The Impact of Doctoral Studies on Mental Health Care Uptake

Sanna Bergvall[a], Clara Fernström Paues[b], Eva Ranehill[a,c], and Anna Sandberg[d]

[a] Department of Economics, University of Gothenburg
[b] Department of Economics, Stockholm Business School
[c] Department of Economics, Lund University
[d] Swedish Institute for Social Research, Stockholm University

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Abstract

We use administrative data on diagnosed mental health problems to explore mental health care uptake among PhD students. Our data comprise all individuals starting PhD studies in Sweden between 2006 and 2017 and contain detailed information on all medical prescriptions, as well as inpatient and specialized outpatient care visits and diagnoses. They allow us to follow the mental health care uptake of each individual PhD student before, during and after the they start their doctoral studies. We find that PhD students, in the years preceding their PhD, are prescribed psychiatric medication at a rate similar to that of a matched control group of individuals with a master's degree but no PhD education. However, following the start of the PhD program, the rate of prescriptions increases for PhD students relative to the control group. Our main analysis is an event study with individual and calendar year fixed effects, comparing the rate of medical prescriptions among PhD students before and after starting the PhD program. We find a sharp increase in psychiatric medications immediately after PhD start. This increase grows continuously over the course of the PhD program. Our estimates indicate that, by the 5th year of PhD studies, prescriptions of psychiatric medication among PhD students have increased by about 40% relative to the year before PhD start.

Keywords: mental health, doctorate studies

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1. Introduction

Several recent surveys document high levels of reported mental health problems such as anxiety or depression among doctoral students. For example, in Nature´s latest biennial PhD survey, roughly 36 percent of the 6,300 graduate student respondents report having sought help for anxiety or depression related to their doctoral studies (Woolston 2019). Similar numbers are found in other large surveys (e.g., Levecque et al. 2017; Evans et al. 2018; Bolotnyy, Basilico, and Barreira 2022), as well as in a recent meta-analysis by Satinsky et al. (2021). Pooling across 16 studies, Satinsky et al. (2021) report clinically significant symptoms of depression among 24 percent of the respondents. The corresponding number for clinically significant symptoms of anxiety is 17 percent.

This survey evidence call attention to an urgent problem and has led to a broad discussion about a mental health crisis in graduate education. Putting these findings in perspective, the prevalence of mental health problems reported among PhD students is several times higher than that of the general population, or of other more similar populations such as individuals with a university degree (e.g., Levecque et al. 2017; Evans et al. 2018; Bolotnyy, Basilico, and Barreira 2022). As argued in previous studies, these surveys raise concerns not only about individual well-being, but also about the consequences for academia in general. With respect to mental health, graduate students appear to represent an important exception to the otherwise rather robust educational gradient in health (see, e.g., Currie 2009; Conti, Heckman, and Urzua 2010; Cutler and Lleras-Muney 2010).

In this study, we complement previous studies by using Swedish administrative data on diagnosed mental health problems to explore mental health care uptake among PhD students. By using register data, we contribute to the existing research in several ways. First, we circumvent possible issues with small and/or selected samples associated with self-reported survey data. Our data comprise the universe of individuals entering any Swedish PhD education between 2006 and 2017 (N=37,245) and contain detailed and high-quality information on all medical prescriptions as well as inpatient and specialised outpatient care visits and diagnoses for the individuals in our sample.[1] These measures reliably capture the prevalence of depression and other mental health problems as diagnosed by medical expertise and are an important addition to existing data. A further advantage of our approach is the panel structure of our data.

[1] An advantage of the Swedish setting is that Sweden has universal health care coverage enabling all legal residents access to health care at a minor fee. The universal Swedish health care coverage include services such as in- and outpatient care, mental health services, long-term care and prescriptions. Fees vary somewhat by county, but typically lies between USD 10 and 22.

While survey data is restricted to one point in time, the panel dimension of our data allows us to follow the health care uptake – in general and specifically related to mental health – of each individual PhD student before, during and after they start their doctoral studies, to further explore the impact of PhD studies on mental health outcomes. Importantly, since our data extends to the whole population, we can also compare the mental health care uptake of PhD students to other relevant sociodemographic groups over time. Finally, the rich dataset and large sample also allow us to meaningfully explore a broad array of correlations between individual mental health care uptake on the one side and individual and institutional factors (e.g., age, gender, family composition and research field) on the other.

The rest of the manuscript is organized as follows. The next section gives an overview of the data and methods. Section 3 presents the results and Section 4 concludes.

2. Data and methods

2a. Data

Our analyses rely on Swedish administrative data held by Statistics Sweden and the National Board of Health and Welfare. These data cover the Swedish population and allow us to identify all individuals active as PhD students at a Swedish university across all academic fields. Below we describe how we create our main sample and comparison groups, as well as how we define our main outcome variables.

PhD students

We restrict our sample of PhD students to individuals who were registered as a PhD student at a Swedish university between the years 2006 and 2017 (N=37,245). Since data on medical prescriptions are only available from 2005, this restriction allows us to observe the prescriptions of all PhD students at least one year before starting PhD studies.

Next, we exclude all individuals without a Swedish master's degree (defined as a university degree of four years or more), leaving 25,107 individuals in the remaining PhD sample. This restriction is made primarily to ensure that we can observe individual health care uptake during the years before PhD start. Moreover, it makes it more plausible that all included PhD students have a connection to the Swedish health care system and are likely to seek medical care in Sweden when ill.

Finally, since our aim is to capture the outcome of individuals whose primary activity is PhD studies, we exclude from our sample PhD students who are active in a research field where it is common that PhD students are only working part-time. We do this by dropping all

academic fields with a median activity percentage of less than 70 percent. This mainly leads to an exclusion of professions requiring certification, where PhD students may work primarily clinically while completing their PhD thesis.[2] After these restrictions, the final sample consists of 20,650 PhD students.

Table 1 presents summary statistics of our main sample of PhD students. The most common research fields are Engineering and Technology and Medical and Health Sciences, encompassing 26 percent and 23 percent of the sample. The smallest fields are Agricultural Sciences and Humanities, encompassing 2 percent and 7 percent of the sample. On average, individuals are 31 years old when they start their postgraduate education. PhD students in Social Sciences and Humanities are the oldest (34 years at the start), while those studying Natural Sciences are the youngest (28 years at the start). Overall, 46 percent of the PhD students are women, but the gender composition varies substantially across fields. Engineering and technology is the most male dominated field with 29 percent women while Agriculture is the most female dominated with 65 percent women. In total, 28 percent of the individuals in the sample are foreign born (but recall that we dropped all individuals with no Swedish master's degree), 17 percent have at least one young child (below the age of ten) at PhD start, and 7 percent were prescribed psychiatric medications already the year before PhD start.

