consumption – as measured by their sickness absence – following such health shocks, but significantly lower mortality relative to their lower socioeconomic counterparts. Addressing the inequalities in health outcomes in future pandemics thus likely requires an understanding of-, and addressing the causes of the overall health inequalities in the population.

Fourth, while the results from the Covid-19 pandemic largely mirror those for other common health shocks, foreign-born – specifically those born in low- and middle-income countries- have higher mortality risk (relative to natives) due to Covid-19 than what should be expected based on how they fare (in relative terms) after other severe health events, including other infectious diseases and influenza. An interesting avenue for further research therefore consists of focusing on the specific causes by which these groups are particularly affected by the pandemic.

## References


Burström, B. and W. Tao (2020). Social determinants of health and inequalities in covid-19.

Chen, Y., P. Persson, and M. Polyakova (2019). The roots of health inequality and the value of intra-family expertise. Technical report, National Bureau of Economic Research.

de Lusignan, S., J. Dorward, A. Correa, N. Jones, O. Akinyemi, G. Amirthalingam, N. Andrews, R. Byford, G. Dabrera, A. Elliot, et al. (2020). Risk factors for sars-cov-2 among patients in the oxford royal college of general practitioners research and surveillance centre primary care network: a cross-sectional study. *The Lancet Infectious Diseases 20*(9), 1034–1042.

Drefahl, S., M. Wallace, E. Mussino, S. Aradhya, M. Kolk, M. Brandén, B. Malmberg, and G. Andersson (2020). A population-based cohort study of socio-demographic risk factors for covid-19 deaths in sweden. *Nature communications 11*(1), 1–7.

Du, R.-H., L.-R. Liang, C.-Q. Yang, W. Wang, T.-Z. Cao, M. Li, G.-Y. Guo, J. Du, C.-L. Zheng, Q. Zhu, et al. (2020). Predictors of mortality for patients with covid-19 pneumonia caused by sars-cov-2: a prospective cohort study. *European Respiratory Journal 55*(5).

Kleven, H., C. Landais, and J. E. Søgaard (2019). Children and gender inequality: Evidence from denmark. *American Economic Journal: Applied Economics 11*(4), 181–209.

Li, X., S. Xu, M. Yu, K. Wang, Y. Tao, Y. Zhou, J. Shi, M. Zhou, B. Wu, Z. Yang, et al. (2020). Risk factors for severity and mortality in adult covid-19 inpatients in wuhan. *Journal of Allergy and Clinical Immunology 146*(1), 110–118.

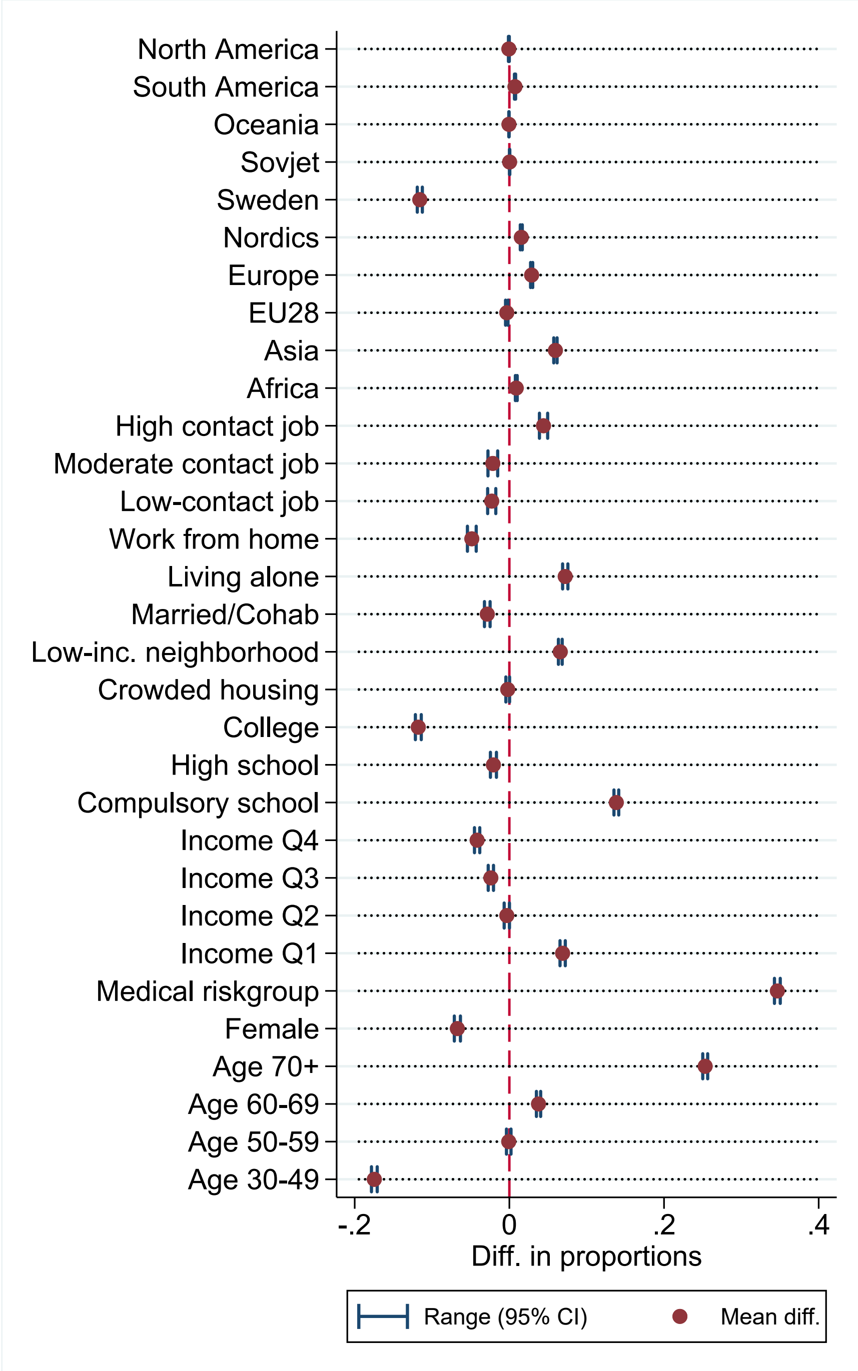
Townsend, M. J., T. K. Kyle, and F. C. Stanford (2020). Outcomes of covid-19: disparities in obesity and by ethnicity/race.

Wångdahl, J., P. Lytsy, L. Mårtensson, and R. Westerling (2018). Poor health and refraining from seeking healthcare are associated with comprehensive health literacy among refugees: a swedish cross-sectional study. *International journal of public health 63*(3), 409–419.

Williamson, E. J., A. J. Walker, K. Bhaskaran, S. Bacon, C. Bates, C. E. Morton, H. J. Curtis, A. Mehrkar, D. Evans, P. Inglesby, et al. (2020). Factors associated with covid-19-related death using opensafely. *Nature 584*(7821), 430–436.

# Tables & Figures

FIGURE 1.
Differences in characteristics between population hospitalized for Covid-19 and the full population




NOTES: The figure shows differences in proportions between the full population and the hospitalized population with certain characteristics, along with 95% confidence intervals of the differences. For mean characteristics in the respective population, see Table A.1 in the Appendix.

TABLE 1.
Summary statistics: outcomes of individuals admitted to inpatient care for severe Covid-19

| | First wave | Second wave | Third wave |
|---|---|---|---|
| | All hospitalized | | |
| Deceased | 0.165 | 0.173 | 0.134 |
| | (0.371) | (0.378) | (0.341) |
| Intensive care (ICU) | 0.117 | 0.091 | 0.100 |
| | (0.321) | (0.288) | (0.301) |
| Days between symptoms & test date | 6.522 | 4.397 | 8.517 |
| | (14.421) | (12.913) | (43.116) |
| Tested at hospital | 0.781 | 0.516 | 0.387 |
| | (0.414) | (0.500) | (0.487) |
| Duration of hospital stay (days) | 9.506 | 9.342 | 8.396 |
| | (13.677) | (11.387) | (9.746) |
| Days between admission and ICU | 3.878 | 4.113 | 3.271 |
| | (19.840) | (11.634) | (5.948) |
| ICU directly on admission day | 0.039 | 0.028 | 0.028 |
| | (0.194) | (0.166) | (0.166) |
| Days btw hospital admission & death | 18.093 | 16.999 | 14.601 |
| | (35.202) | (20.867) | (15.015) |
| Observations | 20,907 | 18,523 | 14,753 |
| | Conditional on discharge (survival) | | |
| Re-admission within 30 days | 0.116 | 0.133 | 0.108 |
| | (0.320) | (0.340) | (0.311) |
| Re-admission within 60 days | 0.157 | 0.174 | 0.145 |
| | (0.364) | (0.379) | (0.352) |
| Re-admission within 90 days | 0.189 | 0.203 | 0.175 |
| | (0.391) | (0.402) | (0.380) |
| Outpatient care within 30 days | 0.303 | 0.337 | 0.300 |
| | (0.460) | (0.473) | (0.458) |
| Outpatient care within 60 days | 0.433 | 0.468 | 0.408 |
| | (0.496) | (0.499) | (0.491) |
| Outpatient care within 90 days | 0.515 | 0.549 | 0.532 |
| | (0.500) | (0.498) | (0.499) |
| Observations | 17,466 | 15,318 | 20,686 |

NOTES: The population consists of Swedish residents aged 20 or older in 2020 who were admitted to the hospital with Covid-19 recorded as the main or secondary diagnosis, sometime during January 2020–May 2021.

TABLE 2.
Causes for re-admissions & outpatient visits post-hospital discharge

| | Inpatient | | Outpatient | |
|---|---|---|---|---|
| | Number | % | Number | % |
| Infectious diseases | 430 | 4.49 | 420 | 2.00 |
| Neoplasms | 477 | 4.98 | 1,820 | 8.66 |
| Diseases of the blood-forming organs | 38 | 0.40 | 116 | 0.55 |
| Endocrine, nutritional and metabolic | 149 | 1.55 | 262 | 1.25 |
| Mental/behavioral disorders | 398 | 4.15 | 893 | 4.25 |
| Diseases of the nervous system | 203 | 2.12 | 672 | 3.20 |
| Diseases of the eye/ear | 42 | 0.44 | 1,319 | 6.28 |
| Diseases of the circulatory system | 1,244 | 12.98 | 1,929 | 9.18 |
| Diseases of the respiratory system | 914 | 9.54 | 778 | 3.70 |
| Diseases of the digestive system | 529 | 5.52 | 804 | 3.83 |
| Diseases of the skin | 73 | 0.76 | 505 | 2.40 |
| Diseases of the musculoskeletal system | 194 | 2.02 | 1,026 | 4.88 |
| Diseases of the genitourinary system | 559 | 5.83 | 996 | 4.74 |
| Pregnancy, childbirth and the puerperium | 277 | 2.89 | 224 | 1.07 |
| Congenital conditions | 3 | 0.03 | 34 | 0.16 |
| Symptoms/signs not elsewhere classified | 827 | 8.63 | 3,758 | 17.89 |
| Injuries/accidents | 467 | 4.87 | 854 | 4.06 |
| Factors influencing health status | 130 | 1.36 | 2,754 | 13.11 |
| Other causes | 137 | 1.43 | 747 | 3.56 |
| Covid-19 | 2,492 | 26.00 | 1,100 | 5.24 |
| Observations (individuals) | 9,583 | 100.00 | 21,011 | 100.00 |

NOTES: The table reports the most common causes (diagnosis category according to ICD-10) for which patients hospitalized for Covid-19 received outpatient care, or for which they were re-admitted to the hospital, post discharge. The sample includes the sub-sample of the population of the Swedish population in 2019 that received inpatient care for Covid-19 (main or secondary diagnosis) sometime during March 2020–May 2021, and that were discharged alive.

