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THE EFFECTS OF BECOMING A PHYSICIAN ON PRESCRIPTION DRUG USE AND MENTAL HEALTH TREATMENT

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ABSTRACT

There is evidence that physicians disproportionately suffer from substance use disorder and mental health problems. It is not clear, however, whether these phenomena are causal. We use data on Dutch medical school applicants to examine the effects of becoming a physician on prescription drug use and the receipt of treatment from a mental health facility. Leveraging variation from lottery outcomes that determine admission into medical schools, we find that becoming a physician increases the use of antidepressants, opioids, anxiolytics, and sedatives, especially for female physicians. Among female applicants towards the bottom of the GPA distribution, becoming a physician increases the likelihood of receiving treatment from a mental health facility.

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1. Introduction

Physicians generally enjoy good physical health. They tend to live longer than non-physicians (Frank et al. 2000; Aasland et al. 2011; Brayne et al. 2021) and the typical physician exercises more, is less likely to smoke, and is less likely to be obese than his or her non-physician counterpart (Nelson et al. 1994; Frank et al. 1998; Abramson et al. 2000; John and Hanke 2003; Smith and Leggat 2007; Frank and Segura 2009; Leuven et al. 2013).

Although physically healthy, there is evidence that physicians disproportionately suffer from substance use disorder (SUD) and mental health problems. Ten to 15 percent of physicians will misuse alcohol or prescription drugs during their career (Baldisseri 2007; Vayr et al. 2019); more than 20 percent of physicians are depressed or exhibit the symptoms of depression (Mata et al. 2015; Rotenstein et al. 2018, eTable 24); and at least one third of physicians describe themselves as suffering from "job burnout" (Drummond 2015), a syndrome closely linked to SUD and depression (Bianchi et al. 2015; Wurm et al. 2016; Stageberg et al. 2020). Compounding these problems, physicians are often reluctant to avail themselves of psychiatric services, perhaps out of shame or confidentiality concerns (Rosvold and Bjertness 2002; Davidson and Schattner 2003; Ruitenburg et al. 2012; Tay et al. 2018).

Several causal explanations have been proposed for why physicians might be especially prone to SUD and mental health problems. Self-treatment is widespread among physicians (Töyry et al. 2000; Rosvold and Bjertness 2002; Hem et al. 2005; Montgomery et al. 2011; Gendel et al. 2012; Hartnett et al. 2020), and there is concern that this practice—combined with easy access to prescription drugs—can lead to abuse and dependency (Hughes et al. 1999; Bennet and O'Donovan 2001; Tyssen 2007; Moberly 2014; Khan et al. 2019; Geuijen et al. 2020). During their residency, physicians work long, irregular hours, which can lead to sleep deprivation (Baldwin and Daugherty 2004; Prins et al. 2007) and adversely affect their relationships with friends and family (Raj 2016).

Finally, physicians are increasingly burdened with administrative and bureaucratic tasks; the adoption of electronic health records and excessive workplace policies and procedures are both predictive of physician burnout (Bianchi et al. 2015; Ehrenfeld and Wanderer 2018; Scheepers et al. 2022).

Using variation from lottery outcomes that determine admission into Dutch medical schools, we estimate the causal effect of becoming a physician on prescription drug use. The number of students admitted to medical school is tightly regulated in the Netherlands: applicants outnumber available slots, and acceptance to one of eight medical schools is determined at random, based on the results of an annual admissions lottery. Following previous researchers (Leuven et al. 2013; Ketel et al. 2016; Artmann et al. 2021, 2022), we use the outcomes from these annual admissions lotteries as an instrumental variable (IV), allowing us to estimate the effects of becoming a physician on the use of antidepressants, opioids (e.g., Vicodin, OxyContin, and Percocet), anxiolytics (e.g., anti-anxiety benzodiazepines such as Ativan, Xanax, and Valium), and sedatives (e.g., pentobarbital and benzodiazepines such as Versed). In addition, we leverage the outcomes of admission lotteries to examine the effect of becoming a physician on the likelihood of receiving treatment from a mental health facility.[1]

IV estimates indicate that students induced into becoming physicians by winning the admissions lottery are more likely to use prescription antidepressants than those who lose the lottery and go into a different profession. This effect could reflect their (relatively poor) mental health, although IV estimates provide evidence of an across-the-board increase in the use of prescription drugs, which could reflect increased access. We view the increased use of anxiolytics, opioids, and sedatives as particularly worrisome because these drugs can be highly addictive and there is descriptive evidence that they are often abused by physicians in the Netherlands and other countries

[1] Leuven et al. (2013), Ketel et al. (2016), Artmann et al. (2021), and Artmann et al. (2022) used the Dutch admissions lottery data to study the effects of becoming a physician on physical health, earnings, partner choice, and parental health, respectively. In section 2.4, we provide a brief review of these papers.

(Merlo and Gold 2008; Oaklander 2015; Moberly 2014; Khan et al. 2019; Geuijen et al. 2023).[2] Although we cannot distinguish legitimate use from misuse in our data, it is clear that Dutch physicians are especially prone to using these drugs and that this phenomenon is entirely explained by their choice of profession.

Female physicians are described in the medical literature as being especially at risk for SUD and depression, possibly because of on-the-job sex-based harassment, the added pressures of motherhood, or an unsupportive work-home culture (Wallace et al. 2009; Pas et al. 2011; Guille et al. 2017; Paauw and Kneepkens 2018; Jenner et al. 2019; Stageberg et al. 2020).[3] Restricting the sample to female applicants, the IV estimates are generally large, positive, and measured with precision across all prescription drug categories. By contrast, when the sample is restricted to male applicants, the IV estimates for antidepressant and anxiolytic use are small and statistically insignificant at conventional levels. When the sample is restricted to female applicants towards the bottom of the GPA distribution, we find that becoming a physician increases the likelihood of receiving treatment from a mental healthcare facility.

2. BACKGROUND

The conventional explanations for why physicians are at risk of developing SUD and depression, described in the introduction, are causal in nature. It is, however, important to recognize that becoming a physician requires intelligence, ambition, and perseverance. While the

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[2] The possibility of physicians becoming addicted is the "main concern when self-prescribing is discussed" (Rosvold and Tyssen 2005, p. 1372). Although their increased use of anxiolytics, opioids, and sedatives could, in theory, reflect a greater capacity to recognize the early symptoms of anxiety and depression (presumably gained through formal medical training and on-the-job experience), it could also reflect an underappreciation of the risks involved with self-prescribing. See, for instance, Hughes et al. (2001) and Rosvold and Tyssen (2005) for more about the benefits and risks of self-prescribing.

[3] In 1999, there were almost twice as many registered male physicians as female physicians in the Netherlands. By 2018, this gender gap had closed. Male physicians were, however, much more likely than their female counterparts to practice in a specialized field of medicine (Statistics Netherlands 2020).

process of becoming a physician varies from country to country, it generally involves overcoming substantial hurdles. In most European countries and the United States, physicians must complete a rigorous 4- to 6-year medical degree before advancing to specialized postgraduate training. The specialization (or residency) period lasts 3-6 years in Europe and 3-7 years in the United States.[4]

Given that occupational choice is not random, could selection explain the relatively high rates of SUD and mental health issues among physicians? There is evidence that intellectually gifted youth are especially susceptible to becoming depressed later in life (Wraw et al. 2016; Karpinski et al. 2018).[5] "Perfectionists," individuals who set unrealistically high standards for themselves, are also at risk for mental health problems (Ashby et al. 2006; Lo and Abbott 2013; de Jonge-Heesen et al. 2020). Perhaps not surprisingly, perfectionism appears to be a common trait among medical students around the world (Enns et al. 2008; Aboalshamat et al. 2017; Seeliger and Harendza 2017; Bußenius and Harendza 2019; Leung et al. 2019; Thomas and Bigatti 2020). For instance, Seeliger and Harendza (2017) found that "maladaptive perfectionism," which is driven by a fear of failure, is a strong predictor of depression among German medical students; Enns et al. (2008) found that maladaptive perfectionism predicted the onset of depression and feelings of hopelessness among medical students in Canada.

From a policy perspective, it is crucial to distinguish between selection and the conventional causal explanations for why physicians are at risk of developing SUD and depression. If easy access to prescription drugs or burdensome administrative tasks are disposing physicians to SUD and

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[4] In the United States, physicians must complete a 4-year graduate program before specializing. In Europe, physicians typically complete a 6-year undergraduate program before specializing, but 4-year graduate programs are becoming more common (Martinho 2012, Landsberg 2021). The specialization period for family medicine is among the shortest in both the United States and Europe, usually taking 3 years to complete. By contrast, neurological surgery is among the longest, usually lasting 7 years in the United States and 6 years in Europe (Murphy 2020; "Medical Specialisation – Medical Residency in Europe" n.d.).

[5] White and Batty (2011) and White et al. (2012) document a positive association between childhood IQ and the likelihood of adult illicit drug use.

creating undue psychological stress, then there are concrete steps that can be taken to shield them. For instance, physicians in Sweden are strongly discouraged from self-prescribing and can even lose their license if they engage in the practice (Moberly 2014); hospital-level policies intended to curb work-related stress include work-hour caps for residents, offloading non-essential tasks to assistants, and increasing appointment times for primary care visits (Ruitenburg et al. 2012; Hirsch 2017; Patel et al. 2019; Scheepers et al. 2020); and supplemental training to improve the quality of physician-patient interactions may reduce burnout and improve mental health (Hardavella et al. 2017).[6]

2.1. Substance use among physicians

Physicians whose substance use causes impairment pose a risk not only to themselves but also to their patients. Qualitative interviews among physicians receiving treatment from an addiction center have identified effects on clinical care (e.g., botched procedures and prescription errors), direct consequences from psychoactive effects of the drug (e.g., physical effects, psychotic symptoms, and sedation), and impaired punctuality (Shadakshari et al. 2021). Other common issues associated with physician substance misuse include conflicts with co-workers, social isolation, mood swings, and patient complaints (Dumitrascu et al. 2014). More generally, physician wellness is an important predictor of adherence to treatment among patients (Wallace et al. 2009).

Reliable, up-to-date data on SUD rates among physicians are scarce, but one survey found that "hazardous drug use" among European physicians is approximately 3 percent (Geuijen et al. 2022). In a recent survey of Dutch physicians, Geuijen et al. (2023) found that 16.5 percent were clinically diagnosed as being dependent on sedatives, hypnotics, or anxiolytics, which was nearly 10

[6] Schaufeli et al. (2011, p. 249) found that Dutch physicians who reported having stressful, "emotionally charged" interactions with their patients were more likely to suffer from burnout. In the United States, physicians are frequently exposed to frivolous malpractice claims, heightening feelings of anxiety, dread, and panic (Charles 2001). There is evidence that the adoption of malpractice reforms, known as communication-and-resolution programs (CRPs), have improved liability outcomes for physicians (LeCraw et al. 2018

percentage points higher than the rate of dependence among a highly educated reference group. In a survey of members of the American Medical Association (AMA), Hughes et al. (1992) found that 11 percent reported misusing prescription benzodiazepines in the past year, and 18 percent reported past-year opioid misuse. By comparison, past-year misuse of benzodiazepines is two percent among the general U.S. adult population (Maust et al. 2019) and 5 percent of the general population report opioid abuse (Han et al. 2017). Using data from a 2011 web-based survey of AMA members, Oreskovich et al. (2015) found that 15 percent of U.S. physicians exhibited the symptoms of alcohol abuse or dependence but only 1.3 percent of respondents reported ever having abused opioids.[7]

2.2. Mental health and burnout among physicians

Less than 5 percent of the general population suffers from major depression, characterized by feelings of hopelessness, loss of energy, and disturbed sleep or appetite (Baxter et al. 2014; Otte et al. 2016). Among medical students and physicians, the prevalence of major depression appears to be much higher.[8] According to recent meta-analyses, 27 to 29 percent of medical students and physicians exhibit depressive symptomology (Mata et al. 2015; Puthran et al. 2016; Rotenstein et al. 2016; Rotenstein et al. 2018), and there is evidence that female medical students and physicians are at elevated risk for depression and psychiatric distress.

[7] Of the 27,276 physicians who received an invitation, 27 percent completed the web-based survey (Oreskovich et al. 2015, p. 30). See also Pförringer et al. (2018) who conducted a web-based survey of German physicians. Nearly 25 percent of German physicians had problematic alcohol intake, but very few German physicians admitted to regularly taking benzodiazepines, opioids, or amphetamines. Underreporting could explain the low rates of drug abuse found by Oreskovich et al. (2015) and Pförringer et al. (2018). Physicians suffering from SUD may be reluctant to admit to having a problem and fear losing their license (Vayr et al. 2019). Finally, there is evidence that SUD is increasingly prevalent among residents in anesthesiology (Bryson 2018).