Table 1: Summary statistics (PhD students)

	All	Medical Health Sciences	Natural Sciences	Social Sciences	Engineering Technology	Humanities	Agriculture
Individuals	20,650	4,741	4,647	4,007	5,292	1,428	485
Year PhD start	2011	2011	2011	2012	2011	2011	2011
Age PhD start	31	32	28	34	29	34	32
Female	0.46	0.61	0.38	0.56	0.29	0.53	0.65
Foreign born	0.28	0.24	0.32	0.22	0.35	0.17	0.17
Young children at PhD start	0.17	0.21	0.09	0.26	0.11	0.23	0.19
Psych. med. 1 year before PhD start	0.07	0.09	0.05	0.09	0.04	0.12	0.10

Control groups

We construct two control groups, one from the general population and one from the highly educated population. The control group from the general population (N=7,045,134) is restricted to individuals who (i) were alive in 2006 and (ii) have never enrolled in PhD studies in Sweden. The highly educated control group (N=542,451) is further restricted to individuals who have a

[2] 98.5 percent of the excluded individuals are PhD students in medical and health sciences. The vast majority are completing a PhD in a research field within clinical medicine (e.g., surgery, obstetrics and gynecology, cardiac and cardiovascular systems, and general practice) or health sciences (e.g., nursing).

Swedish university education of at least 4 years. In most analyses where we compare the control groups to the PhD population, we weigh these groups by gender, birth year and – for the highly educated group – field of master's degree to match the composition of the PhD students.

In some analyses, we also assign the control individuals a "placebo PhD start year". When the analysis is based on a control group with a placebo start year, the control group is constructed by matching individuals from the control group m:1 to the PhD population by gender, birth year and – for the highly educated control group – field of study. Each control individual is given a "placebo" PhD start year equal to the start year of the PhD student they were matched with. In these analyses, we weigh the control individuals by the inverse of the total number of control individuals who were matched to the same PhD student.

Outcome variables

Our data contain detailed and high-quality individual level information on all medicines prescribed as well as outpatient and specialized inpatient care visits and diagnoses. The data on health care visits do not cover visits to primary care physicians. In contrast, the data on medical prescriptions cover the universe of all prescriptions in Sweden, arising from all types of health care visits (including primary care). Hence, our data do not capture visits to primary care centers for possible mental health problems that are not deemed serious enough to require medication or specialized care.

Our main measure of mental health care uptake, *psychiatric medication*, is a dummy variable indicating whether an individual has been prescribed any medication for mental health issues in a given year. We construct this measure using data from the Prescribed Drugs Register, which is available from 2005. We based the classification of medications on the Anatomical Therapeutic Chemical Classification System (ATC), and include the following categories in the definition of psychiatric medication:

1. ATC N06A: Antidepressants (e.g., SSRI)
2. ATC N05B: Anxiolytics (for inhibiting anxiety, e.g., benzodiazepines)
3. ATC N05C: Hypnotics or sedatives (for inducing sleep or sedation, e.g., barbiturates)

We also present some analyses studying *hospital visits and hospitalizations for mental or behavioral disorders.* To this end, we construct a dummy variable indicating whether an individual has received any out- or inpatient care for mental health issues in a given year. We construct this measure using data from the National Patient Register, which is available

from 2001 for all outcomes.[3] We base the classification of hospital visits and hospitalizations on the International Classification of Diseases (ICD) codes. An individual is defined as having been diagnosed with a mental or behavioral disorder in a given year if they have received at least one diagnosis with an ICD code of F00-F99. This includes, e.g., major depression, anxiety disorders, sleep and eating disorders as well as substance abuse. Since this measure captures diagnoses from, e.g., emergency psychiatry and therapy provided by specialized clinics, but not primary care centers, it can be seen as an indicator of more severe and/or acute mental health problems compared to our main outcome measure.

Finally, we construct a variable capturing *all other medications*. This variable includes all prescribed medications except those included in the mental health category outlined above.

2b. Methods

Event studies

Part of this paper aims to causally identify the impact of PhD studies on mental health care uptake. To capture this effect, it is important to address the issue of selection into PhD studies. It is likely that unobserved background characteristics correlate both with (i) the probability of entering PhD studies and (ii) mental health. To address this concern, we use an event-study approach with individual and year fixed effects, in which we compare the mental health care uptake of the same individual before and after PhD start. In addition to our sample of PhD students (who are defined as receiving treatment the year they start a PhD program), we include the sample of highly educated individuals with no PhD education as a never-treated control group in this analysis. The control group is weighted to match the PhD sample in terms of birth year, gender and field of study. Our primary event study specification is outlined in Equation (1) below:

$$Y_{ist} = \sum_{j=-8, j\neq -1}^{8} \beta_j l(t=j) + a_i + \theta_s + \varepsilon_{ist}. \quad (1)$$

In this specification, Y_{ist} is a binary variable indicating whether individual *i* has been prescribed psychiatric medication in calendar year *s* and at event time *t*. *l(t=j)* is a dummy variable that takes the value 1 if the difference between the calendar year and the PhD start

[3] Data on inpatient but not outpatient care is available for earlier years, but we restrict the start year to 2001 for all care types to make the data comparable.

year is *j* years (this variable always takes the value 0 for the never-treated control group). *l(t=0)* indicates the year of PhD start, and the year before PhD start (*t*=-1) is omitted as the baseline. The variable *l(t=8)* captures all periods at least eight years after PhD start and *l(t=-8)* captures all periods at least eight years before PhD start. Finally, a_i denotes individual fixed effects and θ_s calendar year fixed effects. We cluster the standard errors at the individual level.