TABLE 3.
Sub-categories of post-discharge outpatient visits for "symptoms not classified elsewhere" and "factors influencing health status"

| | Number | % |
|---|---|---|
| **Sub-categories of Symptoms/signs not elsewhere classified** | | |
| Symptoms of circulatory/respiratory disease | 1,561 | 41.54 |
| Symptoms of digestive system disease | 446 | 11.87 |
| Symptoms of skin disease | 86 | 2.29 |
| Symptoms of musculoskeletal disease | 99 | 2.63 |
| Symptoms of diseases in the urinary system | 231 | 6.15 |
| Symptoms of illness w.r.t. intellectual & emotional functions | 205 | 5.46 |
| Symptoms of speech- and vocal functions | 34 | 0.90 |
| General symptoms of illness | 862 | 22.94 |
| Abnormal findings in blood-, urine-, & radiology diagnostics | 234 | 6.23 |
| *N* | 3,758 | 100.00 |
| **Sub-categories of Factors influencing health status** | | |
| Contact w. health care for examination & investigation | 1,465 | 53.20 |
| Health risks from contagious diseases | 26 | 0.94 |
| Contact w. health care for reproductive issues | 204 | 7.41 |
| Contact w. health care for special care and actions | 348 | 12.64 |
| Health risks from socioeconomic & psychosocial conditions | 6 | 0.22 |
| Contact w. health care for other situations | 225 | 8.17 |
| Health risks from patient & family medical history | 480 | 17.43 |
| *N* | 2,754 | 100.00 |

NOTES: The table reports the sub-categories contained in the ICD-10 chapters detailing illnesses that are "not classified elsewhere" (chapter R) and "factors influencing health status" (chapter Z). The sample includes the sub-sample of the population of the Swedish population in 2019 that received inpatient care for Covid-19 (main or secondary diagnosis) sometime during March 2020–May 2021, and that were discharged alive, and who had at least one outpatient visit within 90 days from discharge for either of the two diagnosis categories.

TABLE 4.
Re-admission & outpatient care causes (post-discharge) relative to causes for admission and outpatient care in an age-matched sample of individuals not hospitalized for Covid-19

| | Inpatient | Outpatient |
|---|---|---|
| Infectious diseases | 0.026*** | 0.006*** |
| | (0.003) | (0.001) |
| Neoplasms | -0.007* | -0.009*** |
| | (0.004) | (0.003) |
| Diseases of the blood-forming organs | 0.000 | 0.002*** |
| | (0.001) | (0.001) |
| Endocrine, nutritional and metabolic | 0.007*** | -0.000 |
| | (0.002) | (0.001) |
| Mental/behavioral disorders | 0.017*** | 0.001 |
| | (0.003) | (0.002) |
| Diseases of the nervous system | -0.007** | -0.001 |
| | (0.003) | (0.002) |
| Diseases of the eye/ear | -0.010*** | -0.106*** |
| | (0.002) | (0.003) |
| Diseases of the circulatory system | -0.016** | 0.026*** |
| | (0.006) | (0.002) |
| Diseases of the respiratory system | 0.055*** | 0.016*** |
| | (0.005) | (0.002) |
| Diseases of the digestive system | -0.013*** | -0.009*** |
| | (0.004) | (0.002) |
| Diseases of the skin | 0.004** | -0.018*** |
| | (0.001) | (0.002) |
| Diseases of the musculoskeletal system | -0.068*** | -0.049*** |
| | (0.004) | (0.002) |
| Diseases of the genitourinary system | 0.023*** | -0.012*** |
| | (0.004) | (0.002) |
| Pregnancy, childbirth and the puerperium | -0.000 | 0.006*** |
| | (0.003) | (0.001) |
| Congenital conditions | -0.001* | -0.000 |
| | (0.000) | (0.000) |
| Symptoms/signs not elsewhere classified | 0.017*** | 0.083*** |
| | (0.005) | (0.003) |
| Injuries/accidents | -0.040*** | -0.018*** |
| | (0.005) | (0.002) |
| Factors influencing health status | 0.004** | 0.062*** |
| | (0.002) | (0.003) |
| Other causes | 0.011*** | 0.021*** |
| | (0.002) | (0.001) |
| *N* | 15,129 | 50,807 |

NOTES: The table reports estimated differences in distribution of causes for hospital admissions and outpatient care between those re-admitted or visiting outpatient care within 90 days from discharge in the hospitalized sample vis-a-vis an age-matched sample of individuals who were not hospitalized for Covid-19. The latter group's health care consumption are measured in 2019. Individuals in the Covid-19 hospitalized sample who were re-admitted or received outpatient care with Covid-19 as the main cause are excluded from this analysis.

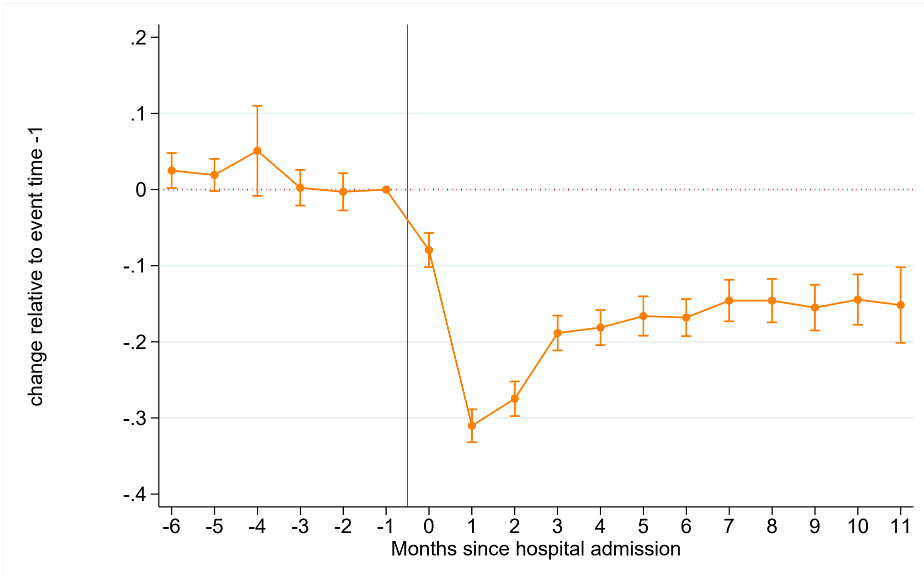
TABLE 5.
Outpatient care causes (post-discharge) relative to causes of outpatient care in an age-matched sample of individuals not hospitalized for Covid-19: sub-categories of the most common causes

| | Mean diff. |
|---|---|
| **Sub-categories of Symptoms/signs not elsewhere classified** | |
| Symptoms of circulatory/respiratory disease | 0.129*** |
| | (0.011) |
| Symptoms of digestive system disease | -0.070*** |
| | (0.009) |
| Symptoms of skin disease | -0.025*** |
| | (0.004) |
| Symptoms of musculoskeletal disease | -0.009** |
| | (0.004) |
| Symptoms of diseases in the urinary system | -0.014** |
| | (0.006) |
| Symptoms of illness w.r.t. intellectual & emotional functions | -0.043*** |
| | (0.006) |
| Symptoms of speech- and vocal functions | -0.006** |
| | (0.003) |
| General symptoms of illness | 0.043*** |
| | (0.010) |
| Abnormal findings in blood-, urine-, & radiology diagnostics | -0.005 |
| | (0.006) |
| *N* | 7,022 |
| **Sub-categories of Factors influencing health status** | |
| Contact w. health care for examination & investigation | -0.022 |
| | (0.014) |
| Health risks from contagious diseases | -0.007** |
| | (0.003) |
| Contact w. health care for reproductive issues | -0.001 |
| | (0.007) |
| Contact w. health care for special care and actions | 0.024*** |
| | (0.009) |
| Health risks from socioeconomic & psychosocial conditions | -0.005*** |
| | (0.002) |
| Contact w. health care for other situations | 0.001 |
| | (0.008) |
| Health risks from patient & family medical history | 0.010 |
| | (0.011) |
| *N* | 5,110 |

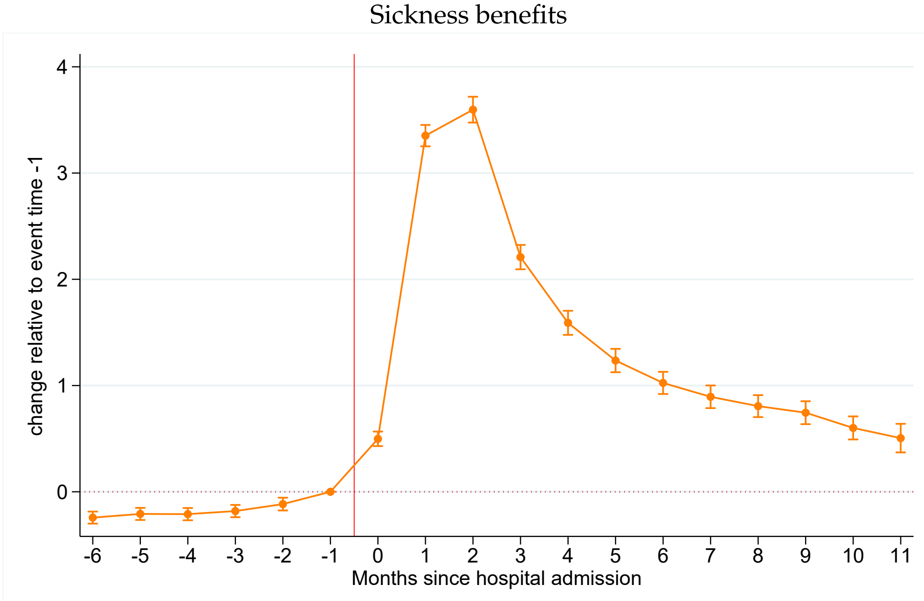
NOTES: The table reports estimated differences in distribution of sub-categories for outpatient care between those visiting outpatient care within 90 days from discharge in the hospitalized sample vis-a-vis an age-matched sample of individuals who were not hospitalized for Covid-19, among those with diagnosis category of "symptoms not classified elsewhere" and "factors associated with the health care system".

FIGURE 2.
Percentage changes in labor income and sickness benefits after hospitalization

(A)
Labor income




(B)
Sickness benefits




NOTE: Each point in the graphs represents the percentage point change in the likelihood of having positive earnings in each month before or after being admitted to the hospital for severe Covid-19, relative to the month before hospitalization. 95% confidence intervals are shown by the vertical lines on each point estimate.

TABLE 6.
Heterogeneity in mortality and intensive care incidence conditional on hospitalization

| | Deceased | | | | ICU admission | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Income quartile 2 | -0.006 | | | -0.005 | -0.012*** | | | -0.012*** |
| | (0.004) | | | (0.004) | (0.003) | | | (0.003) |
| Income quartile 3 | -0.011*** | | | -0.009** | -0.018*** | | | -0.016*** |
| | (0.004) | | | (0.004) | (0.003) | | | (0.004) |
| Income quartile 4 | -0.022*** | | | -0.018*** | -0.021*** | | | -0.017*** |
| | (0.004) | | | (0.004) | (0.004) | | | (0.004) |
| High school | | -0.007* | | -0.005 | | -0.007** | | -0.004 |
| | | (0.004) | | (0.004) | | (0.003) | | (0.003) |
| College/University | | -0.018*** | | -0.012*** | | -0.017*** | | -0.012*** |
| | | (0.004) | | (0.004) | | (0.003) | | (0.004) |
| Married/cohabiting | | | -0.007** | -0.006* | | | -0.003 | -0.002 |
| | | | (0.003) | (0.003) | | | (0.003) | (0.003) |
| Controls | | | | | | | | |
| Age | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Gender | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Medical risk group | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Other medical history | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Week of hospital admission | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Municipality | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Mean of outcome | 0.1592 | 0.1592 | 0.1592 | 0.1592 | 0.1051 | 0.1051 | 0.1051 | 0.1051 |
| $N$ | 54,215 | 54,215 | 54,215 | 54,215 | 62,527 | 62,527 | 62,527 | 62,527 |
| $R^2$ | 0.1840 | 0.1839 | 0.1836 | 0.1842 | 0.0605 | 0.0602 | 0.0599 | 0.0607 |

NOTES: The table reports estimates based on a linear probability model. The sample includes patients that were hospitalized for Covid-19 (main or secondary diagnosis).