[8] Among medical students, predictors of poor mental and emotional health include adjusting to a demanding medical school environment, ethical conflicts, exposure to death and human suffering, and abuse from faculty (Dyrbye et al. 2005). See Siegrist (1996) for a related discussion on the adverse health effects of working in a high-effort/low-reward environment.

"Job burnout" is a common syndrome characterized by emotional exhaustion and feelings of diminished personal accomplishment (Cordes and Dougherty 1993). Among physicians, burnout, depression, and SUD are closely linked (Wurm et al. 2016; Rotenstein et al. 2018; Stageberg et al. 2020), although it is difficult to assess the overall prevalence of burnout among physicians due to fundamental cross-study differences in how it is measured (Rotenstein et al. 2018; Verougstraete and Idrissi 2019).[9] As noted above, the adoption of electronic health records and onerous bureaucratic responsibilities are associated with an increased risk of burnout among physicians (Bianchi et al. 2015; Ehrenfeld and Wanderer 2018; Scheepers et al. 2022). Early-career and primary care physicians may be especially vulnerable to burnout (del Carmen et al. 2019).[10]

2.3. Mental health and burnout among Dutch physicians

A handful of studies have examined depression and burnout among Dutch medical students and physicians. For instance, Ruitenburg et al. (2012) surveyed residents and physicians working at an "academic medical center" in the Netherlands. Twenty-nine percent of the 458 respondents exhibited the symptoms of depression, which is comparable to rates of depression among physicians working in other countries and settings (Mata et al. 2015; Puthran et al. 2016; Rotenstein et al. 2018).[11] Using data from the Dutch-U.S. Physician Burnout Study, Linzer et al. (2001, p. 173) found that "the basic predictors of burnout are concordant across these two industrialized nations." Prins

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[9] In general, depression and burnout are so closely linked that, according to Bianchi et al. (2015, p. 28), it is "notably unclear how the state of burnout (i.e., the end stage of the burnout process) is conceived to differ from clinical depression."

[10] There is no credible evidence that burnout is related to physician gender or other personal characteristics such as race and/or ethnicity (Rotenstein et al. 2018; del Carmen et al. 2019; Verougstraete and Idrissi 2019).

[11] Forty-two percent of respondents reported work-related fatigue, but only 6 percent suffered from burnout (Ruitenburg et al. 2012).

et al. (2010), who conducted a nation-wide survey of Dutch medical residents, found that 21 percent met the criteria for burnout, while 30 percent reported emotional exhaustion.[12]

Panel A of Figure 1 shows rates of burnout by profession in the Netherlands. It is based on the 2019 National Survey on Labor Conditions (NSLC), which is conducted jointly on an annual basis by Statistics Netherlands, the Dutch Organisation for Applied Scientific Research, and the Ministry of Social Affairs. Burnout is assessed using five items. Specifically, survey respondents are asked whether they agree with the following statements:

1.) I feel emotionally exhausted by my work.
2.) I feel empty at the end of the working day.
3.) I feel tired when I get up in the morning and am confronted with my work.
4.) It is demanding for me to work with other people the whole day long.
5.) I feel completely exhausted from my work.

Agreement is expressed on a scale from 1 ("Never") to 7 ("Every day"). The NSLC reports the share of respondents by occupation who answer 4 ("A few times per month") or higher on each item, which we average across the five items.

Twenty-three percent of Dutch physicians meet our criterion for burnout (i.e., their average response across the five items is 4 or greater). By comparison, 16 percent of managers, 18 percent of science and engineering professionals, and 19 percent of public servants meet the burnout criterion. Only teachers, social workers, and machine operators exhibit higher rates of burnout than physicians. Dutch physicians also appear to be under more work and emotional pressure than members of other occupations (Panels B and C of Figure 1).[13]

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[12] Residents who met the criteria for burnout reported making more on-the-job mistakes than those who did not (Prins et al. 2009). Fifty-six percent of residents reported having made a mistake "with a negative consequence" (Prins et al. 2009). See also Linzer et al. (2001), Visser et al. (2003), Prins et al. (2007) and Geuijen et al. (2020). According to Geuijen et al. (2020), one-third of Dutch physicians report interacting with a colleague whom they presumed was using substances at work.

[13] The NSLC assessed work pressure using three questionnaire items. Respondents were asked whether they have to work quickly, whether they have to work a lot, and whether they have to work overtime at their main job. The NSLC

2.4. Becoming a physician in the Netherlands

In the Netherlands, the Minister of Education sets an annual cap on the number of high school graduates allowed to study medicine, dentistry, and veterinary medicine at university. During the period 1973-1993, this annual cap was set at 1,458. Although it was gradually increased to 2,010 during the period 1994-1999, demand far exceeded supply: every year, more than 5,000 high school students competed for the available slots, which were allocated based on the results of a nation-wide lottery. Applicants are divided into 6 weighted lottery categories (A, B, C, D, E, and F) based on their high school ("voortgezet wetenschappenlijk onderwijs") GPA, which determines their probability of "winning" (i.e., being admitted to medical school), and are permitted to rank their three most preferred medical schools (Ketel et al. 2016).[14] While their preferences do not influence the lottery outcome, they are taken into consideration when allocating lottery winners to the eight medical schools in the Netherlands. According to Ketel et al. (2016), just over 80 percent of students are placed at their top choice.

reports the share of respondents who answer 3 or higher on a scale of 1 ("Never") to 4 ("Always"), which we average across the three items. Panel B of Figure 1 shows the percentage of respondents who meet our work pressure criterion (i.e., their average response across the three items is 3 or greater) by occupation. Panel C of Figure 1 is constructed in a similar manner. Respondents were asked whether they face emotionally difficult situations at work, whether their work is emotionally demanding, and whether they get emotionally involved in their work.

[14] Students applying to medical school are also required to have passed high school courses in biology, chemistry, math, and physics. High school GPA ranges from 1 to 10 and is based on school and national exams. Strict guidelines ensure that grading differences across schools are minimized. Applicants with the best GPAs are assigned a weight of 2.00 and placed in the A category. Passing requires scoring at 5.5 or higher. The lottery category weights are as follows:

Category	GPA	Weight
A	$GPA \geq 8.5$	2.00
B	$8.0 \leq GPA < 8.5$	1.50
C	$7.5 \leq GPA < 8.0$	1.25
D	$7.0 \leq GPA < 7.5$	1.00
E	$6.5 \leq GPA < 7.0$	0.80
F	$GPA < 6.5$	0.67

Dutch medical school students typically finish their medical degree in 6 years.[15] Students first complete a three-year bachelor's degree, followed by an equally long master's program. During the master's program, students receive hands-on training through a series of internships at general practices and hospitals. At the end of their 6th year, they take a final medical examination ("artsexamen"). Those who pass receive their medical degree and are officially registered as a doctor. Newly minted doctors generally go on to receive specialized postgraduate training and work under the supervision of senior physicians at a teaching hospital or university medical center.[16]

Four previous studies have leveraged Dutch medical school lottery outcomes to identify causal effects among applicants (Leuven et al. 2013; Ketel et al. 2016; Artmann et al. 2021, 2022). Leuven et al. (2013), estimated the effect of attending medical school on a range of physical health outcomes. These authors found that attending medical school reduces the likelihood of being underweight and has a small, negative effect on the frequency of physical exercise.[17] Ketel et al. (2016) found that Dutch physicians earned at least 20-50 percent more than applicants who lost the lottery and chose a different occupation. The labor market returns to becoming a physician increased with experience and only a small portion of these returns could be attributed to differences in working hours or human capital investments.[18] Artmann et al. (2021) found that becoming a physician increases the likelihood of marrying another physician, while Artmann et al.

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[15] There are only small differences in the quality of instruction and content of courses across these eight schools (Ten Cate 2007; Ketel et al. 2016).

[16] Students can choose between 33 medical specialties. The specialization track for a general practitioner is the shortest, taking three additional years. The most advanced specializations (e.g., neurology or cardiology) require an additional four to six years of training. Only 0.3 percent of students choose to not receive specialized training (Vergouw 2015).

[17] There was also evidence of reductions in self-reported alcohol consumption, but going to medical school had little effect on cigarette smoking (Leuven et al. 2013).

[18] Using administrative data from Norway and an IV strategy that exploits admission cutoffs into different fields of study, Kirkeboen et al. (2016) estimate the labor market payoffs to completing one type of postsecondary education relative to a next-best alternative.

(2022) estimated the effect of becoming a physician on parental health. The results of Artmann et al. (2022) suggest that having informal access to the services of a physician does not lead to substantial differences in health or healthcare utilization.[19]

3. Data and Empirical Strategy

3.1. Medical school lottery data

Register data on medical school lottery outcomes were obtained from the Dienst Uitvoering Onderwijs (DUO), which is a Dutch governmental organization under the Ministry of Education.[20] We observe the outcomes of all medical school lotteries conducted between 1987 and 1999. After 1999, the national lottery was replaced with a decentralized selection system that gave medical schools more control over the admissions process (Ketel et al. 2016).

Appendix Table 1 reports the share of medical school applications and admission probabilities by lottery category during the period 1987-1999.[21] Of the 42,445 applications, over 80 percent were assigned to lottery categories F (GPA < 6.5), E (6.5 ≤ GPA < 7.0) and D (7.0 ≤ GPA < 7.5). Ten percent were assigned to category C (7.5 ≤ GPA < 8.0), 6 percent to category B (8.0 ≤ GPA < 8.5), and only 2 percent to category A (GPA ≥ 8.5).[22] On average, 72 percent of applicants

[19] Artmann et al. (2022) considered a range of health outcomes such as mortality, hospitalizations, any medication use, visits to specialists, and total healthcare costs. Leveraging Swedish medical school lottery outcomes, Chen et al. (2021) found that having a doctor in the family decreases the likelihood of "lifestyle-related" diseases (e.g., cardiac events) and promotes preventative care. Chen et al. (2021) speculated that their findings diverge from those reported by Artmann et al. (2022) because of differences between the Dutch and Swedish medical school admission systems.

[20] The admission lotteries from DUO were made available by Ketel et al. (2016) within the microdata environment of Statistics Netherlands.

[21] Note this table refers to "applications" and not "applicants," because rejected students who reapply contribute multiple observations to the sample.

[22] For 7 of the 13 years in our data, all applicants assigned to category A were admitted to medical school. The very few applicants from this category who lost their first lottery generally gained acceptance upon reapplying. After 1999, all students with a GPA of 8.0 or higher (i.e., students in categories A and B) were automatically admitted to medical school.

were eventually admitted (either when they first applied or in a subsequent application round). Seventy-one percent of applicants who lost their first lottery reapplied at least once.

During this period, 33,229 students participated in the medical school lottery for the *first time*. Our focus is on 27,464 of these first-time applicants. Those who completed their high school exams in 1986 or earlier are excluded from the analysis to ensure that we have complete lottery histories (N = 1,468). Likewise, students for whom we could not determine the year in which they took their high school exam are dropped from the sample (N = 1,014). Applicants belonging to lottery category A (N = 692) are excluded because they were all but guaranteed eventual admittance, and applicants from the lottery category "other" (N = 2,377) are excluded because they were admitted without having to take the Dutch high school exam (e.g., foreign students). Finally, we dropped 64 students with missing social security numbers, 142 students from the former colony of the Dutch Antilles (who were assigned a slot in medical school through a separate process), and 8 students who died. Conditional on lottery category and lottery year, the excluded students were evenly distributed between lottery winners and lottery losers (p=0.486).[23]

3.2. Outcomes

Information on prescription drug use for the period 2006-2018 comes from the Dutch prescription reimbursement database, provided by Statistics Netherlands.[24] These data contain information on all persons who received a prescription drug the costs of which were reimbursed

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[23] We closely followed Ketel et al. (2016) in the construction of our sample.

[24] Approximately 91 percent of lottery winners from 1999 (i.e., the last year before the lottery was replaced with a decentralized selection system) were registered as doctors by 2006. The results presented below are similar if we exclude the most recent cohorts of graduating physicians from the analysis. Likewise, we obtained qualitatively similar results to those reported below when we focused on the 5 most recent years of data, 2014-2018.

under the statutory basic medical insurance.[25] Based on the information available in the prescription drug reimbursement database, we construct the following 5 outcomes:

- *Total Prescriptions*, equal to the total number of drug prescriptions for individual *i* during the period 2006-2018.