Our variable of interest, β_j, estimates the difference in the share of individuals that are prescribed psychiatric medication in the j^{th} year before or after PhD start, compared to one year before PhD start, controlling for time trends and time-invariant individual factors. In our main graphs, we express the impact of PhD studies as relative rather than absolute changes. That is, we convert β_j from percentage points to percent. To this end, we divide β_j (the percentage point change in psychiatric medication between *t=-1* and *t=j*) with the mean share of PhD students that were prescribed psychiatric medications at *t=-1*.[4]

As discussed above, one important advantage of the event study approach is that we can address the concern of endogenous selection into PhD studies (i.e., unobserved individual characteristics that are correlated with both PhD studies and the outcome variable). By including individual fixed effects, we control for all time-invariant individual factors. However, there are still some caveats to keep in mind when interpreting the event study results as causal effects on mental health. Below we discuss some of these caveats and how we address them.

First, our estimates may be affected by correlated chocks since starting PhD studies may be associated with other life events that could affect mental health (such as graduating from university, moving to a new city, and starting a new job). To address this concern, we run the same event study specification for other groups that experience similar life events but never start PhD studies (e.g., students graduating from university and starting their first job).

It is also possible that PhD studies may affect mental health care uptake without actually affecting mental health. For example, PhD studies may be associated with increased information or access to health care. In order to address this concern, we compare the increase in mental health care to health care uptake in general. If PhD studies are associated with an increased individual propensity to seek health care this should also impact health care uptake in general. It could also be that PhD students are encouraged to seek health care related to mental health issues in particular. We address this concern indirectly by exploring *hospital visits and hospitalizations for mental or behavioral disorders*. This measure captures more acute and serious mental health conditions

[4] When computing the mean value at *t=-1*, we restrict the sample to PhD students who were observed at *t=j*.

and should be less impacted by individual propensity to seek health care. We do, however, believe that there are several reasons why PhD studies are not associated with an increased propensity to seek mental health care. One reason is that Sweden has universal health care coverage enabling all legal residents access to health care at a minor fee. This universal health care coverage includes services such as in- and outpatient care, long-term care for mental health issues and prescriptions. Hence, access to mental health care is accessible to anyone independent of employment status. Further, mental health problems are still associated with stigma. Finally, it is possible that PhD studies are stressful and may trigger mental health problems. While we argue that such an effect would be a consequence of PHD studies, and part of the effect we aim to capture, in upcoming analyses we explore this issue by comparing the outcome of individuals sorting into PhD studies to those experienced by individuals entering other stressful occupations such as lawyers, consultants, or investment bankers.

Risk ratios

As part of our heterogeneity analyses, we compare different subsamples in terms of the risk of being prescribed psychiatric medications during the PhD program. In these analyses, we restrict the sample of PhD students to individuals who (i) *were not prescribed any psychiatric medication the year before PhD start* and (ii) we can observe at least one year after PhD start. This leaves us with a sample of 17,803 individuals.

To compute the relative risk of being prescribed psychiatric medication during the PhD program, we estimate logistic regressions. The outcome variable takes the value 1 if the individual has been prescribed psychiatric medication at any time during the PhD program, and 0 otherwise. The risk ratio of one group, relative to another, is defined as the relative difference in the probability of being prescribed psychiatric medication during the PhD program. For example, the risk ratio of women relative to men is defined as: $\frac{\text{Predicted probability of medication for women}}{\text{Predicted probability of medication for men}}$. We estimate these risk ratios in STATA using the post-estimation command *adjrr*. In all specifications, we control for the calendar year of PhD start.

For each subgroup, we show two different risk ratios. The first risk ratio (labeled "no controls") is estimated including no control variables except for the year of PhD start. To estimate the second risk ratio (labeled "controls") we add controls for (i) research field, (ii) having been born abroad, (iii) PhD start age (five bins), (iv) gender, (v) having young children (below the age of 10) at PhD start, and (vi) having received psychiatric mediation at any time up until two years before PhD start.

3. Results

Below we first show how the rate of prescriptions of psychiatric medications has evolved over time. Next, we aim to capture the *impact* of starting a PhD program. We do this both by providing a descriptive comparison between our sample of PhD students and the matched control groups, and by conducting an event study analysis. Finally, we explore heterogenous effects across different groups of PhD students.

3a. Prescription of psychiatric medication across the study period

Figure 1 presents time trends in prescriptions of psychiatric medication between the years 2006 and 2017. We show yearly averages for three groups: (i) *PhD students*: All individuals with a Swedish master's degree who were active as PhD students at a Swedish university in a given year, (ii) *The general population*: All individuals living in Sweden in a given year, and (iii) *The highly educated population*: All individuals with at least four years of Swedish university education living in Sweden in a given year. In each calendar year, the controls groups are weighted to resemble the population of active PhD students in terms of gender, year of birth, and – for the highly educated population – field of master studies. The same figure for men and women separately is presented in Figure A1 in Appendix A.

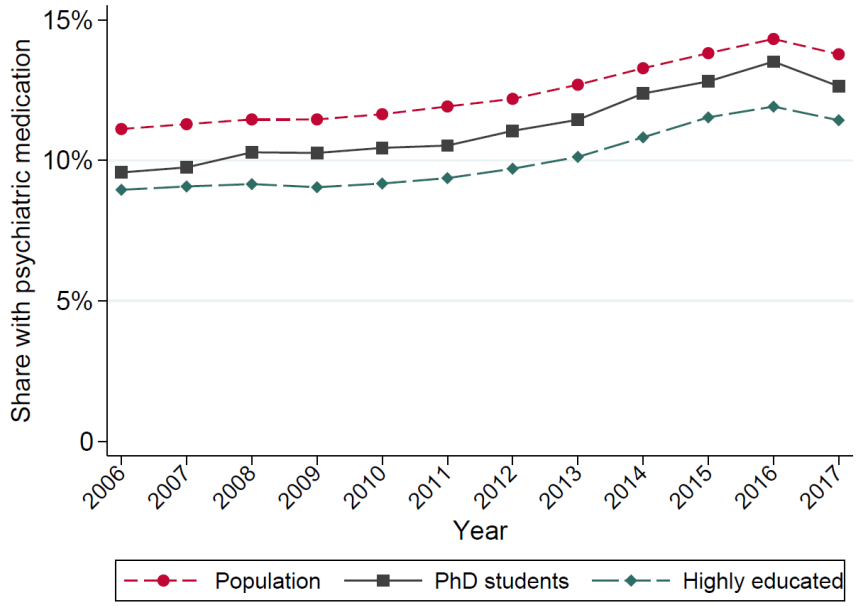

Fig. 1: Prescribed psychiatric medication over time. The figure depicts the yearly average uptake of prescribed psychiatric medication among PhD students, the general population and highly educated individuals (at least 4 years of university education, but no PhD education). For each calendar year, the PhD sample includes all individuals with a Swedish master's degree who were active as a PhD student in Sweden that year. The two controls groups are weighted (separately for each calendar year) to resemble the PhD student population in terms of gender, year of birth, and (for the highly educated population) field of master's degree.