TABLE 7.

Heterogeneity in post-admission outpatient care and hospital re-admission, conditional on discharge (and survival)

| | Outpatient care within 60 days | | | | Re-admission within 60 days | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Income quartile 2 | 0.008 | | | 0.006 | -0.007 | | | -0.008* |
| | (0.006) | | | (0.006) | (0.005) | | | (0.005) |
| Income quartile 3 | 0.018*** | | | 0.015** | -0.007 | | | -0.007 |
| | (0.006) | | | (0.007) | (0.005) | | | (0.005) |
| Income quartile 4 | 0.016** | | | 0.012* | -0.009* | | | -0.009* |
| | (0.007) | | | (0.007) | (0.005) | | | (0.005) |
| High school | | 0.013** | | 0.010* | | -0.003 | | -0.001 |
| | | (0.006) | | (0.006) | | (0.004) | | (0.004) |
| College/University | | 0.016*** | | 0.012* | | -0.000 | | 0.003 |
| | | (0.006) | | (0.007) | | (0.005) | | (0.005) |
| Married/cohabiting | | | 0.003 | 0.001 | | | -0.004 | -0.004 |
| | | | (0.005) | (0.005) | | | (0.004) | (0.004) |
| Controls | | | | | | | | |
| Age | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Gender | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Medical risk group | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Other medical history | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Week of hospital admission | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Municipality | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Mean of outcome | 0.4469 | 0.4469 | 0.4469 | 0.4469 | 0.1602 | 0.1602 | 0.1602 | 0.1602 |
| $N$ | 45,284 | 45,284 | 45,284 | 45,284 | 43,562 | 43,562 | 43,562 | 43,562 |
| $R^2$ | 0.0653 | 0.0653 | 0.0651 | 0.0654 | 0.0792 | 0.0791 | 0.0791 | 0.0792 |

NOTES: The table reports estimates based on a linear probability model. The sample includes patients hospitalized for Covid-19 (main or secondary diagnosis), who were discharged alive.

TABLE 8.
Heterogeneity in immediate ICU admission and testing behavior

| | ICU at admission day | | | | Tested at hospital | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Income quartile 2 | -0.005** | | | -0.005** | -0.044*** | | | -0.043*** |
| | (0.002) | | | (0.002) | (0.006) | | | (0.006) |
| Income quartile 3 | -0.008*** | | | -0.008*** | -0.053*** | | | -0.047*** |
| | (0.002) | | | (0.002) | (0.006) | | | (0.006) |
| Income quartile 4 | -0.010*** | | | -0.008*** | -0.096*** | | | -0.083*** |
| | (0.002) | | | (0.002) | (0.006) | | | (0.006) |
| High school | | -0.001 | | 0.000 | | -0.022*** | | -0.008* |
| | | (0.002) | | (0.002) | | (0.005) | | (0.005) |
| College/University | | -0.008*** | | -0.005** | | -0.062*** | | -0.036*** |
| | | (0.002) | | (0.002) | | (0.006) | | (0.006) |
| Married/cohabiting | | | -0.004*** | -0.004** | | | -0.038*** | -0.034*** |
| | | | (0.002) | (0.002) | | | (0.005) | (0.005) |
| Controls | | | | | | | | |
| Age | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Gender | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Medical risk group | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Other medical history | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Week of hospital admission | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Municipality | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Mean of outcome | 0.0334 | 0.0334 | 0.0334 | 0.0334 | 0.5275 | 0.5275 | 0.5275 | 0.5275 |
| $N$ | 62,527 | 62,527 | 62,527 | 62,527 | 47,998 | 47,998 | 47,998 | 47,998 |
| $R^2$ | 0.0287 | 0.0286 | 0.0284 | 0.0290 | 0.1755 | 0.1732 | 0.1723 | 0.1772 |

NOTES: The table reports estimates based on a linear probability model. The sample includes patients that were hospitalized for Covid-19 (main or secondary diagnosis).

TABLE 9.
Correlations between testing behavior and access to health professionals in the family

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | Tested at hospital | | | | |
| Father health professional | -0.078** | | | | |
| | (0.039) | | | | |
| Mother health professional | | 0.017 | | | |
| | | (0.013) | | | |
| Spouse health professional | | | -0.031*** | | |
| | | | (0.009) | | |
| Child health professional | | | | -0.012* | |
| | | | | (0.007) | |
| Sibling health professional | | | | | -0.001 |
| | | | | | (0.008) |
| Controls | | | | | |
| Age | ✓ | ✓ | ✓ | ✓ | ✓ |
| Gender | ✓ | ✓ | ✓ | ✓ | ✓ |
| Medical risk group | ✓ | ✓ | ✓ | ✓ | ✓ |
| Other medical history | ✓ | ✓ | ✓ | ✓ | ✓ |
| Week of hospital admission | ✓ | ✓ | ✓ | ✓ | ✓ |
| Municipality | ✓ | ✓ | ✓ | ✓ | ✓ |
| Mean of outcome | 0.4811 | 0.4923 | 0.5513 | 0.5671 | 0.5423 |
| $N$ | 7,051 | 9,950 | 28,599 | 34,000 | 23,661 |
| $R^2$ | 0.3054 | 0.2795 | 0.2073 | 0.1738 | 0.2018 |

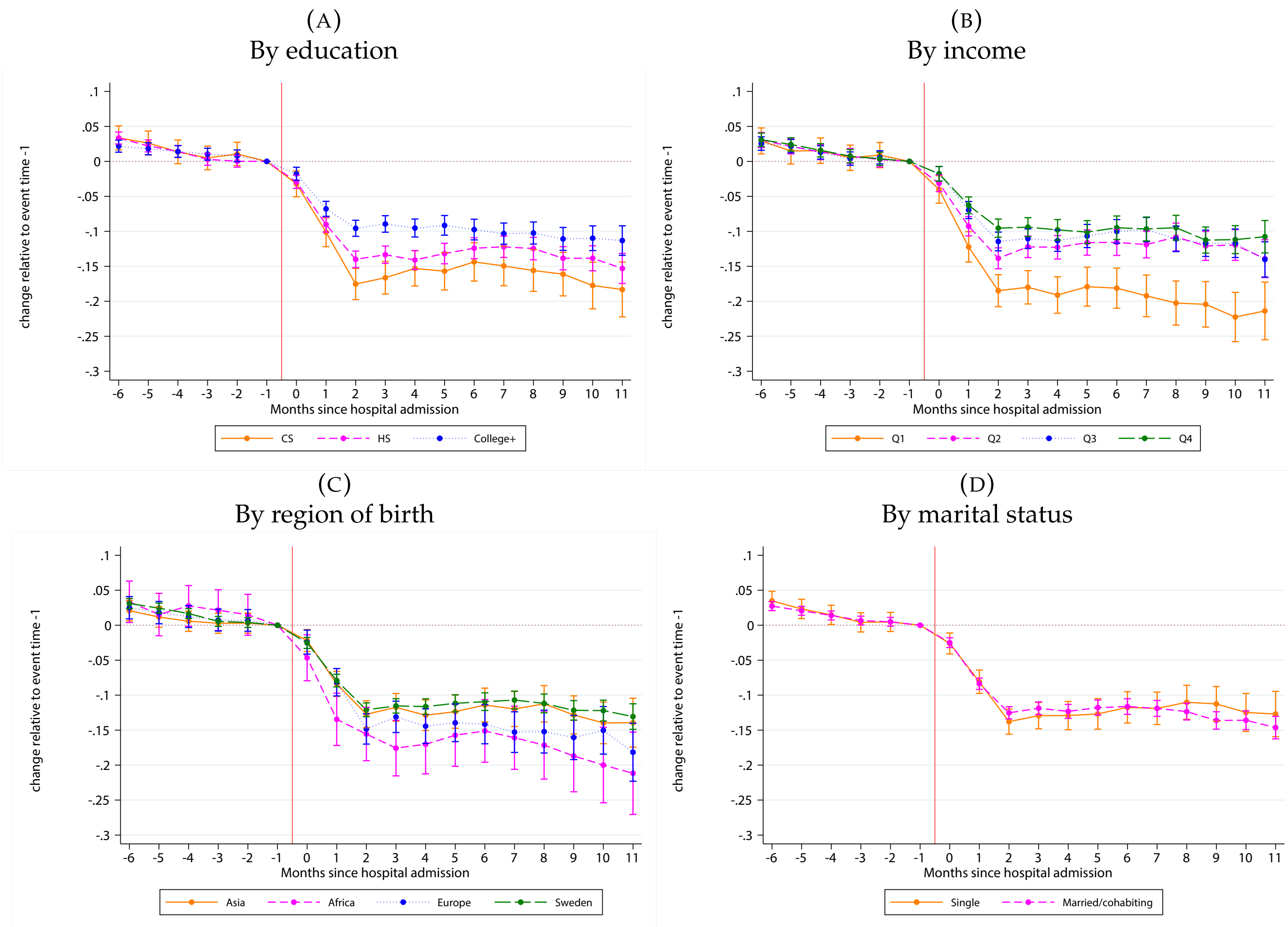
NOTES: The table reports estimates based on linear probability models.