- *AD Use*, equal to 1 if individual *i* was prescribed antidepressants during the period 2006-2018, and equal to 0 otherwise.[26]

- *Anxiolytic Use*, equal to 1 if individual *i* was prescribed an anxiolytic (i.e., an anti-anxiety drug) during the period 2006-2018, and equal to 0 otherwise.

- *Opioid Use*, equal to 1 if individual *i* was prescribed an opioid during the period 2006-2018, and equal to 0 otherwise.[27]

- *Sedative Use*, equal to 1 if individual *i* was prescribed a sedative during the period 2006-2018, and equal to 0 otherwise.[28]

Table 1 presents outcome means separately for the physicians and non-physicians in our sample of medical school applicants. While physicians are no more likely to have used antidepressants than their non-physician counterparts, they used anxiolytics, opioids, and sedatives at higher rates, all of which come with the risk of abuse and addiction (Oaklander 2015; Butler et al.

[25] The database includes anyone appearing in the municipal population register at any point during a specified year. Exceptions include individuals in nursing homes and persons who received a prescription drug while hospitalized. Using hospitalization information from the database of Medical Specialized Care for the period 2013-2017 and the empirical strategy outlined below, we found no evidence to suggest that physicians are, in general, more (or less) likely to be hospitalized than their non-physician counterparts. These estimates have been omitted for the sake of brevity and are available from the authors upon request.

[26] Antidepressants are defined as drugs falling under the Anatomical Therapeutic Chemical (ATC) codes of N06A (antidepressant drugs) and N06B (psychostimulants). Examples include selective serotonin reuptake inhibitors (e.g., sertraline, brand name Zoloft) and non-selective monoamine reuptake inhibitors (e.g., desipramine, brand name Norpramin). The patterns of results presented below were similar if we excluded psychostimulants from our definition of antidepressants.

[27] Other studies in the economics literature that have examined the determinants of opioid and benzodiazepine prescribing include Baker et al. (2020) and Sacks et al. (2021). Baker et al. (2020) found that being enrolled in Medicare Advantage (as compared to being enrolled in a stand-alone drug plan) reduced the likelihood of receiving an opioid prescription. Sacks et al. (2021) found that must-access prescription drug monitoring programs (MA-PDMPs) reduced prescription opioids dispensed to new users.

[28] The "anxiolytic" category includes a number of benzodiazepines (aka "benzos"), buspirone, and hydroxyzine. The "sedative" category, which also includes hypnotics, consists of pentobarbital (a barbiturate) and a range of benzodiazepines and benzodiazepine-related drugs used to treat insomnia.

2016; American Addiction Centers 2021). The gap in sedative use is particularly striking. Physicians were more than twice as likely to have used sedatives such as the highly addictive Versed.

Data on receipt of treatment for a mental health issue, which are available for the period 2012-2016, come from a national register database on mental health facilities, provided by Statistics Netherlands. These data cover all treatments for severe or complex mental health problems the costs of which were reimbursed by the statutory basic medical insurance. The majority of patients at these facilities are treated by specialized providers (e.g., psychiatrists and psychotherapists) for mood and anxiety disorders. We define the variable *Mental Health Treatment* as equal to 1 if individual *i* received treatment for a mental health issue during the period 2012-2016 (and equal to 0 otherwise). Applicants who did not become physicians are 3.1 percentage points (34 percent) more likely than physicians to have received treatment from a mental health facility (Table 1).

3.3. Empirical strategy

Following previous studies described above (Leuven et al. 2013; Ketel et al. 2016; Artmann et al. 2021, 2022), our empirical strategy leverages the fact that medical school admissions in the Netherlands are determined by a lottery. Let the outcome of individual i, y_i, be a linear function of whether he or she becomes a physician, a vector of controls ($\boldsymbol{X}_i$), and an error term (ε_i):

$$y_i = \beta_0 + \beta_1 Physician_i + \boldsymbol{X}_i\boldsymbol{\beta}_2 + \varepsilon_i. \quad (1)$$

Our variable of interest, $Physician_i$, is equal to 1 if i went to medical school in the Netherlands and became a registered doctor (and is equal to 0 otherwise).[29] The vector $\boldsymbol{X}_i$ includes age at first lottery,

[29] Following Ketel et al. (2016), the indicator *Physician* is equal to 0 for licensed physicians in the Netherlands who were educated abroad. However, our results change little if we instead set *Physician* equal to 1 for these individuals or exclude

age squared, gender, ethnicity, *i's* lottery category, the year in which he or she first participated in the admissions lottery, and interactions between lottery category and year of first lottery.

The effect of becoming a physician on y_i is β_1, but OLS estimates of this parameter are potentially biased. The direction of the bias is difficult to predict and depends on unobserved applicant characteristics that are likely associated with reapplying to (and eventually graduating from) medical school such as ability, personality, motivation, temperament, and background. To obtain an unbiased estimate of β_1, we compare the outcomes of applicants who won the lottery to the outcomes of those who lost.

If winning the lottery is random and only affects y_i through becoming a physician, the treatment effect for applicants induced into the profession by winning the lottery can be estimated using two-stage least squares (2SLS).[30] The first-stage equation takes the following form:

$$(2) \qquad Physician_i = a_0 + a_1 Lottery\ Win_i + \boldsymbol{X}_i\boldsymbol{\alpha}_2 + u_i,$$

where *Lottery Win*$_i$ is the outcome of *i*'s first lottery. It is equal to 1 if *i* won his or her first lottery, and is equal to 0 if *i* lost. Note that winning the lottery does not perfectly predict becoming a physician for the following reasons:

> 1.) If a student lost the lottery the first time he or she applied, they could reenter the following year. During the period 1987-1998, there was no limit on how many times students could reenter the lottery. After 1998, students could take the lottery up to two additional times if they failed to win the first time. Forty-four percent of students who lost their first lottery eventually enrolled in medical school. Because the choice to reapply to medical school is likely endogenous, we base *Lottery Win*$_i$ on the outcome of *i*'s first lottery (Ketel et al. 2016).

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them from the analysis entirely. Licensed physicians in the Netherlands who were educated abroad make up only 1.9 percent of our sample.

[30] Specifically, we estimate the local average treatment effect (LATE) of becoming a physician for compliers (i.e., individuals who become a physician because they won the lottery).

2.) Not all lottery winners enrolled in medical school. Every year, between 4 and 8 percent of lottery winners opted to pursue a different major (on average, 6.4 percent across all years in our data).

3.) Not all enrollees graduated from medical school and not all medical school graduates became licensed physicians in the Netherlands. On average, 15 percent of Dutch medical enrollees in our data were not practicing medicine during the period 2006-2018, when our outcomes are measured.[31]

Appendix Table 2 shows balancing tests by lottery category for first-lottery winners and losers. These results, which are similar to those reported in Ketel et al. (2016, Table 2), support the independence assumption necessary for valid instrumental variable estimates.[32] Among lottery losers who pursued other careers, 26 percent worked in health care, 14 percent worked in business services (e.g., legal firms and pharmaceutical companies), 12 percent in education, 10 percent in public administration, 9 percent in wholesale and retail trade, and 7 percent in financial services.[33]

4. RESULTS

4.1. Drug prescriptions

Estimates of the effect of becoming a physician on drug prescriptions for the full-sample (i.e., the sample composed of both male and female lottery participants) are reported in the first column of Table 2.[34] The OLS estimate (Panel A), which does not account for selection, is

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[31] While we do not observe the percentage of graduates who did not become licensed, we expect this phenomenon to be extremely rare.

[32] With only one exception (age at first lottery among applicants in category F), the observable characteristics of lottery winners versus losers are statistically indistinguishable at conventional levels. In Appendix Table 3, we report physician characteristics for the full sample and provide variable definitions.

[33] These statistics are from the Dutch "Polisbus" data (2018), which registers occupational and income data for all employees in the Netherlands.

[34] Robust standard errors are reported in Table 2 and in subsequent tables. Our basic inferences are unchanged when based on permutation tests and Monte Carlo simulation. In Appendix Table 4, we report first-stage results for the full sample and by gender. The estimates of a_1 are consistently positive, large, and measured with precision. With *F*-statistics well over 2,000, we clearly meet the Staiger and Stock (1997) criterion.

statistically significant and positive: on average, applicants who became physicians had 4.25 more drug prescriptions during the period 2006-2018 than those who did not, or 22 percent of the sample mean.[35] The 2SLS estimate (Panel B) of the effect of becoming a physician on drug prescriptions is not qualitatively different from the naïve OLS estimate.[36]

We examine the effect of becoming a physician on prescription drug use by gender in columns (2) and (3) of Table 2. Restricting the sample to female applicants and accounting for selection through instrumenting, becoming a physician is associated with 4.67 additional drug prescriptions, which is 20 percent of the gender-specific mean. Among male applicants, becoming a physician is associated with 2.66 additional drug prescriptions, which is 19 percent of the gender-specific mean.

2SLS estimates of the effects of becoming a physician on the use of antidepressants are reported in Table 3. In the full sample, becoming a physician is associated with a 0.029 increase in the probability of having been prescribed an antidepressant at least once during the period 2006-2018 (or a 23 percent increase relative to the mean). Among female applicants, becoming a physician is associated with a 0.042 increase in the probability of having been prescribed an antidepressant. Although also positive, the corresponding 2SLS estimate for male applicants is much smaller and is nowhere near statistically significant.

In Figure 2, we explore the evolution of antidepressant use among physicians over the course of their careers. Specifically, we report 2SLS estimates of the effect of becoming a physician

[35] Specifically, the OLS estimate reported in Panel A of Table 2 does not account for selective reapplying to medical school, nor does it account for selective enrollment in (and completion of) medical school.

[36] We also experimented with using an indicator for having been prescribed more drugs than the average resident of the Netherlands in *i*'s age group. We found that becoming a physician is associated with a 20 percent increase in the likelihood of having more drug prescriptions than average. These results were similar if we used the 75th percentile as opposed to the average.

on the probability of having been prescribed an antidepressant by years since first lottery.[37] The plot of these 2SLS estimates is essentially flat, suggesting antidepressant use among physicians (as compared to non-physicians) does not depend upon how many years they have been practicing. This same basic pattern of results is obtained when the sample of medical school applicants is split by gender (Appendix Figure 1).

Previous studies have found that lower-performing medical students are at elevated risk for burnout, stress, depression, and anxiety (Stewart et al. 1997; Shadid et al. 2020). In columns (4)-(7) of Table 3, we split our sample by gender and ability. High-ability applicants are defined as those in lottery categories B, C, and D, while low-ability applicants are defined as those in categories E and F. For both female and male applicants, there is little evidence that the estimated effect of becoming a physician on antidepressant use differs across the ability threshold.[38]

In Table 4, we report 2SLS estimates for prescription anxiolytics, opioids, and sedatives. Anxiolytics and sedatives include a range of benzodiazepines (e.g., Xanax, Valium, and Versed), which are popular drugs among physicians seeking self-treatment (Moberly 2014; Khan et al. 2019). Like opioids, benzodiazepines are highly addictive and often misused (O'Brien 2005; Votawa et al. 2019; American Addiction Centers 2021); being prescribed a benzodiazepine or opioid is a strong

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[37] The outcome, y_{it}, is equal to 1 if i was prescribed an antidepressant in year t, where t indexes years since having participated in their first lottery (and is equal to 0 otherwise). As noted above, we observe antidepressant use during the period 2006-2018. In 2006, applicants belonging to the final cohort of our sample (i.e., the 1999 cohort) were 7 years removed from having participated in their first lottery. In 2018, applicants belonging to the first cohort in our sample (i.e., the 1987 cohort) were 31 years removed from having participated in their first lottery.