Across the study period, the prescription of psychiatric medication has increased in all three groups. For example, in 2006, 9.6 percent of PhD students and 11.1 percent of the weighted sample of the general population were prescribed psychiatric medication. By 2017, these numbers had increased to 12.6 percent among PhD students and 13.8 percent in the general population. Figure 1 also illustrates that PhD students are slightly less likely to be prescribed psychiatric medication than the weighted sample from the general population, in line with what the educational gradient in health would suggest (see, e.g., Currie 2009; Conti, Heckman, and Urzua 2010; Cutler and Lleras-Muney 2010). However, comparing PhD students to the highly educated sample, the relationship is reversed with PhD students being slightly more likely to receive prescriptions for psychiatric medication.

3b. Effects of starting a PhD program on mental health care uptake

Figure 2 presents descriptive statistics on the yearly rate of prescriptions of psychiatric medication from 3 years before, to 5 years after, the start of PhD studies. In the figure, we compare PhD students to the matched samples from the general population and the highly educated population. In this comparison, the individuals in the matched samples have been assigned a placebo PhD start year equal to that of their matched PhD student (as described in more detail in Section 2a above), and weighted to resemble the PhD students in terms of gender, age and – for the highly educated group – field of study. This comparison illustrates that, in the years preceding PhD studies, PhD students are prescribed psychiatric medication at rates similar to the sample of highly educated individuals, and at lower rates than the general population. However, following the start of the PhD program, PhD students experience an increase in the rate of prescriptions relative to that of the other two groups. Five years into the PhD program, prescription rates among PhD students are close to the general population and significantly higher than among other highly educated individuals.

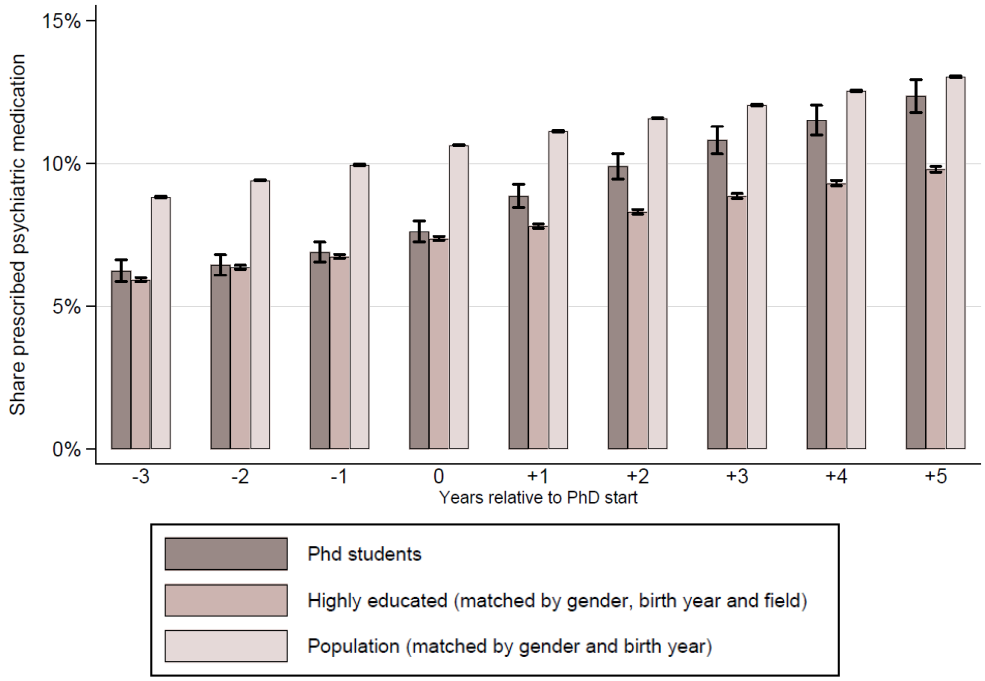

Fig. 2. Prescribed psychiatric medication relative to PhD start. The figure shows the share of individuals that were prescribed psychiatric medication before and after the start of PhD studies. The control groups are constructed by matching individuals from the general population, or the highly educated population (those with a university degree of at least four years), m:1 to the PhD population by gender, birth year and – for the highly educated group– field of study. Each control individual is given a "placebo" PhD start year equal to the start year of the PhD student they were matched with. Each control individual is weighted by the inverse of the total number of control individuals who were matched to the same PhD student.

Our main result is presented in Figure 3. The figure plots the estimates from an event study analysis of mental health care uptake before and after the start of PhD studies, including individual and calendar year fixed effects. The weighted sample of highly educated individuals is used as a never-treated control group. The year before PhD start ($t = -1$) is used as the baseline year, to which all estimates are compared (see Section 2b for a more thorough description of the specification and underlying assumptions).

Figure 3 shows that the likelihood for PhD students to be prescribed psychiatric medication increases sharply after the start of PhD studies. This increase starts already in the first year and grows continuously over the years following the start of PhD studies. Five years later, at the end of PhD studies, our estimates indicate that prescriptions of psychiatric medication have increased by 39.5 % relative to the year before PhD start (this is equivalent to a 2.5 percentage point increase).[5]

[5] As robustness checks, Figure A2 in Appendix A presents the estimates resulting from the estimation method suggested by Borusyak et al. (2022) and Sun and Abraham (2021). These estimation methods produce results that are comparable to our main estimates.