TABLE 10.
Heterogeneity in outcomes of Covid-19 patients by region of birth

| | (1) Deceased | (2) ICU | (3) ICU directly at admission | (4) Tested at hospital | (5) Outpatient care within 60 days | (6) Re-admitted within 60 days |
|---|---|---|---|---|---|---|
| Africa | 0.015** | 0.035*** | 0.014*** | 0.098*** | -0.013 | 0.001 |
| | (0.007) | (0.008) | (0.005) | (0.011) | (0.013) | (0.009) |
| Asia | -0.002 | 0.012*** | 0.001 | 0.035*** | -0.048*** | -0.010** |
| | (0.004) | (0.004) | (0.002) | (0.007) | (0.007) | (0.005) |
| South America | 0.008 | 0.030*** | 0.010 | 0.019 | -0.057*** | -0.012 |
| | (0.009) | (0.011) | (0.007) | (0.016) | (0.018) | (0.012) |
| Europe & North America | 0.006 | 0.008** | 0.002 | 0.012* | -0.025*** | -0.007 |
| | (0.004) | (0.004) | (0.002) | (0.006) | (0.007) | (0.005) |
| Controls | | | | | | |
| Age | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Gender | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Medical risk group | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Other medical history | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Week of hospital admission | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Municipality | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| $N$ | 54,144 | 62,443 | 62,443 | 47,934 | 43,504 | 43,504 |
| $R^2$ | 0.1824 | 0.0601 | 0.0285 | 0.1727 | 0.0664 | 0.0792 |

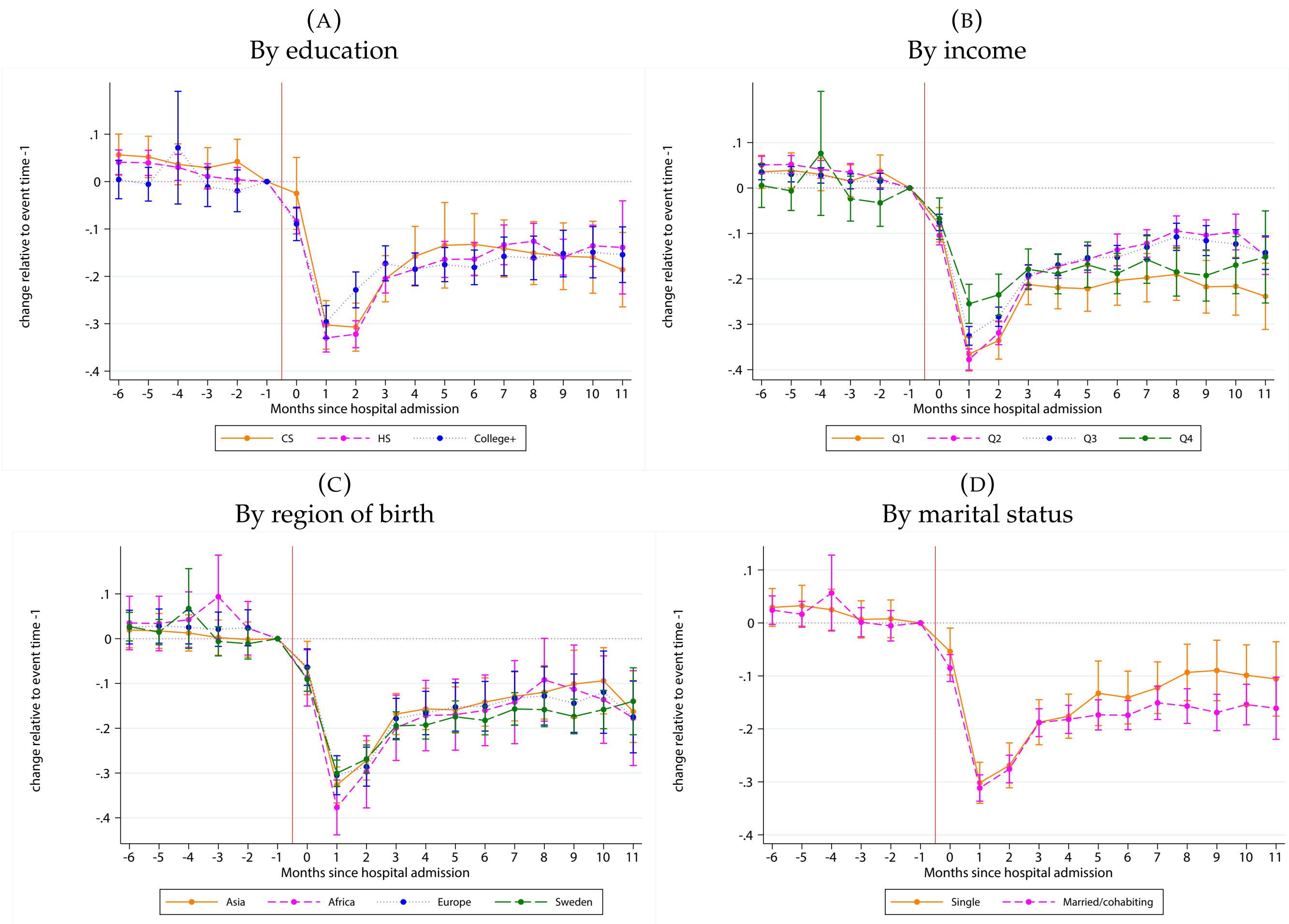
NOTES: The table reports estimates based on linear probability models.

FIGURE 3.
Heterogeneity in the effects of severe Covid-19: **Monthly earnings > 0 SEK**



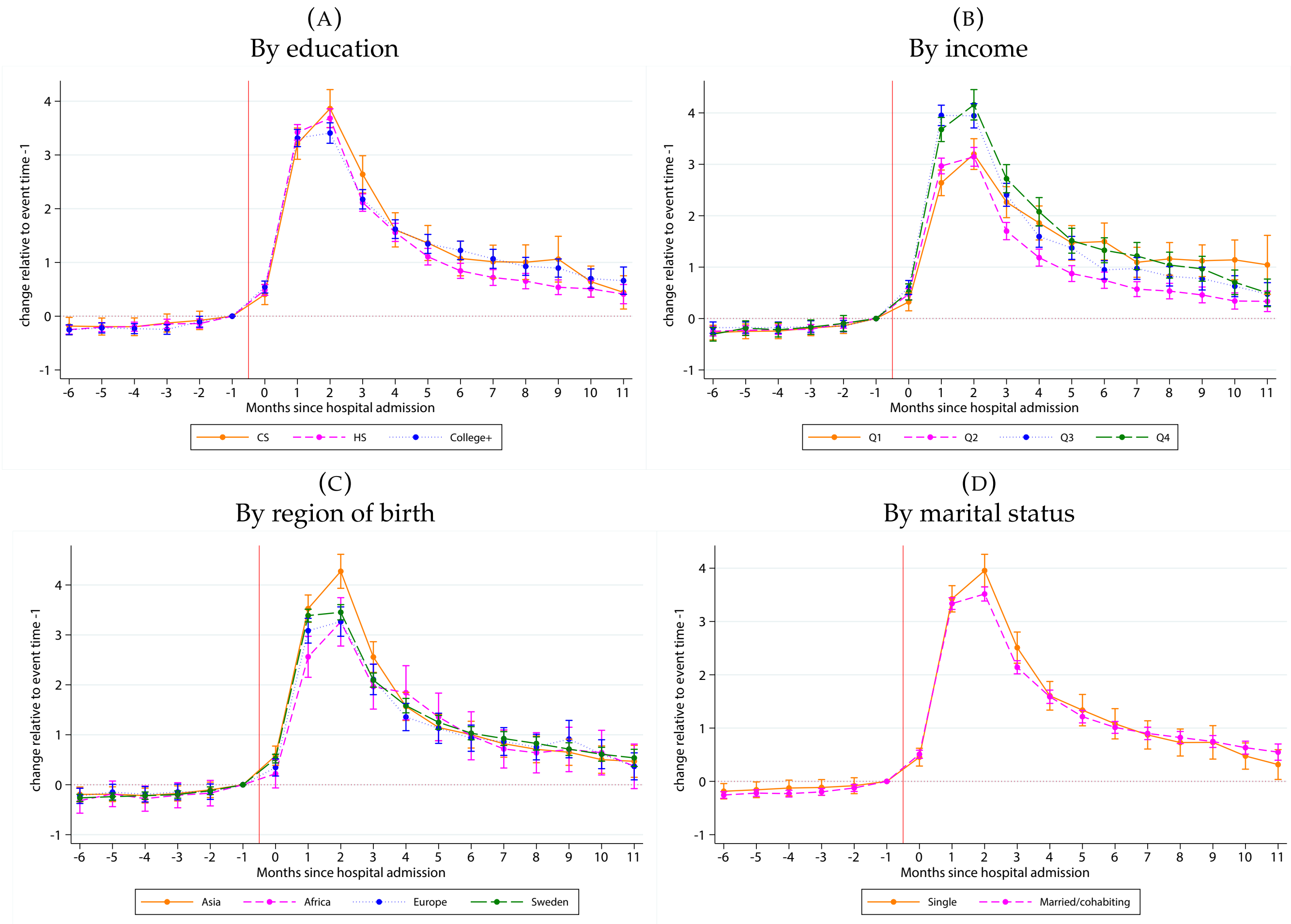

NOTE: Each point in the graphs represents the percentage point change in the likelihood of having positive earnings in each month before or after being admitted to the hospital for severe Covid-19, relative to the month before hospitalization. 95% confidence intervals are shown by the vertical lines on each point estimate.

FIGURE 4.
Heterogeneity in the effects of severe Covid-19: **Monthly earnings (percentage change)**




NOTE: Each point in the graphs represents the percentage change in labor earnings in each month before or after being admitted to the hospital for severe Covid-19, relative to the month before hospitalization. 95% confidence intervals are shown by the vertical lines on each point estimate.

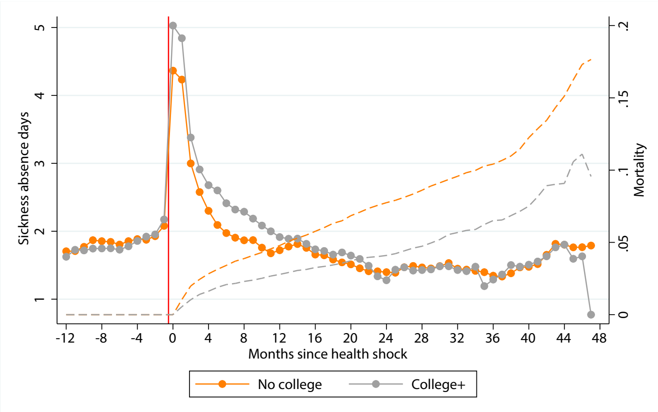
FIGURE 5.
Heterogeneity in the effects of severe Covid-19: **Monthly sickness benefits (percentage change)**



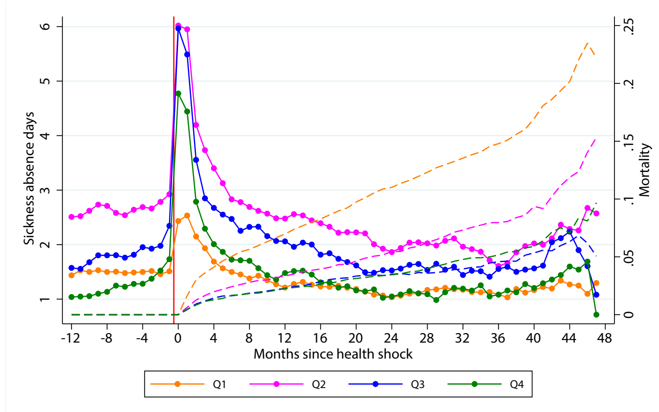

NOTE: Each point in the graphs represents the percentage change in sickness benefits received in each month before or after being admitted to the hospital for severe Covid-19, relative to the month before hospitalization. 95% confidence intervals are shown by the vertical lines on each point estimate.