[38] OLS estimates of the effect of becoming a physician on the use of antidepressants are available from the authors upon request. Examining the effect of becoming a physician on the probability of using antidepressants in at least two (as opposed to one) of the 13 years under study produces similar results to those reported in Table 3. See Appendix Table 5 for these results.

predictor of subsequent dependency and misuse (Sullivan et al. 2012; Edlund et al. 2014; Butler et al. 2016; Barnett et al. 2017; Votawa et al. 2019).[39]

In the full sample, there is strong evidence that becoming a physician increases the use of anxiolytics, opioids, and sedatives. Specifically, becoming a physician is associated with a 0.021 increase in the probability of having been prescribed an anxiolytic. This estimate is 20 percent of the sample mean and is, in fact, more than large enough to explain the unadjusted gap between physicians and non-physicians in our sample of applicants (Table 1). Becoming a physician is also associated with a 0.044 increase in the probability of having been prescribed an opioid (which is 25 percent of the sample mean), and a 0.070 increase in the probability of having been prescribed a sedative (which is 61 percent of the sample mean). Again, these 2SLS estimates can explain the entire unadjusted gaps between physicians and non-physicians.[40]

Among female applicants, becoming a physician is associated with a 0.031 increase in the probability of having been prescribed an anxiolytic (or 27 percent of the mean), a 0.043 increase in the probability of having been prescribed an opioid (or 24 percent of the mean), and a 0.093 increase

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[39] Barnett et al. (2017) leveraged the quasi-random assignment of Medicare beneficiaries to physicians during emergency department visits. They found that being assigned to a physician with a history of high-intensity opioid prescribing led to long-term opioid use.

[40] OLS estimates of the effect of becoming a physician on the use of anxiolytics, opioids, and sedatives are available from the authors upon request. In Appendix Table 6, we explore the effects of becoming a physician on alternative measures of anxiolytic, opioid, and sedative use based on two-year thresholds (e.g., having been prescribed an anxiolytic in at least two years during the period 2006-2018). The two-year thresholds roughly correspond to average use among applicants (conditional on having been prescribed the drug in question). The 2SLS estimates are positive and statistically significant for opioids and sedatives. Alternative thresholds (e.g., at least 4 years of use during the period 2006-2018) produced qualitatively similar results. We view these estimates as noteworthy given that long-term use of opioids is an indicator of abuse and addiction (Baldini et al. 2012; Johnson and Streltzer 2013; Mayo Clinic Staff 2022). In Appendix Table 7, we interact *Physician* with the indicator *Specialist*, equal to 1 if individual *i* was a medical or surgical specialist as defined by the European World Health Organization (2022a, 2022b). The coefficient estimates for the interaction term are generally negative and often statistically significant, implying that specialists were less likely than their non-specialist counterparts to use prescription drugs. These results are consistent with reports that primary care physicians are at a heightened risk for burnout (Finnegan 2019), but could also reflect selection into specialty. In results omitted for the sake of brevity, we estimated the effects of becoming a physician by specialty and years since first lottery. The patterns of results were similar to those shown above regardless of the outcome of interest. That is, prescription drug use does not appear to have evolved differently with experience for certain types of doctors as opposed to others.

in the probability of being prescribed a sedative (or 72 percent of the mean). Restricting the sample to male applicants produces positive, but much smaller, 2SLS estimates for anxiolytics and sedatives.

In Figure 3, we explore the evolution of anxiolytic, opioid, and sedative use among physicians over the course of their careers. The 2SLS estimates for anxiolytic and sedative use are largest during the specialization phase (i.e., 7-10 years removed from their first lottery), when Dutch physicians are working almost 20 percent more hours than their non-physician counterparts (Ketel et al. 2016) and are especially prone to burnout (Prins et al. 2010). These results are consistent with the hypothesis that physicians are turning to anxiolytics and sedatives in response to working long, irregular hours during their residencies. By contrast, the estimates for opioid use are no higher during the specialization phase than later in physicians' careers (Panel B, Figure 3).[41]

4.2. Receipt of treatment from a mental healthcare facility

Using information from the treatment database of all mental healthcare facilities in the Netherlands, we explore the effects of becoming a physician on receiving treatment from a mental healthcare facility. The estimates in columns (1)-(3) of Table 5 provide no evidence of a statistically significant relationship between becoming a physician and treatment for a mental health issue in the full sample. Likewise, when we split the full sample by gender, there is little evidence of a relationship between becoming a physician and treatment for a mental health issue.

However, estimates reported in columns (4)-(7) of Table 5 provide evidence of heterogeneous effects by ability. Specifically, among low-ability female applicants, the 2SLS estimate is positive and statistically significant: becoming a physician is associated with a 0.037 increase (31

[41] In Appendix Figures 2, 3, and 4, we examine anxiolytic, opioid, and sedative use by gender and years since first lottery. The 2SLS estimates by years since first lottery are roughly similar for female as compared to male physicians. In columns (4)-(7) of Table 4, we document that the estimated effects of becoming a physician on having used anxiolytics, opioids, and sedatives are qualitatively similar across the ability threshold.

percent of the mean) in the probability of having received treatment from a mental health facility. Among high-ability male applicants becoming a physician is associated with a 0.045 reduction (52 percent of the mean) in the probability of having received treatment from a mental health facility.[42]

5. CONCLUSION

While the high risk of suicide, abuse of substances, and general "silent suffering" among physicians has been well documented (Feist 2021; Kaliszewski 2021), we do not know whether becoming a physician has a causal effect on substance use and mental health. This study uses data on Dutch medical school applicants to explore the effects of becoming a physician on prescription drug use and receipt of treatment from a mental health facility. One of the advantages of focusing on the Netherlands is that admission to medical school was determined by a lottery, allowing us to isolate exogenous variation in occupation uncorrelated with intelligence or personality. Previous studies provide evidence that medical school students and physicians are "perfectionists," who often set unrealistically high standards for themselves and are prone to becoming depressed (Ashby et al. 2006; Lo and Abbott 2013; Leung et al. 2019), which may explain their relatively high rates of SUD and even suicide (Schernhammer and Colditz 2004; Liem et al. 2015; Duarte et al. 2020).

We find that medical school applicants induced into becoming physicians by winning the admissions lottery were more likely to use prescription drugs than those who lost the lottery and

[42] At the start of this research project, one of our goals was to estimate the effect of becoming a physician on the likelihood of suicide. However, because there were only 42 completed suicides among lottery participants during the period 1995-2022, we decided to focus on prescription drug use and receipt of treatment from a mental health facility. In a supplementary analysis, we examined the effect of becoming a physician on hospitalizations due to a possible suicide attempt using information from the database of Medical Specialized Care (MSZ), made available by Statistics Netherlands, for the period 2013-2017. These data record all diagnoses and treatments made by medical specialists, which we used to create the outcome *Possible Suicide Attempt*. According to Hoeymans and Schoemaker (2010), the 5 most common suicide-related injuries in the Netherlands are: intoxication, head trauma, trauma to internal organs, damage by an alien object, and laceration of the wrist. Based on this information, we defined *Possible Suicide Attempt* as equal to 1 if individual *i* was hospitalized during the period 2013-2017 due to one of the injuries listed above (and equal to 0 otherwise). The results of this exercise are reported in Appendix Table 8 and provide evidence that, among female applicants, becoming a physician increases the likelihood of being hospitalized for a possible suicide attempt.

went into a different profession. Specifically, IV estimates, which correct for selection, show that applicants who became physicians were more likely to use antidepressants, anxiolytics, opioids, and sedatives than those who did not. Anxiolytics (i.e., anti-anxiety medications) and sedatives include a range of popular benzodiazepines such as Xanax, Valium, and Versed.

It is important to note that, given our data and research design, we cannot precisely pin down *why* becoming a physician increased the use of prescription drugs. Potential mechanisms include stressful working conditions, heavy workloads, and excessive administrative and bureaucratic responsibilities. It is also possible that our IV estimates reflect increased access to prescription drugs or even income effects.[43] Although we cannot distinguish between these potential mechanisms, our estimated effects on the use of anxiolytics, opioids, and sedatives are particularly worrisome for at least three reasons. First, prescription benzodiazepines and opioids are highly addictive (National Institute on Drug Abuse 2021). Second, perhaps because they are so addictive, being prescribed an opioid or benzodiazepine is a strong predictor of subsequent dependency and misuse (Sullivan et al. 2012; Edlund et al. 2014; Butler et al. 2016; Votawa et al. 2019). Third, our estimated effects tend to be quite large. For instance, becoming a physician is associated with a 20 percent increase in the likelihood of having been prescribed an anxiolytic, a 25 percent increase in the likelihood of having been prescribed an opioid, and a 61 increase in the likelihood have having been prescribed a sedative.

The medical literature describes female physicians as being at risk for substance use disorder and depression (Oreskovich et al. 2015; Guille et al. 2017). Estimates from meta-analyses show that female physicians commit suicide at much higher rates than male physicians (Schernhammer and

[43] As noted above, Ketel et al. (2016) found that Dutch physicians earn 20-50 percent more than medical school applicants who lose the lottery and choose a different occupation. Ketel et al. (2016) also found that becoming a physician increases the likelihood of being married and having children, both of which could be related to mental health and the use of prescription drugs.

Colditz 2004; Duarte et al. 2020). In our sample, female physicians used prescription drugs at higher rates than their male counterparts. This pattern is, in fact, exhibited across each of the prescription drug categories under consideration (i.e., antidepressants, opioids, anxiolytics, and sedatives). IV estimates provide strong evidence of pronounced gender-based differences. Specifically, the estimated effects of becoming a physician on antidepressant, anxiolytic, and sedative use are all much larger for female, as opposed to male, medical school applicants. This pattern of results is consistent with descriptions of female physicians being at elevated risk for depression and SUD because they are being exposed to on-the-job sex-based harassment and are under added pressure to balance professional and family responsibilities (Merlo and Gold 2008; Wallace et al. 2009; Jenner et al. 2019; Stageberg et al. 2020). Prior research suggests that systemic modifications to alleviate work-life conflict may disproportionally benefit female physicians (Guille et al. 2017).

Finally, we estimate the effect of becoming a physician on having received treatment from a mental health facility. We find that "low-ability" female applicants, defined as those with GPAs placing them in lottery categories E and F, were 30 percent more likely to have received mental health treatment. This estimate is consistent with descriptive evidence showing that lower-performing medical students are at elevated risk for subsequent burnout, stress, depression, and anxiety (Steward et al. 1997; Shadid et al. 2020).