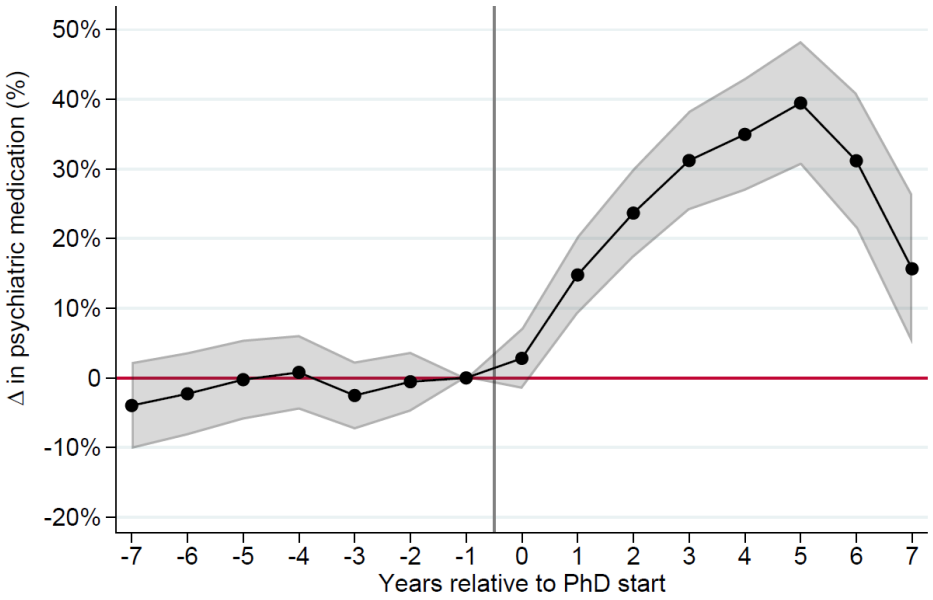

Fig. 3. Event study of the impact of PhD studies on prescribed psychiatric medication. The Figure shows estimates from an event study of PhD students. The estimates indicate the difference in the share of individuals that are prescribed psychiatric medication in the *j*th year before or after PhD start, compared to one year before PhD start, controlling for time trends (calendar year fixed effects) and time-invariant individual factors (individual fixed effects). The effect is measured in percent relative to average prescribed psychiatric medication uptake in the year before PhD start. Standard errors are clustered by individual. A sample of highly educated individuals, with a university education of at least four years but no PhD education (weighted to resemble the PhD sample in terms of gender, birth year and field of master studies), is included as a never-treated control group. See Section 2b for the full regression specification.

We also implement the event study analysis presented in Figure 3 for men and women separately (see Figure A3 in Appendix A). While this analysis indicates a similar and significant increase for both genders, the relative impact of PhD studies on mental health care uptake is directionally stronger for male PhD students as they have a lower incidence of being prescribed psychiatric medication at baseline.

While Figure 3 indicates a sharp change in mental health care uptake around the time of PhD start, it is possible that our estimates are impacted by correlated chocks since starting PhD studies may be associated with other life events that could affect mental health (such as graduating from university, moving to a new city, and starting a new job). We therefore implement the same event study as presented in Figure 3 separately for the PhD sample and the control group of highly educated individuals without a PhD. For the control group, we use the year after graduating from the master's program as the event time. This analysis indicates no increase in psychiatric medication for the highly educated control group, while the estimates for the PhD sample remain unchanged (see Figure A4 in Appendix A).

In Section 2 we discussed the possibility that PhD studies may impact aspects other than mental health that may influence mental health care uptake, such as information or access to health

care. To address this concern, we estimate our main specification using an indicator for all medications other than psychiatric medications as the outcome variable. Figure A5 in Appendix A shows the results for psychiatric medications and all other medications separately. The figure illustrates that also prescriptions of other medications increase somewhat at the onset of PhD studies. However, the percentage increase is several orders of magnitudes larger for psychiatric medication than for other medication. Moreover, additional analyses exploring the impact of PhD studies across a variety of different categories of medication in isolation finds the by far largest increase for psychiatric medication.

We also attempt to address the concern that PhD studies are associated with an increased propensity to seek health care specifically for mental health problems. To do so we implement our main event study specification for our secondary outcome measure *hospital visits and hospitalizations for mental or behavioral disorders* (see Figure A6 in Appendix A). While the percentage increase in hospital visits and hospitalizations is somewhat lower (peaking at a 25% increase), and much less precisely estimated, this analysis supports our main findings in the sense that we see a marked increase in mental health care uptake at the start of PhD studies

3c. Heterogeneity

Finally, our rich administrative data, as well as the size of our sample, allows us to meaningfully implement a heterogeneity analysis and compare the prevalence of mental health care uptake across different groups in the PhD population, in addition to gender. Figure 4 presents the relative risk of being prescribed psychiatric medication for PhD students with varying characteristics. We restrict the sample to PhD students who *were not prescribed any psychiatric medication the year before PhD start*. The risk ratios are obtained by estimating logistic regressions, with an outcome variable taking the value 1 if the individual has been prescribed psychiatric medication at any time during the PhD program (see Section 2 for more information). The blue dots represent the risk ratios from regressions controlling only for the PhD start year, while the red dots are from regressions controlling also for research field and all other characteristics indicated on the y-axis.

Figure 4 shows that, compared to the baseline category of PhD students who were younger than 26 when entering the PhD program, older students have a significantly higher probability of being prescribed psychiatric medication during their PhD studies. We find small or no differences in risk ratios when comparing Swedish and foreign-born PhD students, or when comparing those with and without young children at PhD start. If anything, being foreign born is associated with a somewhat lower risk of being prescribed psychiatric medication and

having children is associated with a small effect in the opposite direction. However, these effects are only significant without controls, and thus likely depend on other, related factors.

Returning to the gender difference in medication, this time in absolute terms, women have a substantially higher risk of being prescribed psychiatric medication than men, regardless of whether we control for other characteristics or not. The same applies to individuals who had been prescribed psychiatric medication at any point before entering the PhD program.[6] On average, individuals with a history of mental health care uptake are more than 2.5 times more likely to be prescribed psychiatric medication during the PhD program, compared to those who had never been prescribed psychiatric medication before.