FIGURE 6.
Heterogeneity in morbidity/mortality after a health shock: **Infectious diseases**

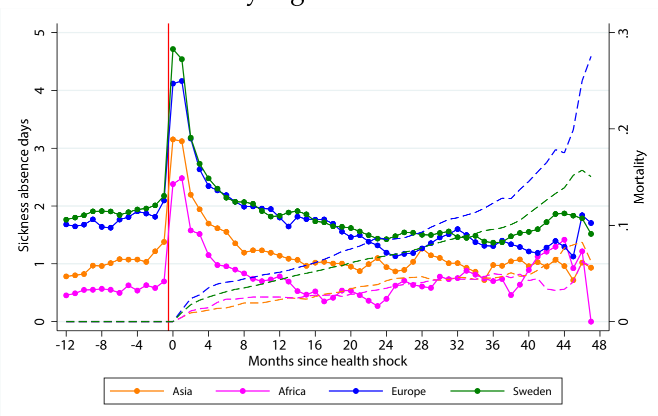
(A)
By education



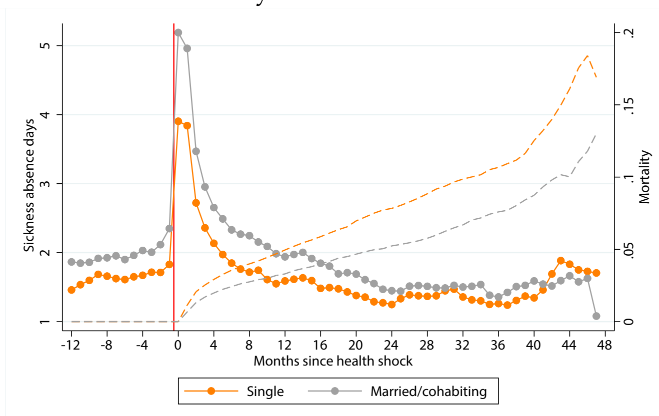

(B)
By income




(C)
By region of birth



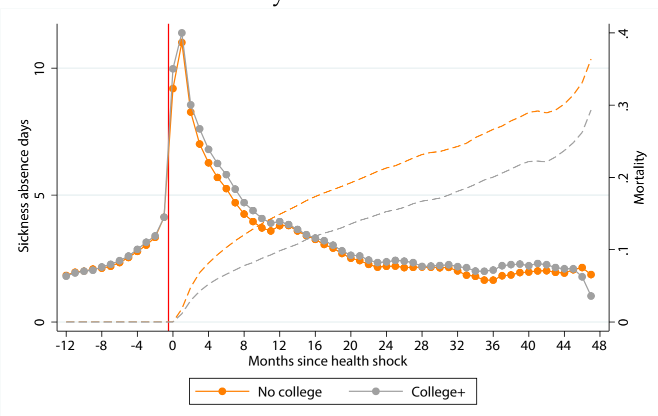

(D)
By marital status



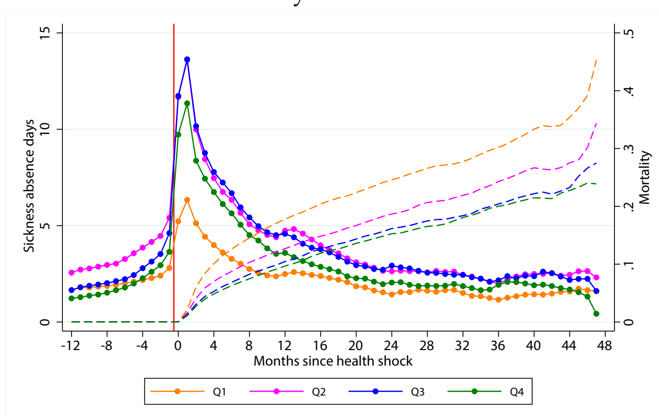

NOTE: The graphs report the average number of days on sickness absence in each month since hospitalization for different groups of individuals, along with the cumulative mortality rate (dashed lines) for each group.

FIGURE 7.
Heterogeneity in morbidity/mortality after a health shock: **Tumors**

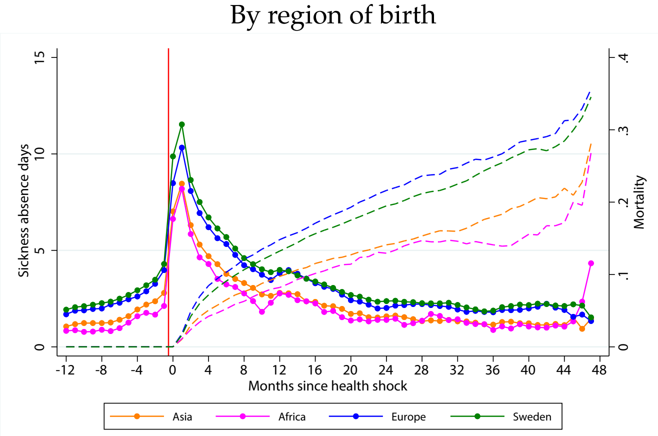
(A)
By education



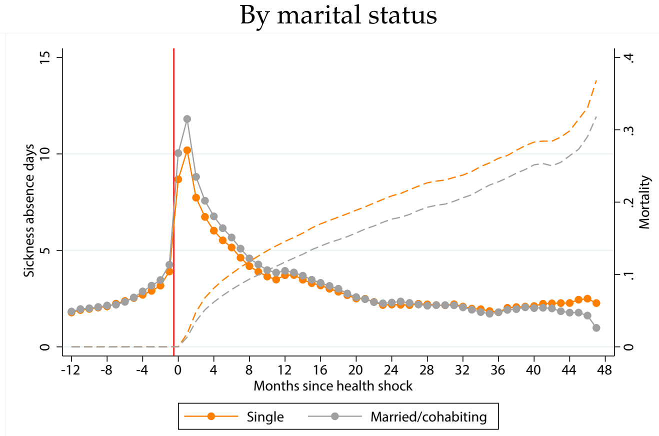

(B)
By income




(C)
By region of birth

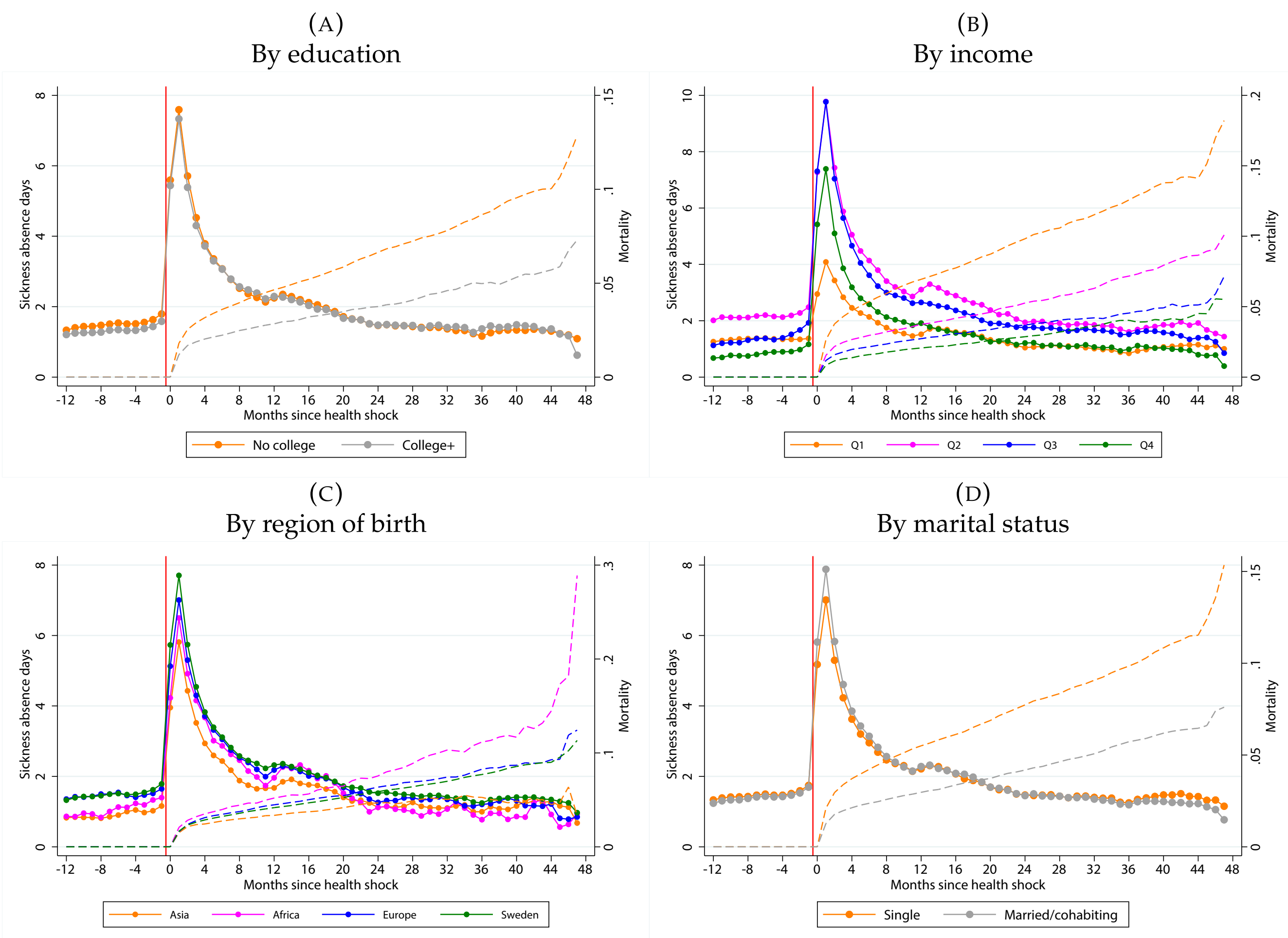



(D)
By marital status




NOTE: The graphs report the average number of days on sickness absence in each month since hospitalization for different groups of individuals, along with the cumulative mortality rate (dashed lines) for each group.

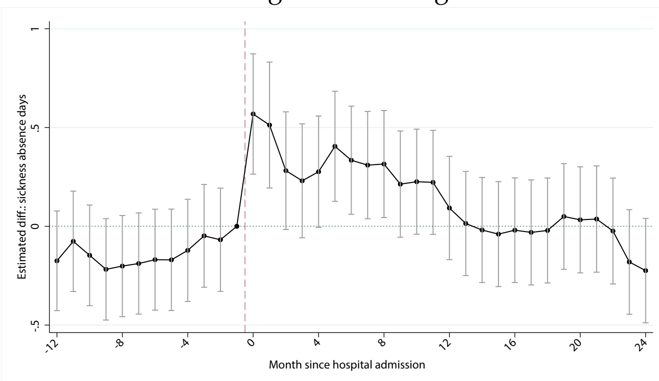
FIGURE 8.
Heterogeneity in morbidity/mortality after a health shock: **Diseases of the circulatory system**



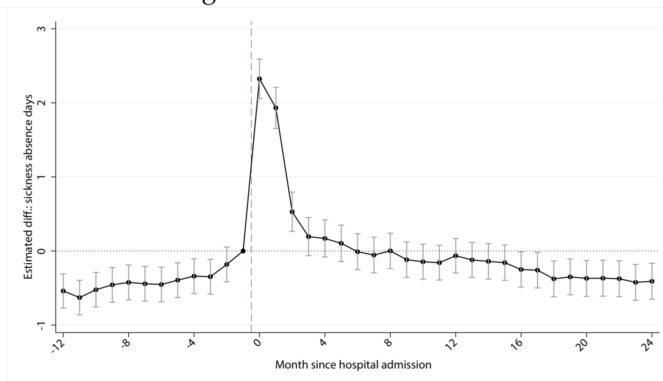

NOTE: The graphs report the average number of days on sickness absence in each month since hospitalization for different groups of individuals, along with the cumulative mortality rate (dashed lines) for each group.