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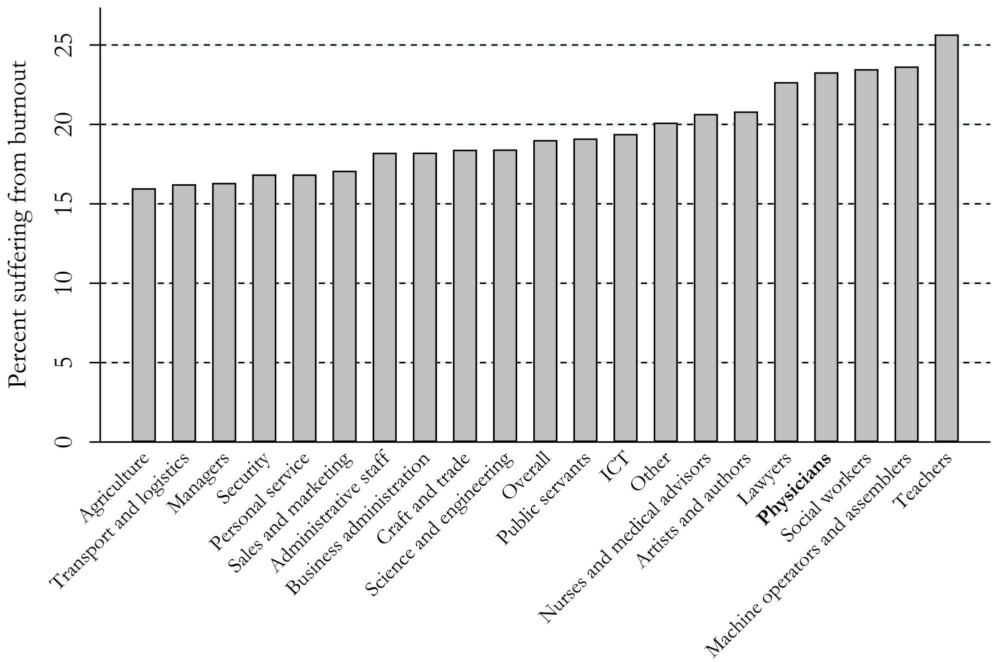
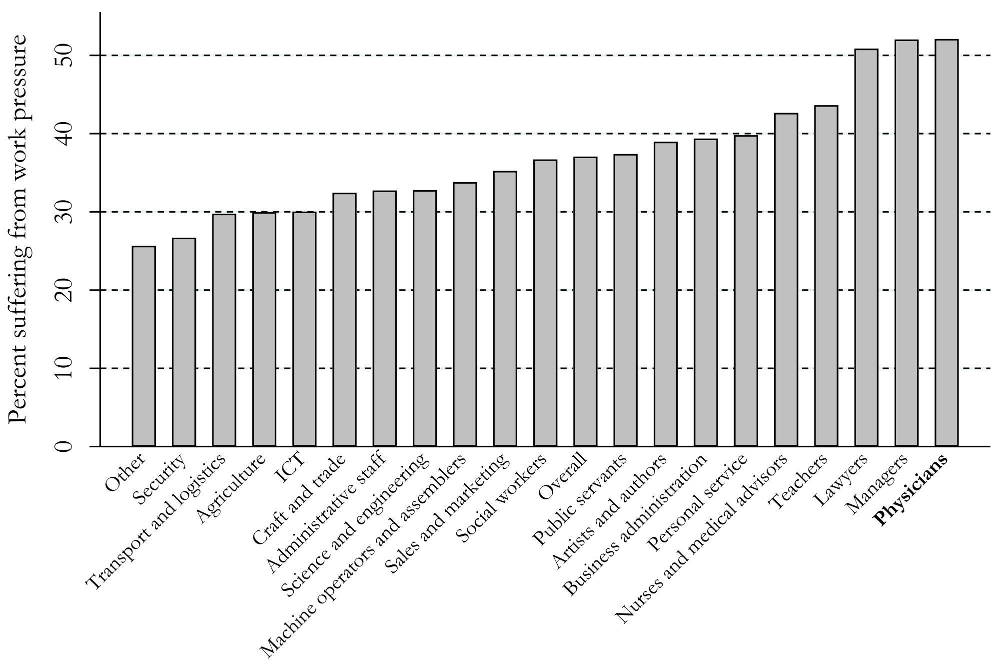
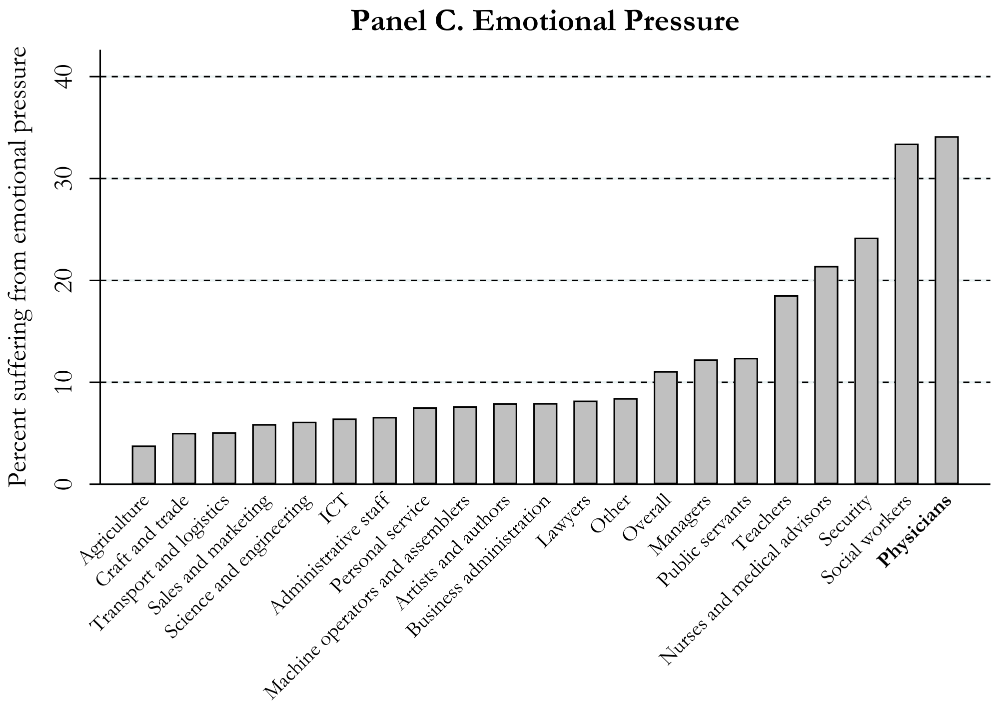
Figure 1. Burnout, Work Pressure, and Emotional Pressure by Occupation in the Netherlands

Panel A. Burnout



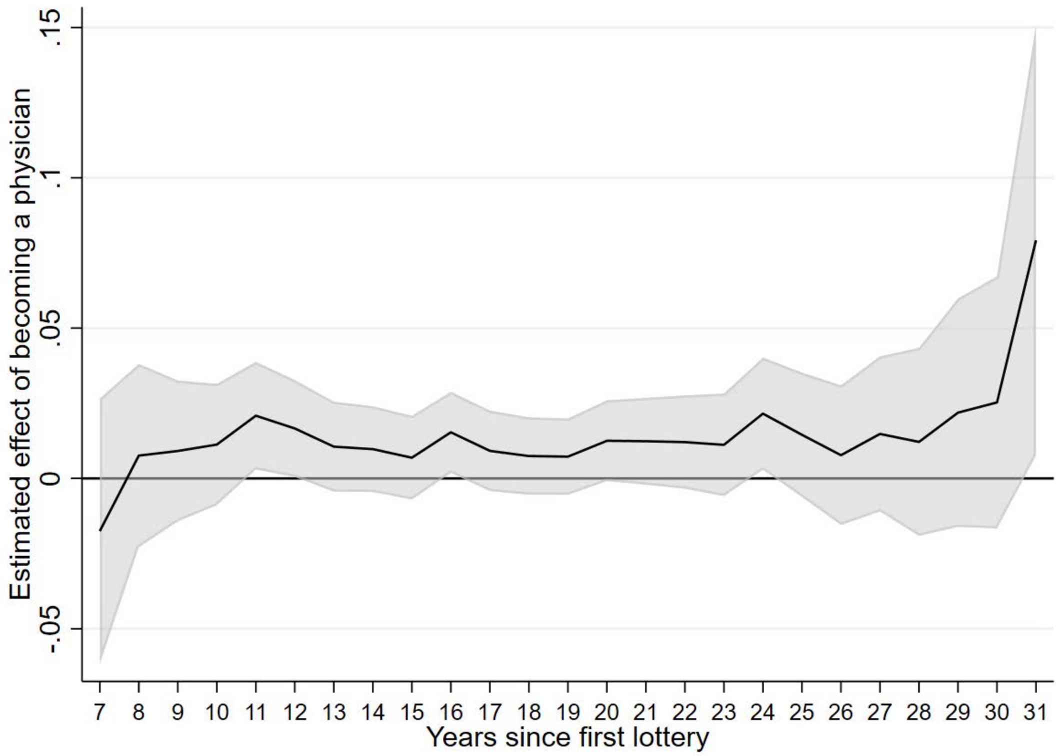
Panel B. Work Pressure





Notes: Based on data from the 2019 National Survey on Labor Conditions.

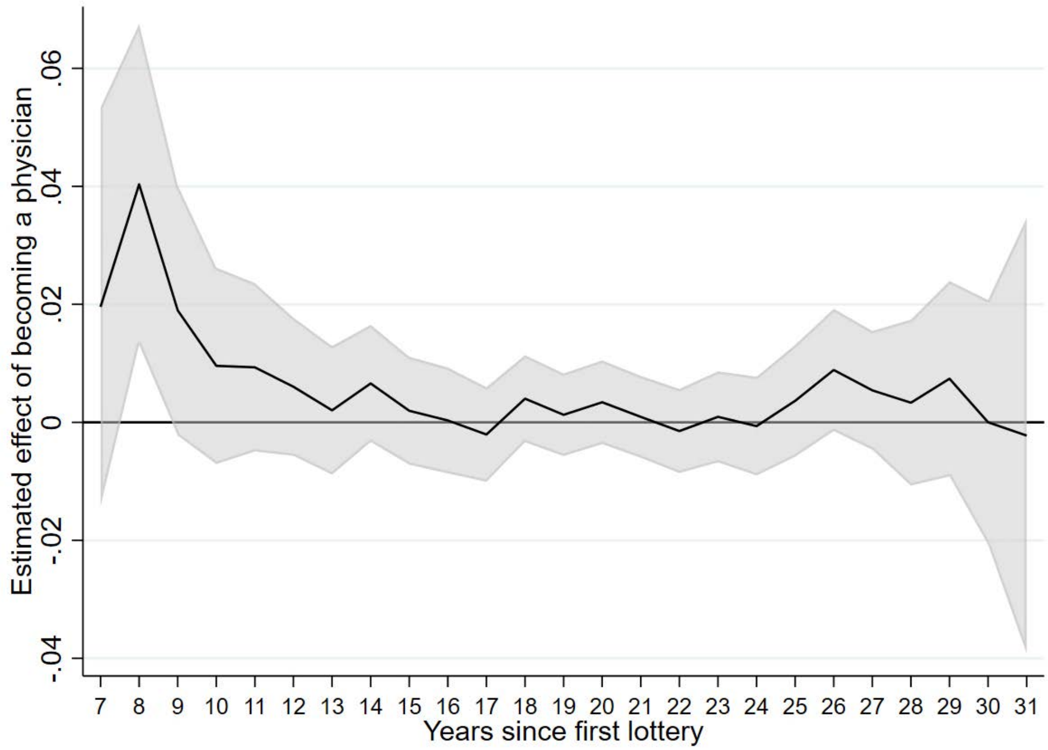
Figure 2. The Effect of Becoming a Physician on Antidepressant (AD) Use, 2006-2018: Years Since First Lottery



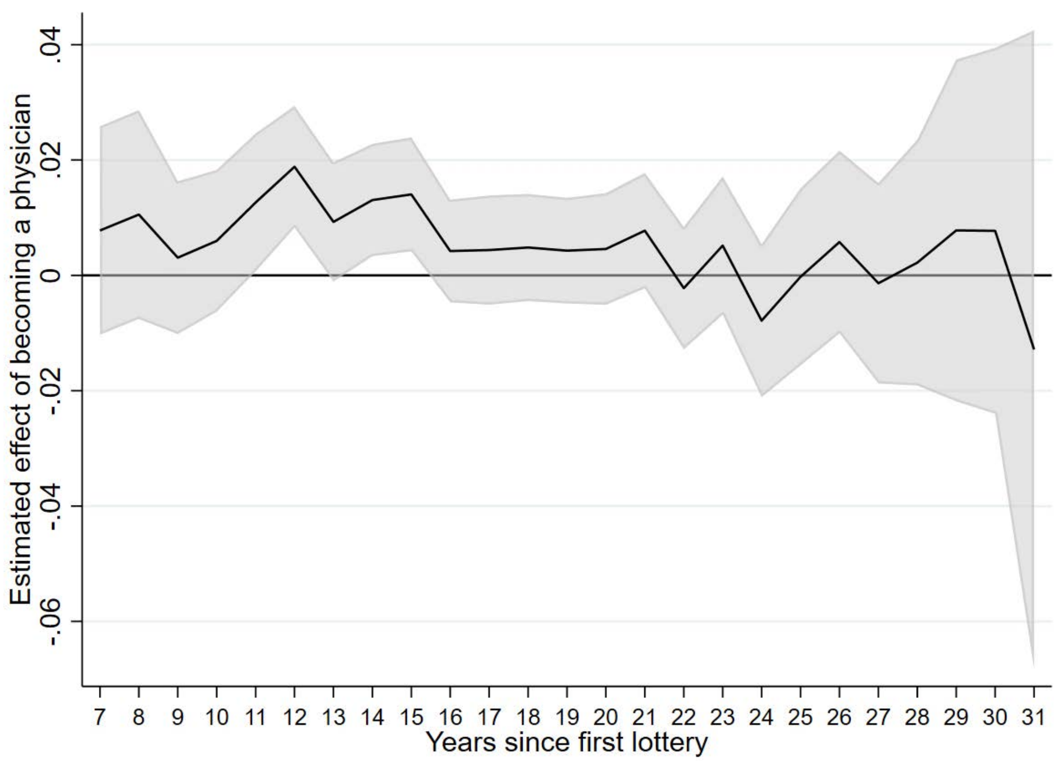
Notes: Based on information from the prescription reimbursement database for the population of the Netherlands for the period 2006-2018. Two-stage least squares (2SLS) estimates (and their 95% confidence intervals) are reported. The dependent variable is equal to 1 if individual *i* was prescribed an antidepressant in year *t*, where *t* indexes years since having participated in their first lottery (and is equal to 0 otherwise). We control for the covariates listed in Appendix Table 3, lottery category fixed effects, year-of-first-lottery fixed effects, and lottery category by year-of-first-lottery fixed effects. Robust standard errors are used to construct the 95% confidence intervals.