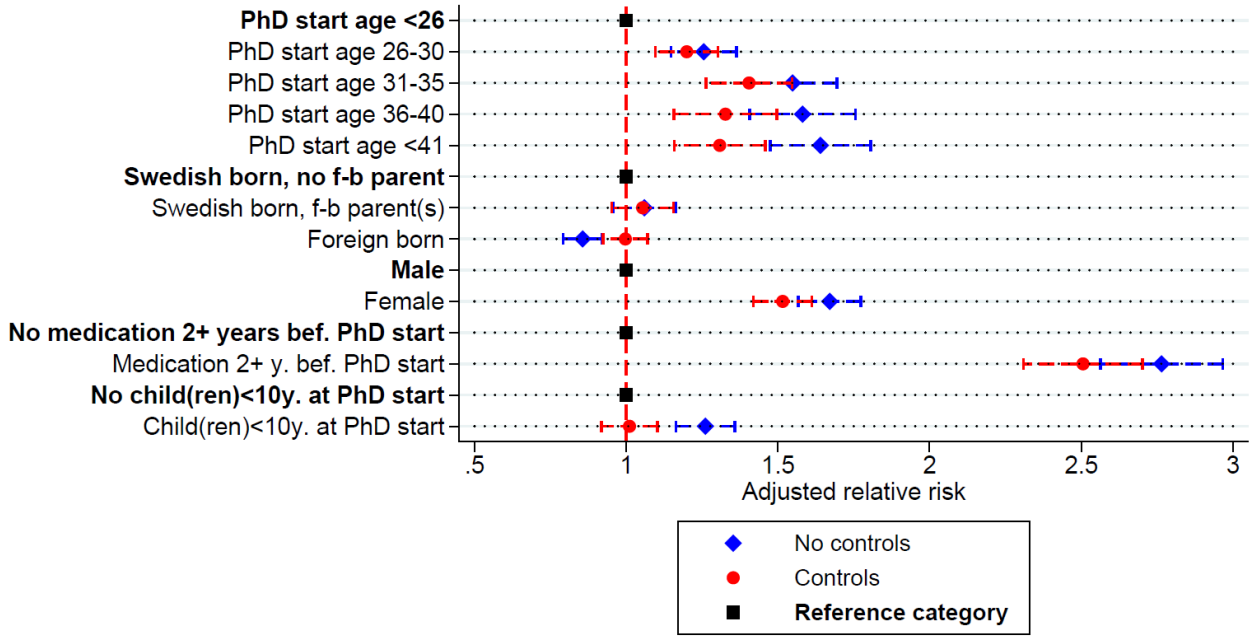

Fig. 4. Risk ratios of being prescribed psychiatric medication during PhD studies. Error bars show 95% confidence intervals. The sample is restricted to PhD students who were not prescribed any psychiatric medication in the calendar year before PhD start. See section 2b for a description of how the risk ratios are estimated. The blue dots ("No controls") include control only for PhD start year dummies. The red dots ("Controls") also control for all variables listed on the y-axis and research field.

[6] The variable for psychiatric medication before PhD studies indicates if the individual has been prescribed psychiatric medication during any time before entering the PhD program, *excluding* the calendar year preceding PhD studies. We exclude the year preceding PhD studies since, by construction, no-one in the sample used for the risk ratio estimations were prescribed psychiatric medication in this year.

4. Discussion

We use administrative high-quality data to study the impact of PhD studies on mental health care uptake among PhD students in Sweden. Our data cover the universe of Swedish PhD students, across all fields, from 2005 to 2017. We document that, in the years preceding PhD studies, the sample of prospective PhD students have a similar mental health care uptake as a matched sample of highly educated individuals with no PhD education. This similarity ends at the onset of PhD studies. Using an event-study analysis, we show that the onset of PhD studies is associated with a sharp increase in the rate of prescription of psychiatric medication for the PhD students that increases over the course of the PhD studies. At the end of PhD studies, the prevalence of being prescribed psychiatric medication has increased by 39.5 percent compared to the year before PhD studies. We further document that female PhD students, as well as those with a history of being prescribed psychiatric medication, are more at risk than other individuals.

Our results provide valuable insights for academic institutions in Sweden and countries with a similar institutional structure. In addition to the important questions our results raise with respect to individual wellbeing, they also raise questions about academia and academic institutions in general. How are academic institutions and the academic system organized and what implications does this have for work conditions and work life balance? Importantly, it also raises questions about scientific productivity, retention of the best competence and diversity.

Our research provides a valuable complement to previous research by using population wide administrative date to study the impact of PhD studies on mental health. In their meta-analysis of previous survey evidence, Satinsky et al. (2021) report a pooled prevalence of stated clinically significant symptoms of depression among PhD students at 24%. The screening instruments often used in the research summarized in Satinsky et al. (2021) tend to overestimate the prevalence of depression compared to structured clinical interviews by a factor of about 2 see, e.g., Satinsky et al. 2021). Relating our estimated prevalence of mental health care uptake among PhD students to previous reports, our finding that around 11% of active PhD students are diagnosed with mental health problems and prescribed psychiatric medication in a given year provide support for the numbers presented in previous literature.

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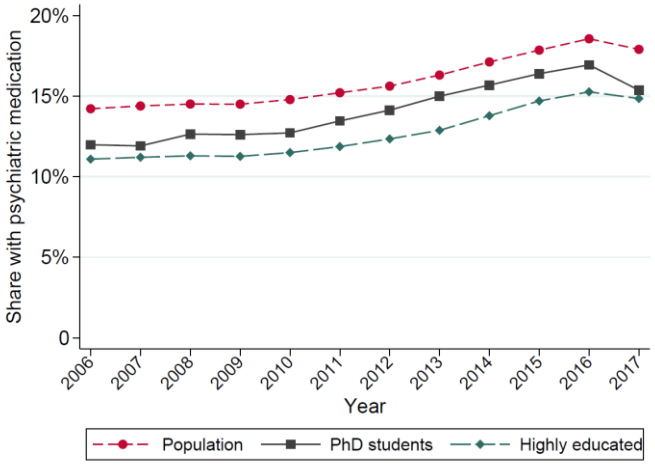
APPENDIX A