FIGURE 9.
Difference-in-difference estimates of the effect of health shocks on sickness absence: **Infectious diseases**

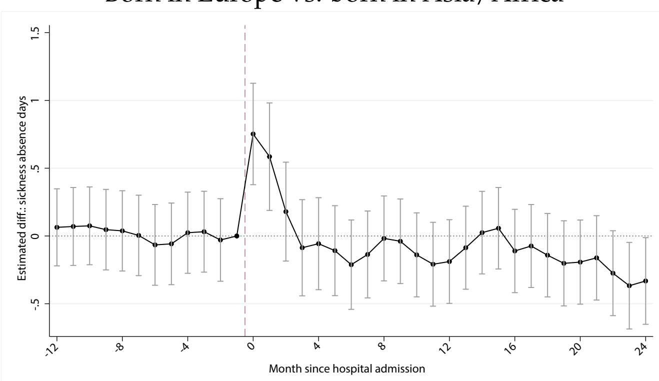
(A)
College vs. no college



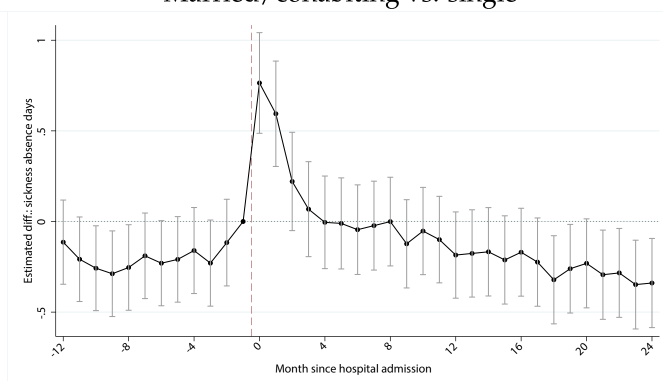

(B)
High income vs. low income




(C)
Born in Europe vs. born in Asia/Africa



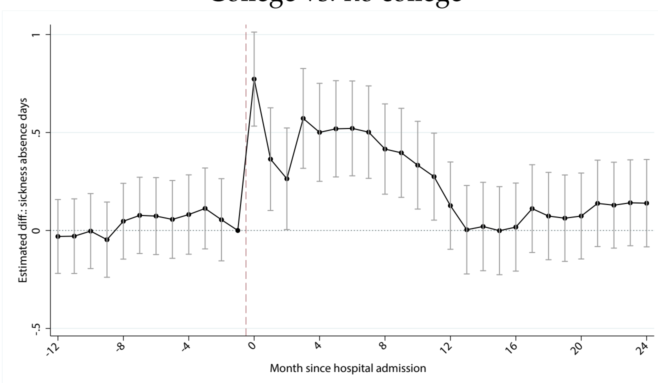

(D)
Married/cohabiting vs. single



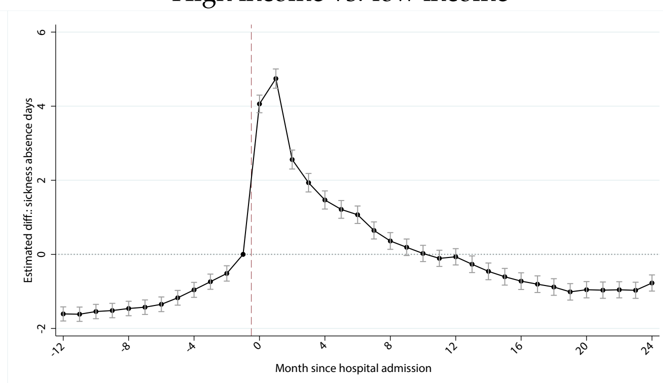

NOTE: Each point in the graphs report the coefficient on an interaction term between an indicator for event time (month since hospitalization) and a dummy variable indicating the characteristic in the graph headings. The omitted event time is $-1$, so the point estimates correspond to the difference in the change in the outcome variable in each month since the hospitalization, relative to the month before hospitalization, between individuals with and without a college degree (panel A), etc. The vertical lines around each point estimate indicate 95% confidence intervals.

FIGURE 10.
Difference-in-difference estimates of the effect of health shocks on sickness absence: **Tumors**

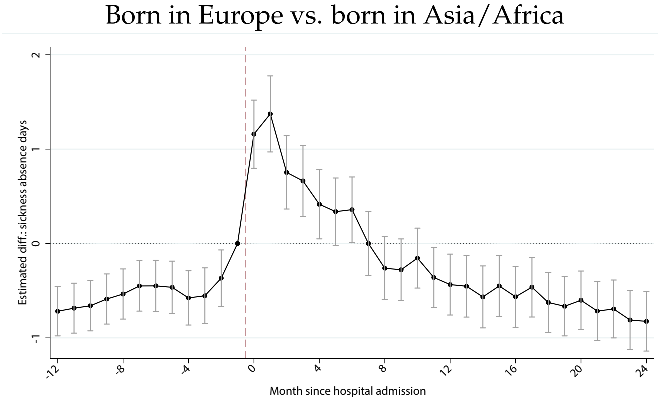
(A)
College vs. no college



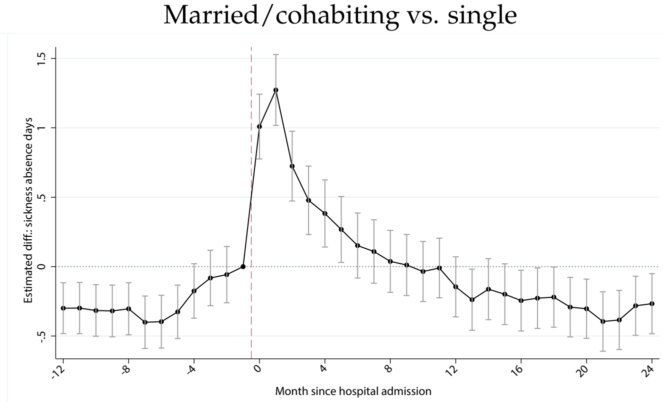

(B)
High income vs. low income




(C)
Born in Europe vs. born in Asia/Africa



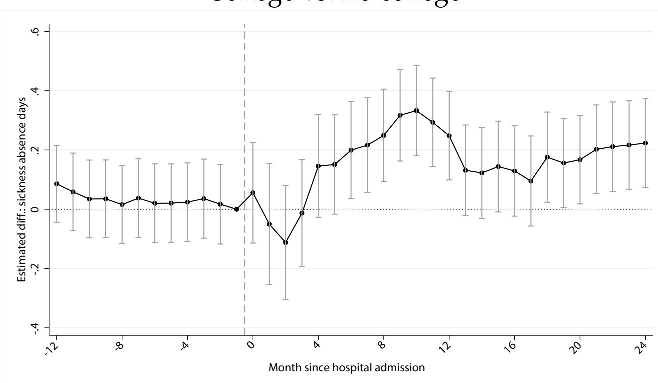

(D)
Married/cohabiting vs. single



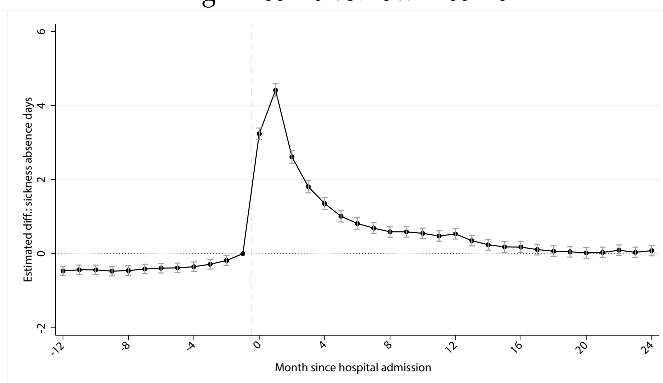

NOTE: Each point in the graphs report the coefficient on an interaction term between an indicator for event time (month since hospitalization) and a dummy variable indicating the characteristic in the graph headings. The omitted event time is $-1$, so the point estimates correspond to the difference in the change in the outcome variable in each month since the hospitalization, relative to the month before hospitalization, between individuals with and without a college degree (panel A), etc. The vertical lines around each point estimate indicate 95% confidence intervals.

FIGURE 11.
Difference-in-difference estimates of the effect of health shocks on sickness absence: **Diseases of the circulatory system**

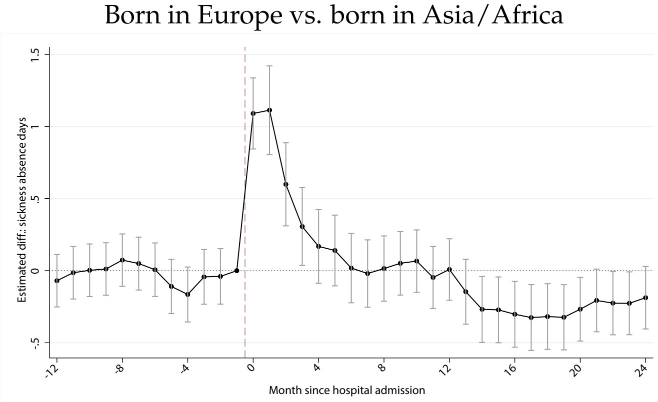
(A)
College vs. no college



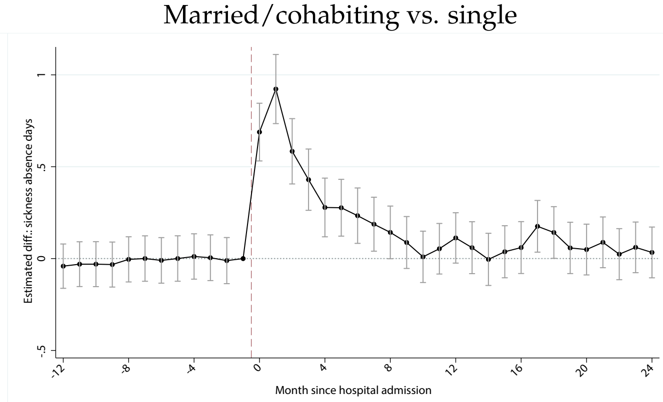

(B)
High income vs. low income




(C)
Born in Europe vs. born in Asia/Africa




(D)
Married/cohabiting vs. single




NOTE: Each point in the graphs report the coefficient on an interaction term between an indicator for event time (month since hospitalization) and a dummy variable indicating the characteristic in the graph headings. The omitted event time is $-1$, so the point estimates correspond to the difference in the change in the outcome variable in each month since the hospitalization, relative to the month before hospitalization, between individuals with and without a college degree (panel A), etc. The vertical lines around each point estimate indicate 95% confidence intervals.

TABLE 11.
Heterogeneity in the effect of a health shock on mortality

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Income quartile 2 | -0.021*** | | | -0.019*** | | -0.021*** |
| | (0.002) | | | (0.002) | | (0.002) |
| Income quartile 3 | -0.031*** | | | -0.027*** | | -0.029*** |
| | (0.002) | | | (0.002) | | (0.002) |
| Income quartile 4 | -0.036*** | | | -0.030*** | | -0.033*** |
| | (0.002) | | | (0.002) | | (0.002) |
| High school | | -0.007*** | | -0.002 | | -0.004** |
| | | (0.002) | | (0.002) | | (0.002) |
| College/university | | -0.020*** | | -0.009*** | | -0.010*** |
| | | (0.002) | | (0.002) | | (0.002) |
| Married/cohabiting | | | -0.017*** | -0.012*** | | -0.012*** |
| | | | (0.001) | (0.001) | | (0.001) |
| Europe | | | | | 0.004** | -0.002 |
| | | | | | (0.002) | (0.002) |
| Africa | | | | | -0.004 | -0.014*** |
| | | | | | (0.003) | (0.004) |
| Asia | | | | | -0.009*** | -0.018*** |
| | | | | | (0.002) | (0.002) |
| Controls | | | | | | |
| Age | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Gender | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Medical history | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Week of hospital admission | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Municipality | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Mean of outcome | 0.0583 | 0.0583 | 0.0583 | 0.0583 | 0.0583 | 0.0583 |
| $N$ | 166,988 | 164,833 | 166,987 | 164,833 | 164,805 | 162,710 |
| $R^2$ | 0.0824 | 0.0800 | 0.0801 | 0.0834 | 0.0794 | 0.0843 |

NOTES: The estimations include controls for age, female gender, municipality-fixed effects, fixed effects for month of hospital admission,

TABLE 12.
Heterogeneity in the effect of a health shock on mortality: infectious diseases