Figure 3. The Effect of Becoming a Physician on Anxiolytic, Opioid, and Sedative Use, 2006-2018: Years Since First Lottery

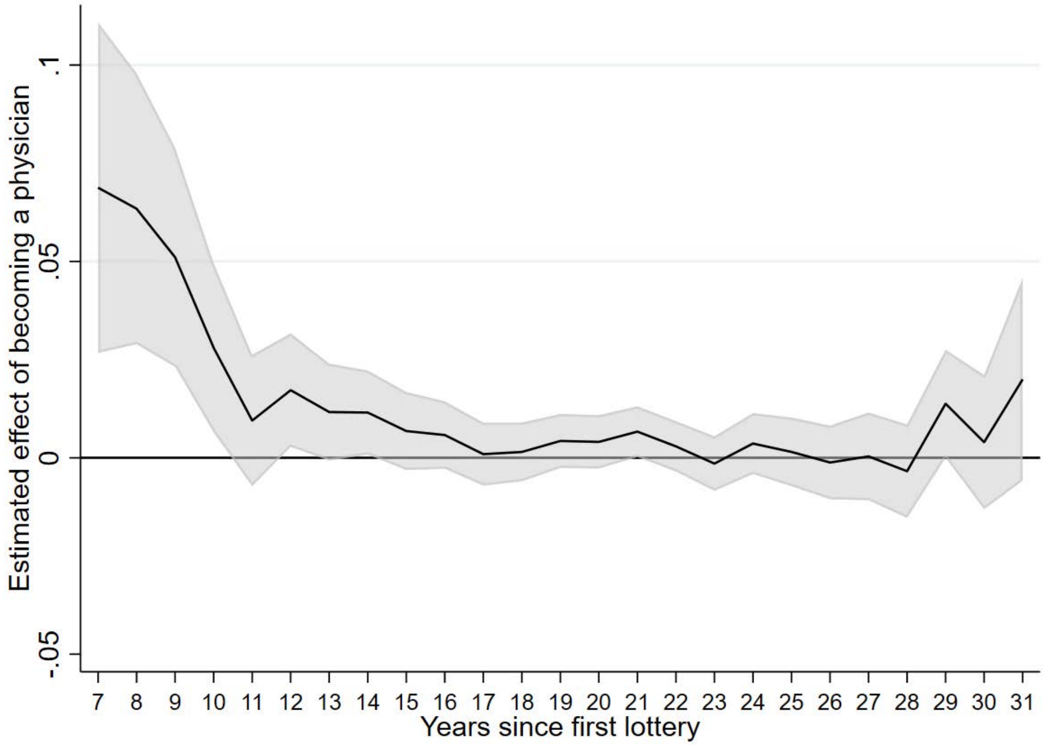
Panel A. ***Anxiolytic Use***



Panel B. ***Opioid Use***



Panel C. ***Sedative Use***



Notes: Based on information from the prescription reimbursement database for the population of the Netherlands for the period 2006-2018. Two-stage least squares (2SLS) estimates (and their 95% confidence intervals) are reported. The dependent variable in Panel A is equal to 1 if individual *i* was prescribed an anxiolytic in year *t*, where *t* indexes years since having participated in their first lottery (and is equal to 0 otherwise). The dependent variable in Panel B is equal to 1 if individual *i* was prescribed an opioid in year *t* (and is equal to 0 otherwise). The dependent variable in Panel C is equal to 1 if individual *i* was prescribed a sedative in year *t* (and is equal to 0 otherwise). All models control for the covariates listed in Appendix Table 3, lottery category fixed effects, year-of-first-lottery fixed effects, and lottery category by year-of-first-lottery fixed effects. Robust standard errors are used to construct the 95% confidence intervals.

Table 1. Means of Outcomes for Physicians vs. Non-Physicians

	Physicians	Non-Physicians	Statistically different at 5% level?
Total Prescriptions	21.0	17.0	Yes (p-value = 0.000)
	(20.6)	(19.0)	
AD Use	0.125	0.131	No (p-value = 0.116)
	(0.331)	(0.338)	
Anxiolytic Use	0.109	0.096	Yes (p-value = 0.001)
	(0.311)	(0.295)	
Opioid Use	0.185	0.159	Yes (p-value = 0.000)
	(0.388)	(0.366)	
Sedative Use	0.146	0.072	Yes (p-value = 0.000)
	(0.353)	(0.258)	
Mental Health Treatment	0.092	0.123	Yes (p-value = 0.000)
	(0.289)	(0.329)	
N	15,869	11,595	

Notes: Means with standard deviations in parentheses.

Table 2. The Effect of Becoming a Physician on Total Prescription Drug Use, 2006-2018

	(1) Full sample	(2) Females	(3) Males
Panel A. *Total Prescriptions* (OLS)			
Physician	4.245***	5.003***	3.145***
	(0.245)	(0.347)	(0.333)
Panel B. *Total Prescriptions* (2SLS)			
Physician	3.813***	4.666***	2.663***
	(0.628)	(0.918)	(0.819)
Mean of dependent variable	19.31	23.11	14.10
F-test of instrument	5,053.8	2,774.0	2,267.7

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each cell represents the results from a separate regression based on information from the prescription reimbursement database for the population of the Netherlands. *Total Prescriptions* is equal to the total number of prescription drugs individual *i* used during the period 2006-2018. All models control for the covariates listed in Appendix Table 3, lottery category fixed effects, year-of-first-lottery fixed effects, and lottery category by year-of-first-lottery fixed effects. Robust standard errors are in parentheses.

Table 3. The Effect of Becoming a Physician on Antidepressant (AD) Use, 2006-2018 (2SLS Estimates)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Full sample	Females	Males	High-ability females	Low-ability females	High-ability males	Low-ability males
Physician	0.029***	0.042***	0.013	0.048*	0.038**	-0.004	0.022
	(0.011)	(0.015)	(0.015)	(0.025)	(0.019)	(0.025)	(0.019)
Mean of dependent variable	0.128	0.140	0.111	0.136	0.142	0.101	0.118
F-test of instrument	5,053.8	2,774.0	2,267.7	973.0	1,812.9	738.8	1,527.4
N	27,464	15,896	11,568	6,820	9,076	4,558	7,010

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each column represents the results from a separate 2SLS regression based on information from the prescription reimbursement database for the population of the Netherlands. The dependent variable, *AD Use*, is equal to 1 if individual *i* ever used antidepressants during the period 2006-2018, and equal to 0 otherwise. All models control for the covariates listed in Appendix Table 3, lottery category fixed effects, year-of-first-lottery fixed effects, and lottery category by year-of-first-lottery fixed effects. Robust standard errors are in parentheses.

Table 4. The Effect of Becoming a Physician on Anxiolytic, Opioid, and Sedative Use, 2006-2018 (2SLS Estimates)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Full sample	Females	Males	High-ability females	Low-ability females	High-ability males	Low-ability males
Panel A. ***Anxiolytic Use***							
Physician	0.021**	0.031**	0.009	0.049**	0.020	-0.001	0.015
	(0.010)	(0.014)	(0.014)	(0.023)	(0.017)	(0.023)	(0.017)
Mean of dependent variable	0.103	0.113	0.091	0.108	0.117	0.084	0.094
Panel B. ***Opioid Use***							
Physician	0.044***	0.043**	0.047***	0.043	0.042**	0.031	0.055**
	(0.012)	(0.017)	(0.018)	(0.028)	(0.021)	(0.030)	(0.022)
Mean of dependent variable	0.174	0.180	0.166	0.167	0.189	0.148	0.177
Panel C. ***Sedative Use***							
Physician	0.070***	0.093***	0.042***	0.092***	0.093***	0.030	0.050***
	(0.010)	(0.015)	(0.014)	(0.026)	(0.018)	(0.025)	(0.017)
Mean of dependent variable	0.115	0.129	0.094	0.143	0.119	0.103	0.089
N	27,464	15,896	11,568	6,820	9,076	4,558	7,010

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each cell represents the results from a separate 2SLS regression based on information from the prescription reimbursement database for the population of the Netherlands. Each outcome is equal to 1 if individual *i* ever used the specified drug during the period 2006-2018, and equal to 0 otherwise. All models control for the covariates listed in Appendix Table 3, lottery category fixed effects, year-of-first-lottery fixed effects, and lottery category by year-of-first-lottery fixed effects. Robust standard errors are in parentheses.

Table 5. The Effect of Becoming a Physician on Treatment for a Mental Health Issue, 2012-2016 (2SLS Estimates)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Full sample	Females	Males	High-ability females	Low-ability females	High-ability males	Low-ability males
Physician	0.002	0.020	-0.021	-0.007	0.037**	-0.045*	-0.008
	(0.010)	(0.014)	(0.014)	(0.024)	(0.018)	(0.024)	(0.017)
Mean of dependent variable	0.105	0.118	0.088	0.115	0.120	0.086	0.090
F-test of instrument	5,053.8	2,774.0	2,267.7	973.0	1,812.9	738.8	1,527.4
N	27,464	15,896	11,568	6,820	9,076	4,558	7,010

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

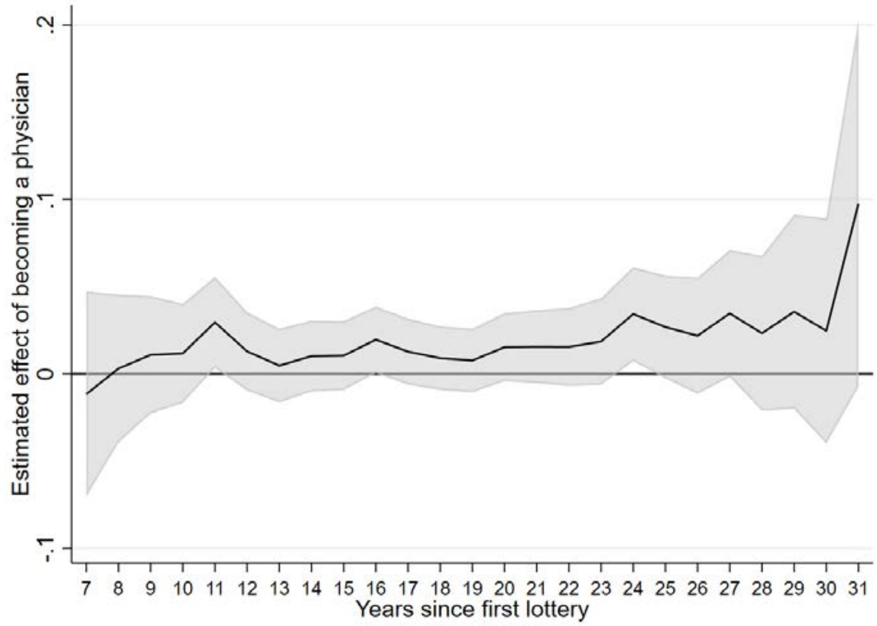
Notes: Each column represents the results from a separate 2SLS regression based on information from the treatment database of all mental healthcare facilities in the Netherlands. The dependent variable, *Mental Health Treatment*, is equal to 1 if individual *i* ever received treatment for a mental health issue during the period 2012-2016, and equal to 0 otherwise. All models control for the covariates listed in Appendix Table 3, lottery category fixed effects, year-of-first-lottery fixed effects, and lottery category by year-of-first-lottery fixed effects. Robust standard errors are in parentheses.