Fig. A1: Prescribed psychiatric medication over time by gender

a) Women



b) Men

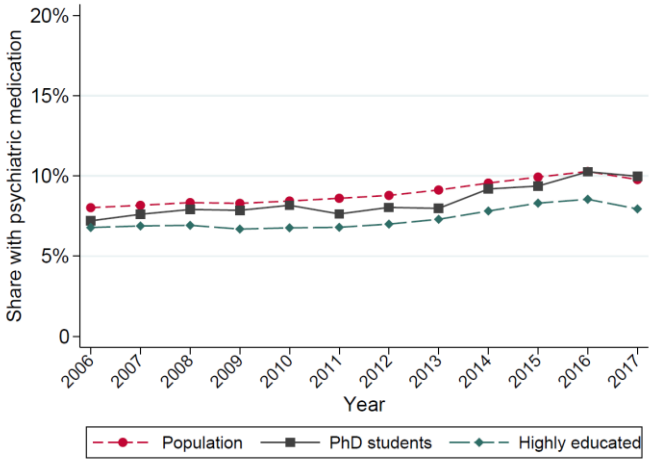
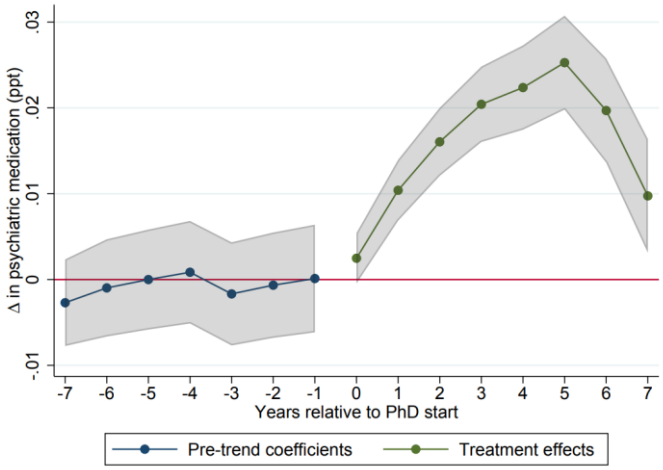


Fig. A2. Event studies of the impact of PhD studies on prescribed psychiatric medication, using alternative estimation methods

(a) Borusyak et al. (2022)



(b) Sun and Abraham (2021)

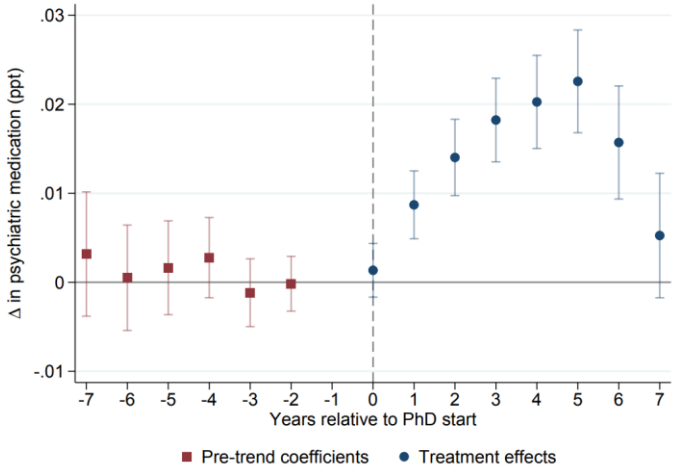
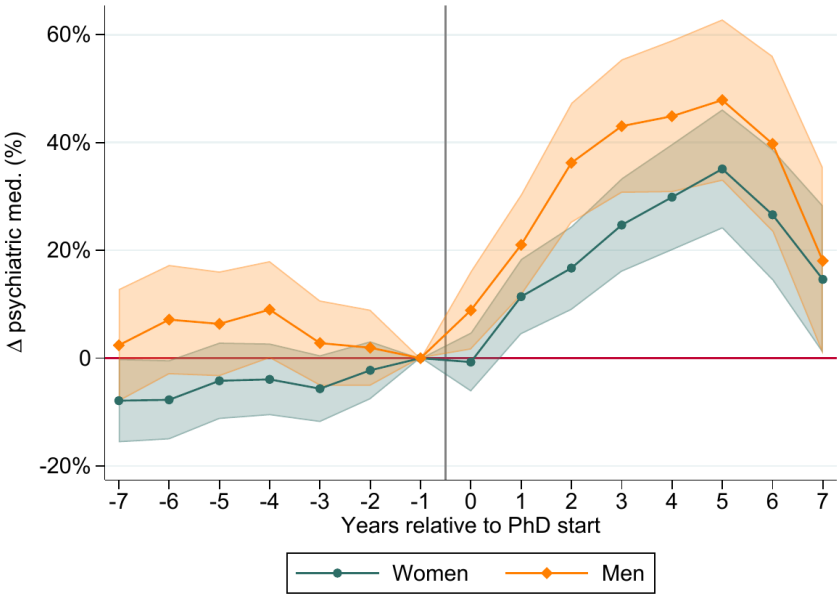
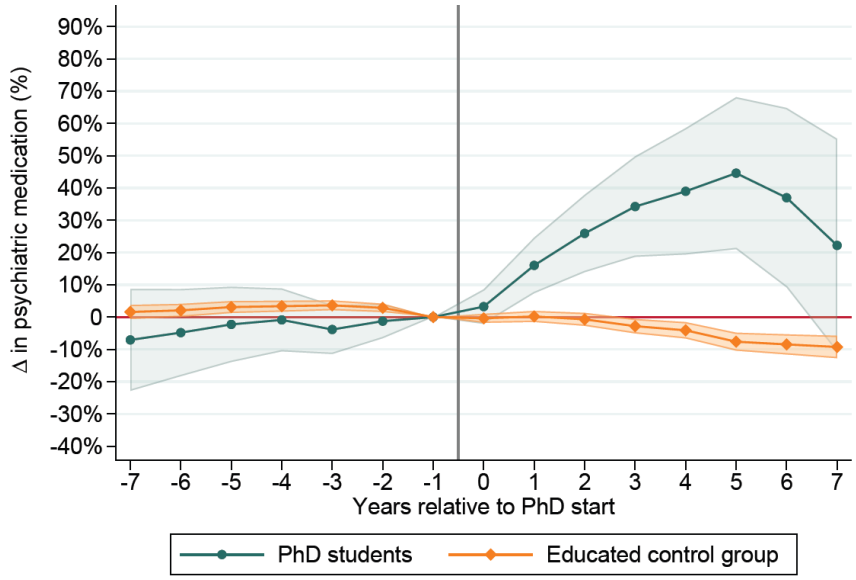


Fig. A3. Event study of the impact of PhD studies on prescribed psychiatric medication, by gender