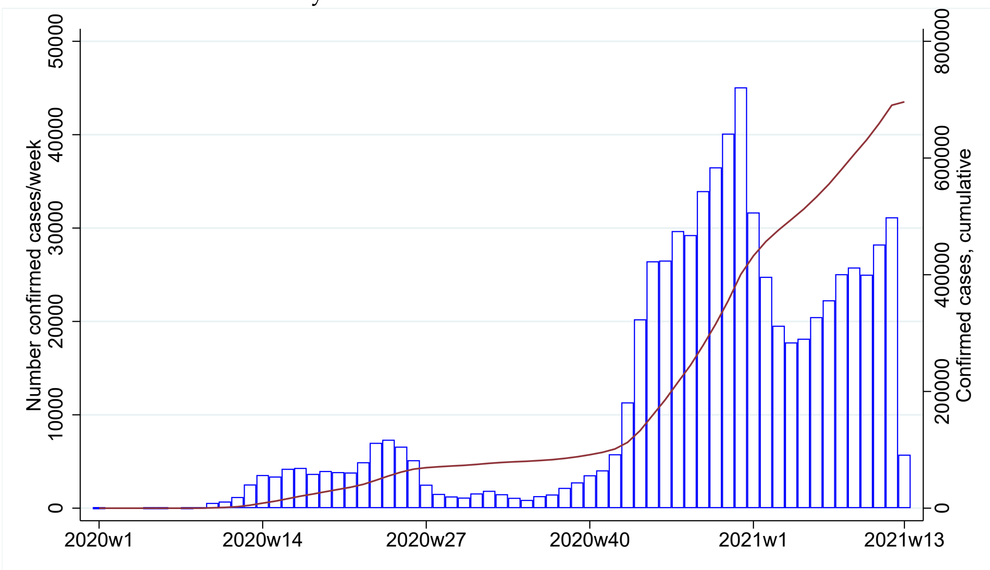
| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Income quartile 2 | -0.020*** | | | -0.017*** | | -0.018*** |
| | (0.003) | | | (0.003) | | (0.003) |
| Income quartile 3 | -0.023*** | | | -0.020*** | | -0.020*** |
| | (0.003) | | | (0.003) | | (0.003) |
| Income quartile 4 | -0.022*** | | | -0.017*** | | -0.018*** |
| | (0.003) | | | (0.003) | | (0.003) |
| High school | | -0.008** | | -0.004 | | -0.006 |
| | | (0.004) | | (0.004) | | (0.004) |
| College/university | | -0.017*** | | -0.010*** | | -0.011*** |
| | | (0.004) | | (0.004) | | (0.004) |
| Married/cohabiting | | | -0.014*** | -0.010*** | | -0.009*** |
| | | | (0.002) | (0.002) | | (0.002) |
| Europe | | | | | 0.006 | 0.004 |
| | | | | | (0.005) | (0.005) |
| Africa | | | | | -0.003 | -0.009 |
| | | | | | (0.005) | (0.006) |
| Asia | | | | | -0.008** | -0.013*** |
| | | | | | (0.003) | (0.004) |
| Controls | | | | | | |
| Age | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Gender | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Medical history | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Week of hospital admission | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Municipality | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Mean of outcome | 0.0350 | 0.0349 | 0.0350 | 0.0349 | 0.0351 | 0.0350 |
| $N$ | 26,041 | 25,448 | 26,041 | 25,448 | 25,672 | 25,099 |
| $R^2$ | 0.0898 | 0.0903 | 0.0882 | 0.0932 | 0.0887 | 0.0950 |

NOTES: The estimations include controls for age, female gender, municipality-fixed effects, fixed effects for month of hospital admission,

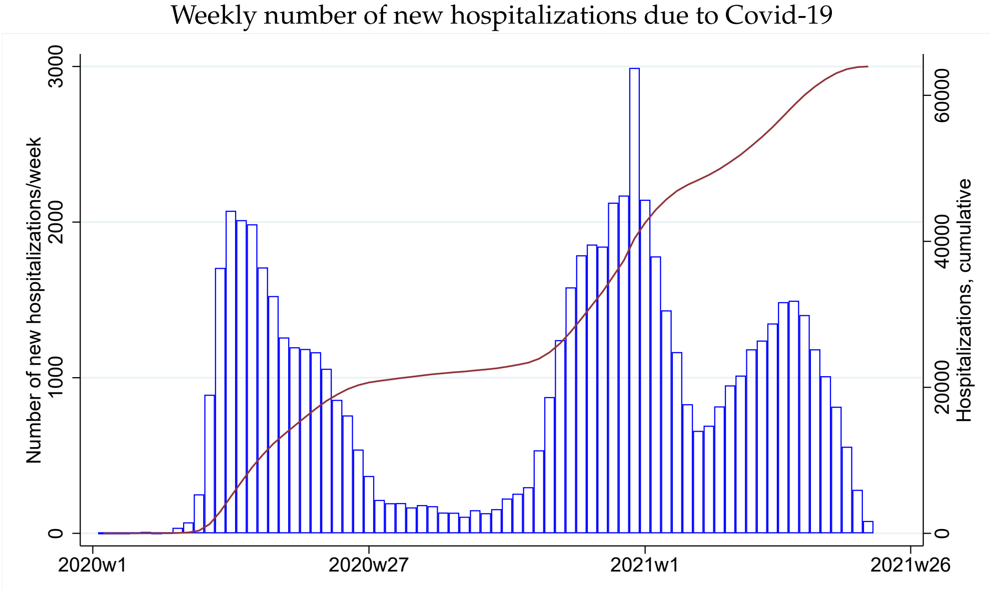
# A Appendix

FIGURE A.1.
Weekly number of confirmed Covid-19 cases based on PCR tests, and new inpatient hospitalizations due to Covid-19

(A)
Weekly number of confirmed Covid-19 cases



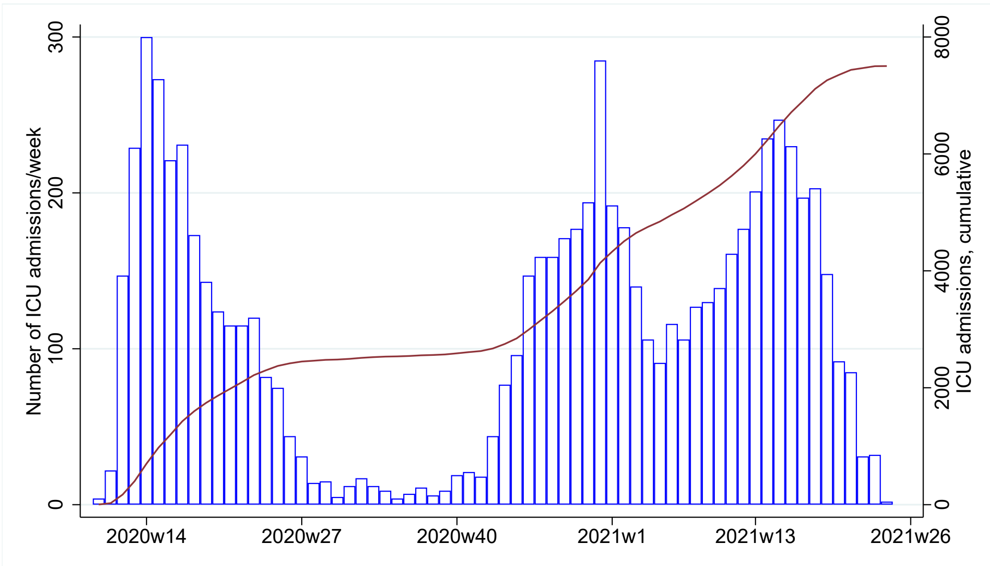

(B)
Weekly number of new hospitalizations due to Covid-19



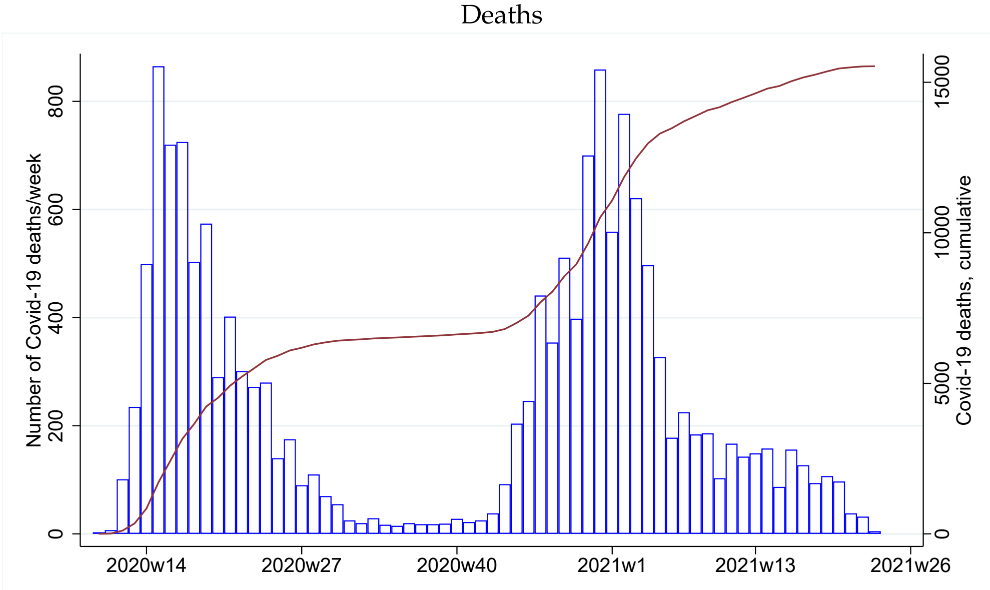

NOTES: Weekly number of new hospitalizations with Covid-19 recorded as the main or secondary diagnosis (ICD codes U071 or U072). The data covers the time period January 2020–May 2021. *Source:* Own calculations based on data from the Inpatient Registry, National Board of Health.

FIGURE A.2.
Weekly number of new ICU admissions and deaths due to Covid-19

(A)
ICU admissions




(B)
Deaths




NOTES: Weekly number of new ICU admissions of Covid-19 patients, and weekly number of Covid-19 related deaths. The data covers the time period January 2020–May 2021. *Source:* Own calculations based on data from the Swedish ICU registry and the Cause-of-Death registry, National Board of Health.

TABLE A.1.
Summary Statistics

| | Population | Hospitalized |
|---|---|---|
| Age group | | |
| 30–49 | 0.340 | 0.166 |
| 50–59 | 0.166 | 0.165 |
| 60–69 | 0.141 | 0.178 |
| 70+ | 0.206 | 0.457 |
| Female | 0.501 | 0.434 |
| Medical risk group | 0.346 | 0.690 |
| Income quartile | | |
| Q1 | 0.250 | 0.318 |
| Q2 | 0.250 | 0.247 |
| Q3 | 0.250 | 0.226 |
| Q4 | 0.250 | 0.209 |
| Education level | | |
| Compulsory school | 0.186 | 0.323 |
| High school | 0.433 | 0.413 |
| College/University | 0.381 | 0.264 |
| Housing/living situation | | |
| Crowded housing | 0.103 | 0.101 |
| Deprived neighborhood | 0.104 | 0.170 |
| Married/cohabiting | 0.691 | 0.662 |
| Living alone | 0.253 | 0.324 |
| Working conditions | | |
| Can work from home | 0.281 | 0.232 |
| Low exposure occupation | 0.224 | 0.201 |
| Moderate exposure occupation | 0.545 | 0.524 |
| High exposure occupation | 0.231 | 0.275 |
| Region of origin | | |
| Africa | 0.023 | 0.032 |
| Asia | 0.081 | 0.140 |
| EU28 (not Nordic) | 0.042 | 0.039 |
| Europe | 0.031 | 0.060 |
| Nordic (not Sweden) | 0.028 | 0.043 |
| Sweden | 0.780 | 0.665 |
| Soviet | 0.001 | 0.001 |
| Oceania | 0.001 | 0.000 |
| South America | 0.009 | 0.016 |
| North America | 0.004 | 0.004 |
| Observations | 7,923 643 | 62,527 |

NOTES: Column (1) contains summary statistics for the full population (aged 20 or older in 2020), registered in Sweden and alive by the end of 2019; column (2) contains the subset of the population in (1) that received inpatient care with Covid-19 recorded as the main or secondary diagnosis during January 2020–May 2021.