Appendix

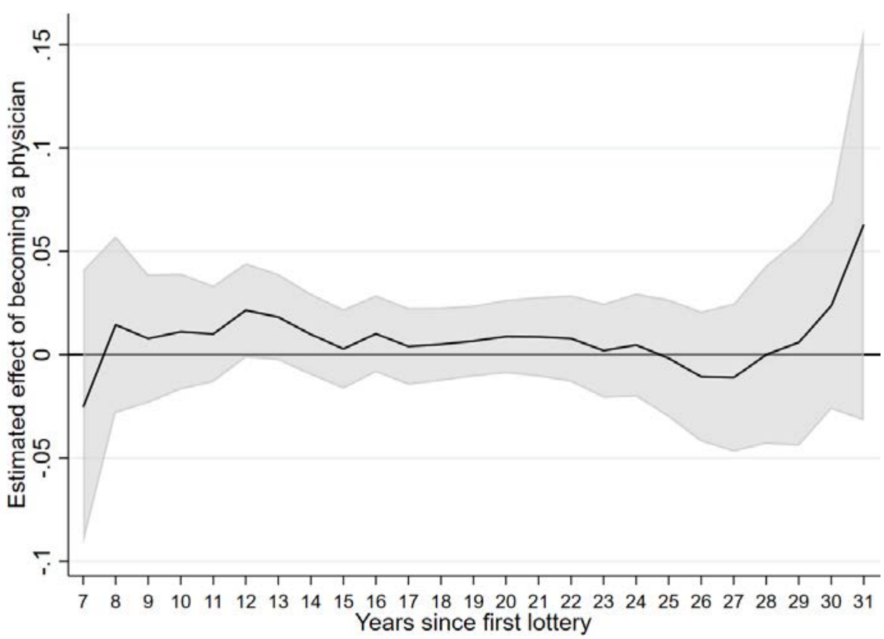
For Online Publication

Appendix Figure 1. The Effect of Becoming a Physician on Antidepressant (AD) Use by Gender, 2006-2018: Years Since First Lottery

Panel A. Females



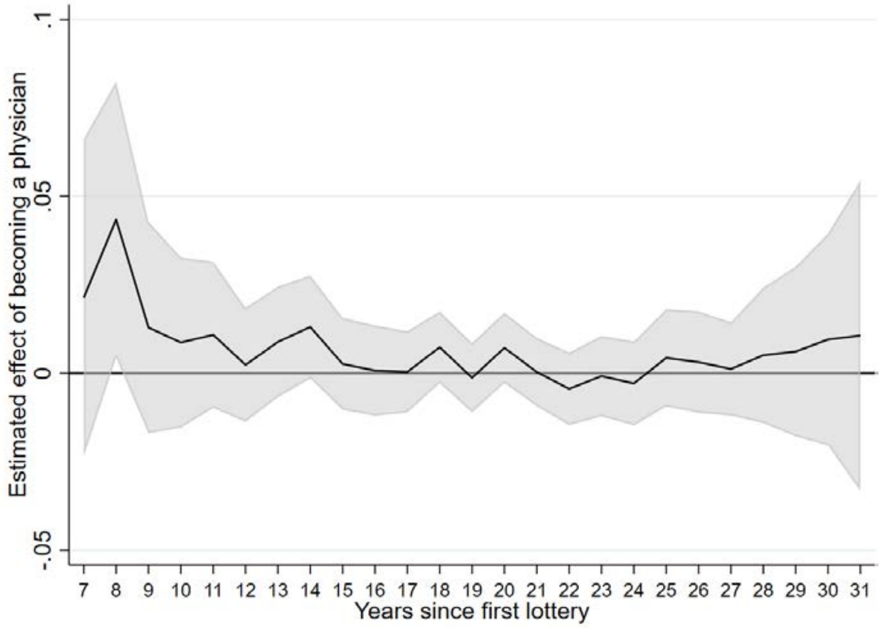
Panel B. Males



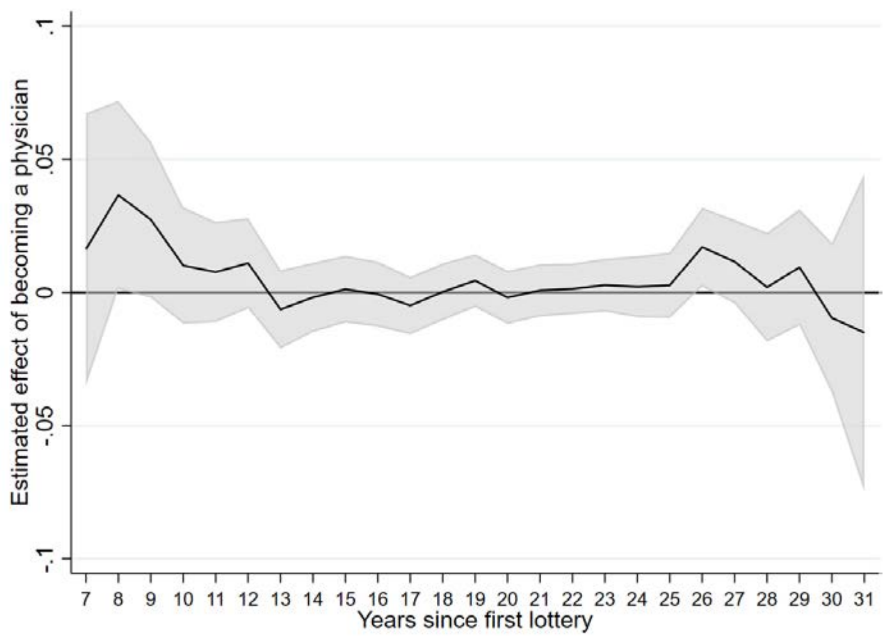
Notes: Based on information from the prescription reimbursement database for the population of the Netherlands for the period 2006-2018. Two-stage least squares (2SLS) estimates (and their 95% confidence intervals) are reported. The dependent variable is equal to 1 if individual *i* was prescribed an antidepressant in year *t*, where *t* indexes years since having participated in their first lottery (and is equal to 0 otherwise). All models control for the covariates listed in Appendix Table 3, lottery category fixed effects, year-of-first-lottery fixed effects, and lottery category by year-of-first-lottery fixed effects. Robust standard errors are used to construct the 95% confidence intervals.

Appendix Figure 2. The Effect of Becoming a Physician on Anxiolytic Use by Gender, 2006-2018: Years Since First Lottery

Panel A. Females



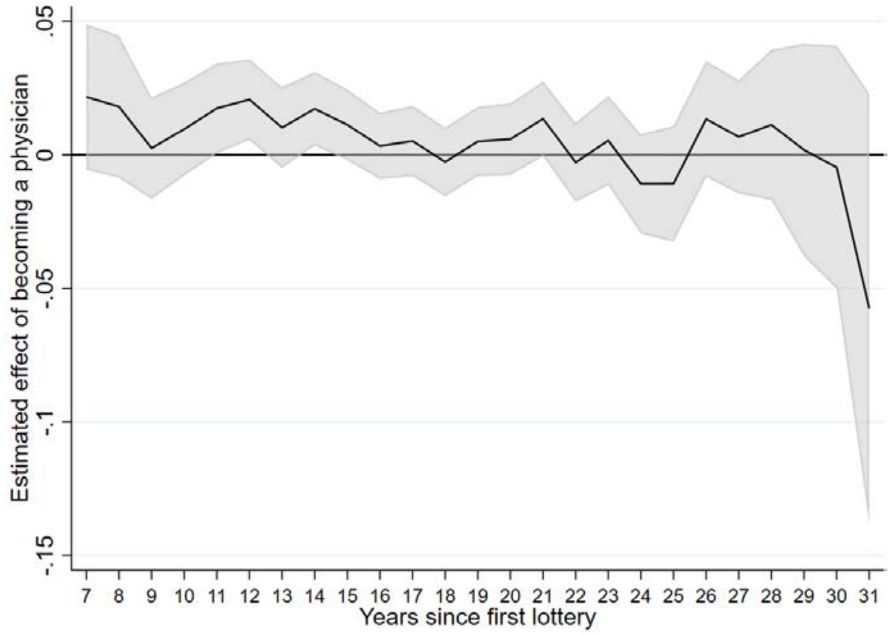
Panel B. Males



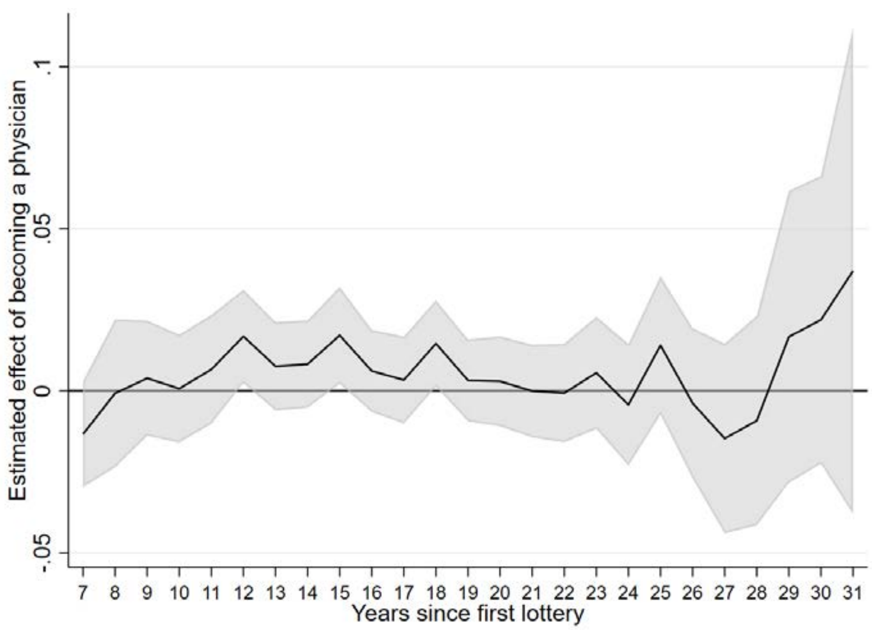
Notes: Based on information from the prescription reimbursement database for the population of the Netherlands for the period 2006-2018. The dependent variable is equal to 1 if individual *i* was prescribed an anxiolytic in year *t*, where *t* indexes years since having participated in their first lottery (and is equal to 0 otherwise). All models control for the covariates listed in Appendix Table 3, lottery category fixed effects, year-of-first-lottery fixed effects, and lottery category by year-of-first-lottery fixed effects. Robust standard errors are used to construct the 95% confidence intervals.

Appendix Figure 3. The Effect of Becoming a Physician on Opioid Use by Gender, 2006-2018: Years Since First Lottery

__Panel A. Females__



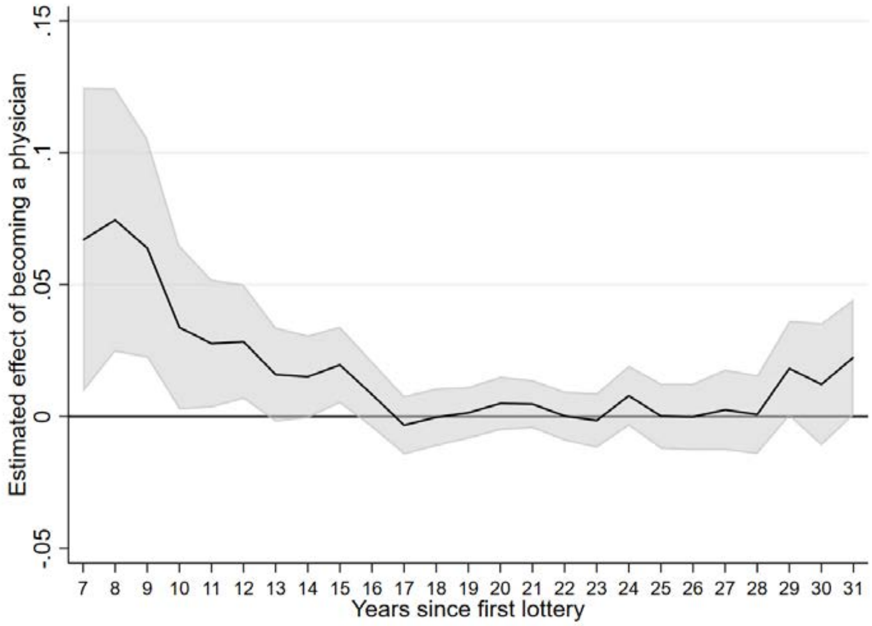
__Panel B. Males__



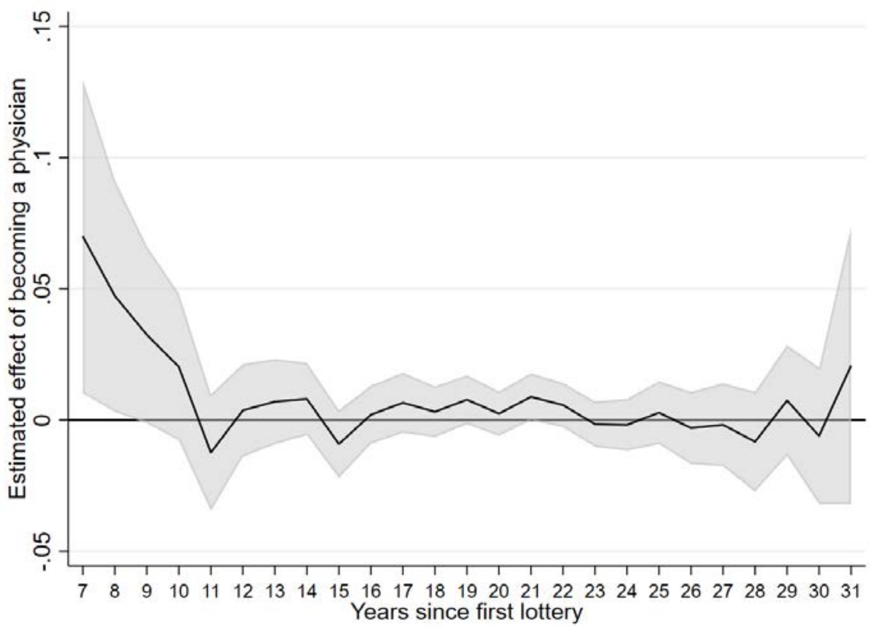
Notes: Based on information from the prescription reimbursement database for the population of the Netherlands for the period 2006-2018. Two-stage least squares (2SLS) estimates (and their 95% confidence intervals) are reported. The dependent variable is equal to 1 if individual *i* was prescribed an opioid in year *t*, where *t* indexes years since having participated in their first lottery (and is equal to 0 otherwise). All models control for the covariates listed in Appendix Table 3, lottery category fixed effects, year-of-first-lottery fixed effects, and lottery category by year-of-first-lottery fixed effects. Robust standard errors are used to construct the 95% confidence intervals.