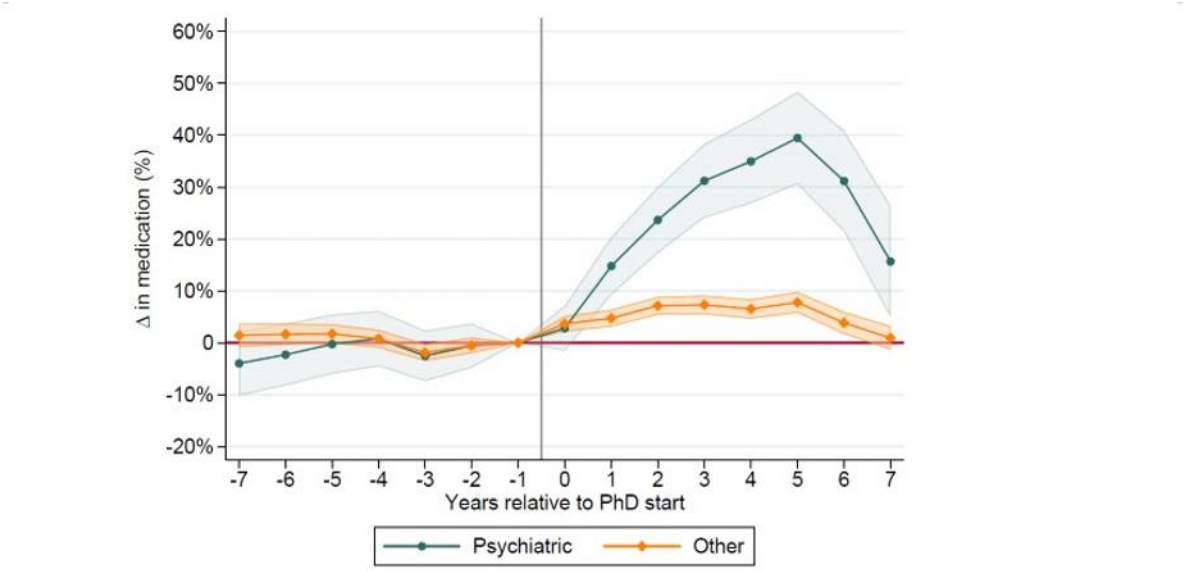
Footnote: The figure shows the estimated coefficients and 95 % confidence intervals for event study regressions corresponding to Equation (1). Outcome variable: Yearly indicator for being prescribed psychiatric medication. Control variables: Individual and calendar and year fixed effects, and event time dummies indicating years before/after PhD start. Standard errors are clustered by individual. The green line shows results for women and the orange line shows results for men. As a never-treated control group, we include individuals with a Swedish master's degree but no PhD studies, weighted to resemble the sample of PhD studies in terms of birth year and field of master's studies. The effects are measured in percent relative to the average uptake of psychiatric medication the year before PhD start.

Fig. A4. Event study of the impact of PhD studies on prescribed psychiatric medication for PhD students and the highly educated control group separately



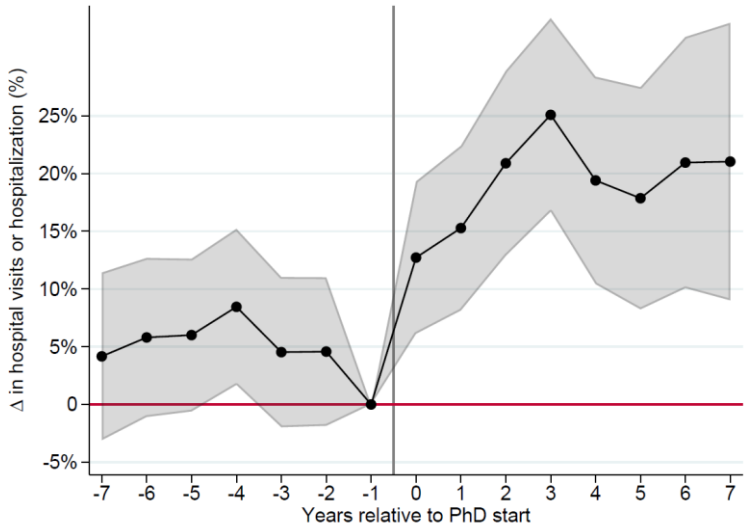
Footnote: The figure shows the estimated coefficients and 95 % confidence intervals for event study regressions corresponding to Equation (1). Outcome variable: Yearly indicator for being prescribed psychiatric medication. Control variables: Individual and calendar and year fixed effects, and event time dummies indicating years before/after PhD start. Standard errors are clustered by individual. The green line shows results for our sample of PhD students. The orange line shows results for individuals with a Swedish master degree but no PhD studies, weighted to resemble the PhD population in terms of gender, year of birth, and field of master studies. These individuals are assigned a ”placebo” PhD start year equal to the year after they graduated from their master’s studies. The effect is measured in percent relative to the average uptake of psychiatric medication the year before PhD start. In contrast to our main specification, these even study analyses do not include any never-treated control group.

Fig. A5. Event study of the impact of PhD studies on the prescription of psychiatric medication to all other medications



Footnote: The figure shows the estimated coefficients and 95 % confidence intervals for event study regressions corresponding to Equation (1). Outcome variable: Yearly indicator for being prescribed medication. Control variables: Individual and calendar and year fixed effects, and event time dummies indicating years before/after PhD start. Standard errors are clustered by individual. The green line shows results for psychiatric medications and the orange line shows results for all other medications (for more information, see Section 2a). As a never-treated control group, we include individuals with a Swedish master's degree but no PhD studies, weighted to resemble the sample of PhD studies in terms of birth year and field of master's studies. The effects are measured in percent relative to the average uptake of medication the year before PhD start.

Fig. A6. Event study of the impact of PhD studies on hospital visits and hospitalizations for mental health problems



Footnote: The figure shows the estimated coefficients and 95 % confidence intervals for event study regressions corresponding to Equation (1). Outcome variable: Yearly indicator for being diagnosed with a mental or behavioral condition during an inpatient or outpatient hospital visit (for more information, see Section 2a). Control variables: Individual and calendar and year fixed effects, and event time dummies indicating years before/after PhD start. Standard errors are clustered by individual. As a never-treated control group, we include individuals with a Swedish master's degree but no PhD studies, weighted to resemble the sample of PhD studies in terms of birth year and field of master's studies. The effects are measured in percent relative to the average uptake of medication the year before PhD start.