TABLE A.2.
Heterogeneity in intensive care incidence and mortality conditional on hospitalization, separately by waves 1, 2, and 3

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Deceased | | | ICU | | |
| | First wave | Second wave | Third wave | First wave | Second wave | Third wave |
| Income quartile 2 | -0.008 | -0.005 | -0.004 | -0.007 | -0.018*** | -0.011** |
| | (0.006) | (0.007) | (0.007) | (0.006) | (0.006) | (0.006) |
| Income quartile 3 | -0.019*** | -0.003 | -0.002 | -0.012* | -0.014** | -0.020*** |
| | (0.007) | (0.007) | (0.007) | (0.006) | (0.006) | (0.006) |
| Income quartile 4 | -0.026*** | -0.011 | -0.015* | -0.011 | -0.023*** | -0.018*** |
| | (0.007) | (0.008) | (0.008) | (0.007) | (0.006) | (0.006) |
| High school | -0.003 | -0.006 | -0.004 | -0.000 | -0.001 | -0.012** |
| | (0.006) | (0.007) | (0.007) | (0.005) | (0.005) | (0.005) |
| College/University | -0.011* | -0.014* | -0.014* | -0.003 | -0.013** | -0.020*** |
| | (0.007) | (0.007) | (0.007) | (0.006) | (0.006) | (0.006) |
| Married/cohabiting | -0.008 | -0.004 | -0.004 | -0.005 | 0.000 | -0.003 |
| | (0.005) | (0.006) | (0.006) | (0.005) | (0.005) | (0.005) |
| Controls | | | | | | |
| Age | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Gender | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Medical risk group | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Other medical history | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Week of hospital admission | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Municipality | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Mean of outcome | 0.1646 | 0.1730 | 0.1343 | 0.1169 | 0.0911 | 0.1058 |
| $N$ | 20,907 | 18,523 | 14,753 | 20,907 | 18,523 | 23,065 |
| $R^2$ | 0.1996 | 0.2011 | 0.1859 | 0.0984 | 0.0652 | 0.0599 |

NOTES:

TABLE A.3.
Heterogeneity in immediate ICU admission and testing behavior: separately for waves 1, 2, and 3

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | ICU upon admission | | | Tested at hospital | | |
| | First wave | Second wave | Third wave | First wave | Second wave | Third wave |
| Income quartile 2 | -0.001 | -0.008** | -0.005 | -0.017** | -0.060*** | -0.061*** |
| | (0.004) | (0.003) | (0.003) | (0.008) | (0.010) | (0.011) |
| Income quartile 3 | -0.010*** | -0.006 | -0.006* | -0.004 | -0.058*** | -0.090*** |
| | (0.004) | (0.004) | (0.003) | (0.009) | (0.011) | (0.011) |
| Income quartile 4 | -0.004 | -0.014*** | -0.006 | -0.035*** | -0.117*** | -0.104*** |
| | (0.004) | (0.004) | (0.004) | (0.009) | (0.012) | (0.012) |
| High school | 0.002 | 0.003 | -0.005 | 0.011 | -0.021** | -0.013 |
| | (0.003) | (0.003) | (0.003) | (0.007) | (0.009) | (0.010) |
| College/University | -0.002 | -0.005 | -0.009** | -0.017* | -0.041*** | -0.050*** |
| | (0.004) | (0.003) | (0.004) | (0.009) | (0.011) | (0.012) |
| Married/cohabiting | -0.002 | -0.004 | -0.006** | -0.004 | -0.047*** | -0.060*** |
| | (0.003) | (0.003) | (0.003) | (0.007) | (0.008) | (0.009) |
| Controls | | | | | | |
| Age | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Gender | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Medical risk group | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Other medical history | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Week of hospital admission | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Municipality | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Mean of outcome | 0.0393 | 0.0282 | 0.0323 | 0.7808 | 0.5165 | 0.3761 |
| $N$ | 20,907 | 18,523 | 23,065 | 17,422 | 16,836 | 13,721 |
| $R^2$ | 0.0473 | 0.0427 | 0.0367 | 0.1011 | 0.0799 | 0.1381 |

NOTES: The table reports estimates from linear probability models.

TABLE A.4.
Correlations between testing behavior and access to a lawyer in the family

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | Tested at hospital | | | | |
| Father lawyer | 0.027 | | | | |
| | (0.072) | | | | |
| Mother lawyer | | -0.079 | | | |
| | | (0.088) | | | |
| Spouse lawyer | | | -0.031 | | |
| | | | (0.030) | | |
| Child lawyer | | | | -0.031* | |
| | | | | (0.017) | |
| Sibling lawyer | | | | | -0.023 |
| | | | | | (0.026) |
| Controls | | | | | |
| Age | ✓ | ✓ | ✓ | ✓ | ✓ |
| Gender | ✓ | ✓ | ✓ | ✓ | ✓ |
| Medical risk group | ✓ | ✓ | ✓ | ✓ | ✓ |
| Other medical history | ✓ | ✓ | ✓ | ✓ | ✓ |
| Week of hospital admission | ✓ | ✓ | ✓ | ✓ | ✓ |
| Municipality | ✓ | ✓ | ✓ | ✓ | ✓ |
| Mean of outcome | 0.4811 | 0.4923 | 0.5513 | 0.5671 | 0.5423 |
| $N$ | 7,051 | 9,950 | 28,599 | 34,000 | 23,661 |
| $R^2$ | 0.3050 | 0.2795 | 0.2070 | 0.1738 | 0.2019 |

NOTES: The table reports estimates based on linear probability models.

TABLE A.5.
Heterogeneity in outcomes of Covid-19 patients by region of birth: First wave

| | (1) Deceased | (2) ICU | (3) ICU directly at admission | (4) Tested at hospital | (5) Outpatient care within 60 days | (6) Re-admitted within 60 days |
|---|---|---|---|---|---|---|
| Africa | 0.023** | 0.055*** | 0.019** | 0.028** | -0.032* | -0.013 |
| | (0.010) | (0.013) | (0.009) | (0.014) | (0.018) | (0.012) |
| Asia | 0.007 | 0.020*** | 0.003 | -0.000 | -0.071*** | -0.020*** |
| | (0.006) | (0.007) | (0.005) | (0.009) | (0.011) | (0.007) |
| South America | 0.012 | 0.054*** | 0.017 | 0.043** | -0.091*** | -0.024 |
| | (0.014) | (0.019) | (0.013) | (0.020) | (0.026) | (0.016) |
| Europe & North America | 0.006 | 0.009 | -0.005 | -0.008 | -0.038*** | -0.002 |
| | (0.007) | (0.006) | (0.004) | (0.009) | (0.011) | (0.008) |
| Controls | | | | | | |
| Age | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Gender | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Medical risk group | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Other medical history | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Week of hospital admission | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Municipality | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Mean of outcome | 0.1648 | 0.1168 | 0.0394 | 0.7810 | 0.4335 | 0.1574 |
| $N$ | 20,879 | 20,879 | 20,879 | 17,400 | 17,436 | 17,436 |
| $R^2$ | 0.1978 | 0.0993 | 0.0475 | 0.0996 | 0.0844 | 0.1043 |

NOTES: The table reports estimates based on linear probability models. The sample includes individuals hospitalized during the first half of 2020 (first wave of the pandemic).

TABLE A.6.
Heterogeneity in outcomes of Covid-19 patients by region of birth: Second and third waves

| | (1) Deceased | (2) ICU | (3) ICU directly at admission | (4) Tested at hospital | (5) Outpatient care within 60 days | (6) Re-admitted within 60 days |
|---|---|---|---|---|---|---|
| Africa | 0.005 | 0.016 | 0.008 | 0.149*** | 0.004 | 0.018 |
| | (0.008) | (0.010) | (0.006) | (0.018) | (0.019) | (0.013) |
| Asia | -0.011*** | 0.007 | -0.000 | 0.058*** | -0.029*** | -0.003 |
| | (0.004) | (0.005) | (0.003) | (0.009) | (0.009) | (0.006) |
| South America | 0.000 | 0.014 | 0.006 | -0.016 | -0.026 | -0.004 |
| | (0.011) | (0.014) | (0.008) | (0.023) | (0.026) | (0.017) |
| Europe & North America | 0.006 | 0.007 | 0.006** | 0.019** | -0.018* | -0.009 |
| | (0.006) | (0.004) | (0.003) | (0.008) | (0.009) | (0.007) |
| Controls | | | | | | |
| Age | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Gender | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Medical risk group | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Other medical history | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Week of hospital admission | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Municipality | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Mean of outcome | 0.1558 | 0.0992 | 0.0304 | 0.4539 | 0.4552 | 0.1621 |
| $N$ | 33,265 | 41,564 | 41,564 | 30,534 | 26,068 | 26,068 |
| $R^2$ | 0.1861 | 0.0507 | 0.0280 | 0.1003 | 0.0732 | 0.0789 |

NOTES: The table reports estimates based on linear probability models. The sample includes individuals hospitalized during the second half of 2020 and first two months of 2021 (second and third waves of the pandemic).

TABLE A.7.
Heterogeneity in outcomes of Covid-19 patients by region of birth, controlling for SES: First wave

| | Deceased | | ICU admission | |
|---|---|---|---|---|
| Africa | 0.023** | 0.012 | 0.055*** | 0.054*** |
| | (0.010) | (0.011) | (0.013) | (0.014) |
| Asia | 0.007 | -0.003 | 0.020*** | 0.020** |
| | (0.006) | (0.007) | (0.007) | (0.008) |
| South America | 0.012 | 0.004 | 0.054*** | 0.053*** |
| | (0.014) | (0.014) | (0.019) | (0.019) |
| Europe & North America | 0.006 | 0.001 | 0.009 | 0.009 |
| | (0.007) | (0.007) | (0.006) | (0.007) |
| Income quartile 2 | | -0.007 | | -0.004 |
| | | (0.006) | | (0.006) |
| Income quartile 3 | | -0.020*** | | -0.005 |
| | | (0.007) | | (0.006) |
| Income quartile 4 | | -0.027*** | | -0.002 |
| | | (0.008) | | (0.007) |
| High school | | -0.003 | | 0.003 |
| | | (0.006) | | (0.005) |
| College/university | | -0.011 | | -0.001 |
| | | (0.007) | | (0.006) |
| Married/cohabiting | | -0.010* | | -0.004 |
| | | (0.005) | | (0.005) |
| Controls | | | | |
| Age | ✓ | ✓ | ✓ | ✓ |
| Gender | ✓ | ✓ | ✓ | ✓ |
| Medical risk group | ✓ | ✓ | ✓ | ✓ |
| Other medical history | ✓ | ✓ | ✓ | ✓ |
| Week of hospital admission | ✓ | ✓ | ✓ | ✓ |
| Municipality | ✓ | ✓ | ✓ | ✓ |
| Mean of outcome | 0.1648 | 0.1648 | 0.1168 | 0.1168 |
| $N$ | 20,879 | 20,879 | 20,879 | 20,879 |
| $R^2$ | 0.1978 | 0.1990 | 0.0993 | 0.0994 |

NOTES: The table reports estimates based on linear probability models. The sample includes individuals hospitalized during the first half of 2020 (first wave of the pandemic).