Appendix Figure 4. The Effect of Becoming a Physician on Sedative Use by Gender, 2006-2018: Years Since First Lottery

Panel A. Females



Panel B. Males



Notes: Based on information from the prescription reimbursement database for the population of the Netherlands for the period 2006-2018. The dependent variable is equal to 1 if individual *i* was prescribed a sedative in year *t*, where *t* indexes years since having participated in their first lottery (and is equal to 0 otherwise). All models control for the covariates listed in Appendix Table 3, lottery category fixed effects, year-of-first-lottery fixed effects, and lottery category by year-of-first-lottery fixed effects. Robust standard errors are used to construct the 95% confidence intervals.

Appendix Table 1. Share of Medical School Applications and Probabilities of Admittance by Lottery Categories A through F, 1987-1999

Lottery category	GPA on final exams in high school	Share of applications	Number of applications	Average probability of admittance
A	GPA ≥ 8.5	0.02	815	0.86
B	8.0 ≤ GPA < 8.5	0.06	2,568	0.75
C	7.5 ≤ GPA < 8.0	0.10	4,118	0.60
D	7.0 ≤ GPA < 7.5	0.24	10,033	0.50
E	6.5 ≤ GPA < 7.0	0.25	10,660	0.42
F	GPA < 6.5	0.34	14,521	0.36

Notes: Based on administrative data from the Dienst Uitvoering Onderwijs, a Dutch organization under the Ministry of Education. GPA ranges from 1 to 10, where a score of 10 is perfect and scores below 5.5 are considered "insufficient." Applicants from the "A" (GPA ≥ 8.5) category are excluded from our sample because nearly all of them were eventually admitted to medical school. Applicants who did not take the nationwide high school exam (e.g., foreign students) are also excluded from the sample.

Appendix Table 2. Balancing Tests by First-Lottery Outcome

	(1)	(2)	(3)
	First-lottery winners	First-lottery losers	Statistically different at 5% level?
Lottery category B			
Female	0.601	0.602	No (p-value = 0.962)
	(0.490)	(0.490)	
Age at first lottery	18.1	18.1	No (p-value = 0.891)
	(1.02)	(1.13)	
Non-Western migrant	0.047	0.038	No (p-value = 0.395)
	(0.212)	(0.192)	
N	1,467	475	
Lottery category C			
Female	0.621	0.626	No (p-value = 0.786)
	(0.485)	(0.484)	
Age at first lottery	18.2	18.2	No (p-value = 0.825)
	(1.16)	(1.04)	
Non-Western migrant	0.041	0.039	No (p-value = 0.735)
	(0.199)	(0.193)	
N	1,801	1,108	
Lottery category D			
Female	0.585	0.594	No (p-value = 0.482)
	(0.493)	(0.491)	
Age at first lottery	18.3	18.3	No (p-value = 0.932)
	(1.05)	(1.05)	
Non-Western migrant	0.054	0.053	No (p-value = 0.937)
	(0.226)	(0.225)	
N	3,395	3,132	
Lottery category E			
Female	0.570	0.581	No (p-value = 0.383)
	(0.495)	(0.493)	
Age at first lottery	18.5	18.5	No (p-value = 0.754)
	(1.20)	(1.27)	
Non-Western migrant	0.077	0.072	No (p-value = 0.480)
	(0.266)	(0.259)	
N	2,887	4,058	
Lottery category F			
Female	0.552	0.556	No (p-value = 0.725)
	(0.497)	(0.497)	
Age at first lottery	18.8	18.7	Yes (p-value = 0.015)
	(1.25)	(1.25)	
Non-Western migrant	0.113	0.107	No (p-value = 0.451)
	(0.316)	(0.309)	
N	3,368	5,773	

Notes: Weighted means with standard deviations in parentheses. Tests of equality were performed by separately regressing *First Lottery* on each physician characteristic, where regressions were weighted by yearly admittance probabilities.

Appendix Table 3. Descriptive Statistics

	Full sample	Lottery winners	Lottery losers	Description
Female	0.579	0.580	0.578	= 1 if physician is female, = 0 otherwise
	(0.494)	(0.494)	(0.494)	
Age at first lottery	18.5	18.4	18.5	Age at which physician participated in first medical school lottery
	(1.19)	(1.18)	(1.21)	
Non-Western migrant	0.077	0.073	0.081	= 1 if physician or one of the physician's parents was born in a non-Western country, = 0 otherwise
	(0.267)	(0.260)	(0.273)	
N	27,464	12,918	14,546	

Notes: Means with standard deviations in parentheses.

Appendix Table 4. The Effect of Winning Medical School Lottery on Becoming a Physician

	(1)	(2)	(3)
	Physician (Full sample)	*Physician* (Females)	*Physician* (Males)
First Lottery	0.401***	0.389***	0.417***
	(0.006)	(0.007)	(0.009)
Mean of dependent variable	0.578	0.600	0.547
N	27,464	15,896	11,568

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each column represents the results from a separate regression based on information from the Dienst Uitvoering Onderwijs, a Dutch organization under the Ministry of Education. *Physician* is equal to 1 if individual *i* was a licensed physician, and equal to 0 otherwise. All models control for the covariates listed in Appendix Table 3, lottery category fixed effects, year-of-first-lottery fixed effects, and lottery category by year-of-first-lottery fixed effects. Robust standard errors are in parentheses.

Appendix Table 5. The Effect of Becoming a Physician on Antidepressant (AD) Use for Two or More Years, 2006-2018 (2SLS Estimates)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Full sample	Females	Males	High-ability females	Low-ability females	High-ability males	Low-ability males
Physician	0.019***	0.028**	0.009	0.021	0.032**	-0.010	0.020
	(0.011)	(0.013)	(0.013)	(0.022)	(0.016)	(0.021)	(0.016)
Mean of dependent variable	0.088	0.098	0.074	0.100	0.096	0.068	0.078
F-test of instrument	5,053.8	2,774.0	2,267.7	973.0	1,812.9	738.8	1,527.4
N	27,464	15,896	11,568	6,820	9,076	4,558	7,010

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each column represents the results from a separate 2SLS regression based on information from the prescription reimbursement database for the population of the Netherlands. The dependent variable, *AD Use 2+ Years*, is equal to 1 if individual *i* ever used antidepressants in two or more years during the period 2006-2018, and equal to 0 otherwise. All models control for the covariates listed in Appendix Table 3, lottery category fixed effects, year-of-first-lottery fixed effects, and lottery category by year-of-first-lottery fixed effects. Robust standard errors are in parentheses.

Appendix Table 6. The Effect of Becoming a Physician on Anxiolytic, Opioid, and Sedative Use for Two or More Years, 2006-2018 (2SLS Estimates)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Full sample	Females	Males	High-ability females	Low-ability females	High-ability males	Low-ability males
Panel A. ***Anxiolytic Use***							
Physician	0.006	0.006	0.006	0.005	0.007	-0.014	0.017*
	(0.006)	(0.009)	(0.008)	(0.014)	(0.011)	(0.014)	(0.010)
Mean of dependent variable	0.035	0.039	0.030	0.035	0.041	0.028	0.031
Panel B. ***Opioid Use***							
Physician	0.017**	0.019**	0.015	0.026*	0.014	0.009	0.018
	(0.007)	(0.010)	(0.010)	(0.015)	(0.012)	(0.015)	(0.012)
Mean of dependent variable	0.045	0.048	0.041	0.039	0.055	0.032	0.047
Panel C. ***Sedative Use***							
Physician	0.023***	0.032***	0.013	0.036**	0.029**	0.008	0.015
	(0.007)	(0.010)	(0.009)	(0.017)	(0.012)	(0.016)	(0.011)
Mean of dependent variable	0.045	0.052	0.036	0.055	0.049	0.039	0.033
N	27,464	15,896	11,568	6,820	9,076	4,558	7,010

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each cell represents the results from a separate 2SLS regression based on information from the prescription reimbursement database for the population of the Netherlands. Each outcome is equal to 1 if individual *i* ever used the specified drug in two or more years during the period 2006-2018, and equal to 0 otherwise. All models control for the covariates listed in Appendix Table 3, lottery category fixed effects, year-of-first-lottery fixed effects, and lottery category by year-of-first-lottery fixed effects. Robust standard errors are in parentheses.

Appendix Table 7. The Effect of Becoming a Physician on Antidepressant, Anxiolytic, Opioid, and Sedative Use by Specialization, 2006-2018 (2SLS Estimates)

	(1) Full sample	(2) Females	(3) Males
Panel A. ***AD Use***			
Physician	0.063***	0.065***	0.064***
	(0.013)	(0.017)	(0.020)
*Physician*Specialist*	-0.094***	-0.084***	-0.106***
	(0.008)	(0.010)	(0.013)
Panel B. ***Anxiolytic Use***			
Physician	0.031***	0.035**	0.029*
	(0.011)	(0.015)	(0.018)
*Physician*Specialist*	-0.028***	-0.015	-0.042***
	(0.007)	(0.010)	(0.012)
Panel C. ***Opioid Use***			
Physician	0.042***	0.040***	0.047**
	(0.014)	(0.018)	(0.022)
*Physician*Specialist*	0.006	0.010	-0.0004
	(0.009)	(0.012)	(0.015)
Panel D. ***Sedative Use***			
Physician	0.077***	0.096***	0.050***
	(0.012)	(0.016)	(0.017)
*Physician*Specialist*	-0.017**	-0.011	-0.015
	(0.008)	(0.011)	(0.012)
N	27,464	15,896	11,568

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each cell represents the results from a separate 2SLS regression based on information from the prescription reimbursement database for the population of the Netherlands. Each outcome is equal to one if individual *i* ever used the specified drug during the period 2006-2018, and equal to zero otherwise. All models control for the covariates listed in Appendix Table 3, lottery category fixed effects, year-of-first-lottery fixed effects, and lottery category by year-of-first-lottery fixed effects. The variable *Specialist* is equal to 1 if individual *i* was a medical or surgical specialist as defined by the European World Health Organization (2022a, 2022b), and equal to 0 if individual *i* was a general practitioner, pediatrician, obstetrician-gynecologist, psychiatrist, or another type of physician without a specialization. Robust standard errors are in parentheses.

Appendix Table 8. The Effect of Becoming a Physician on the Likelihood of Hospitalization Due to a Possible Suicide Attempt, 2013-2017 (2SLS Estimates)

	(1) Full sample	(2) Females	(3) Males
Physician	0.003	0.009**	-0.005
	(0.003)	(0.005)	(0.005)
Mean of dependent variable	0.011	0.011	0.011
N	27,464	15,896	11,568

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each cell represents the results from a separate 2SLS regression based on information from the Medical Specialized Care database for the population of the Netherlands. The dependent is equal to 1 if individual *i* was ever hospitalized due to intoxication, head trauma, trauma to internal organs, damage by an alien object, or laceration of the wrist during the period 2013-2017, and equal to zero otherwise. All models control for the covariates listed in Appendix Table 3, lottery category fixed effects, year-of-first-lottery fixed effects, and lottery category by year-of-first-lottery fixed effects. Robust standard errors are in parentheses.