School Milestones Impact on Child Mental Health in Taiwan

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Abstract:

We examine child mental health treatment surrounding four school milestones in Taiwan: Primary and middle school entry and high stakes testing for high school and college entry. Given age cutoffs for school entry, we compare August-born to September-born children. August-born reach milestones one year earlier, allowing identification of each milestone's effect. Entry into primary and middle school increases in mental health prescribing, especially for ADHD and depression. Middle school entry also increases prescribing of anti-anxiety and antipsychotic medications. Use of psychiatric medications falls sharply following high-stakes tests. Effects are stronger in counties where parents and children have higher educational aspirations.

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The World Health Organization estimates that one in seven children 10 to 19 years old has a mental health disorder, and that for this age group, mental health problems account for 13 percent of the global burden of disease (WHO, 2021). In addition to the current suffering children and families experience from these conditions, child mental health problems are predictive of negative outcomes across a broad range of important domains, including future educational attainment, labor force participation, and adult health (Currie, forthcoming).

While the causes of child mental health problems are not well understood, recent literature in economics has highlighted several significant causal factors, including family background and income shocks (e.g. Akee et al., 2024; Baird et al., 2013; Butikofer et al., 2024; Furzer et al., 2024; Golberstein et al., 2019), in utero exposure to maternal stressors, disease, or nutritional deficiencies (e.g. Almond, 2006; Almond and Mazumder, 2011; Black et al., 2016; Persson and Rossin-Slater, 2018), social media (Alcott et al., 2020; Braghieri et al., 2022), and exposure to traumatic events (Bharadwaj et al., 2021; Bhuller et al., 2024; Rossin-Slater et al., 2020).

However, despite the dominant role of school in children's lives, less attention has been paid to the question of whether features of the school environment affect children's mental health in predictable ways. We examine this question using data from Taiwan. Taiwan is an interesting setting for our study because while Taiwanese 8th graders had the second highest math and science scores in the 2019 Trends in International Math and Science Study (TIMSS), surveys suggest that over a quarter of middle schoolers have thought about suicide or self-harm because of school pressures. According to some observers, "They are burdened with constant tests and exams, don't get enough sleep because they cram into the night, and need to cope with the high expectations of their parents to get good grades" (Peng and Hsiao, 2023). Hence, Taiwan may be a good case study of the effects that pressure to achieve academically has on mental health even if it arguably produces high test scores.

This study uses universal health insurance claims data for all children born in Taiwan between 1982 and 2014 to examine how the use of psychiatric medications and diagnoses change with four key milestones: Initial entry into primary school; entry into junior high school (middle school); high-stakes high school entrance exams held at the end of middle school; and equally high-stakes college entrance examinations held at the end of high school. Our study is the first to consider milestones from the beginning of elementary school to the end of high school.

Identification of the effects of reaching these milestones relies on the fact that Taiwanese children born in August typically enter school at age 6, while those born in September enter school at age 7. Hence, children who are very close in age (born on either side of the school entry cutoff) reach these milestones at predictably different times. A great deal of previous work has examined the relationship between diagnoses of Attention Deficit Hyperactivity Disorder (ADHD) and school entry ages by comparing the outcomes of children born just before and just after school entry cutoff dates.[1] This literature often focuses on the effects of being "young for grade" on a range of academic and non-academic outcomes. In contrast, we exploit this source of variation by observing that children born just before and after the school entry dates will reach educational milestones at distinct points, which allows us to identify the effect of the milestones separately for the August-born and the September-born. Hence, even if children who are young-for-grade face different average outcomes, and even if the impact of milestones is different for them, the existence of milestone effects at separate times for the August and September-born supports the conclusion that reaching these milestones has an effect.

We examine prescriptions of antidepressant, anti-anxiety, and antipsychotic medications in addition to those for ADHD, painting a more nuanced picture of the mental health effects of these stressors. These drugs constitute the major categories of psychiatric medications prescribed to children. Concerns have been expressed that ADHD prescribing may be driven at least in part by misdiagnosis (Elder, 2010). Some prescriptions may also reflect perceptions that stimulants will help children to perform better in school whether they have ADHD or not (Wilens and Kaminski, 2019). Changes in

[1] See for example, Bedard and Dhuey (2006), Elder (2010), Evans et al. (2011), Black et al. (2011), Fredriksson and Öckert (2014), Schwandt and Wuppermann (2016), Persson et al. (2021), and a systematic review by Holland and Sayal (2018). Children who are "young-for-grade" are more likely to be diagnosed with ADHD and this is also true in Taiwan (Chen et al., 2016). Students who are relatively young compared to peers are also more likely to report learning disabilities and receive special education services (Dhuey and Lipscomb, 2010).

prescriptions of other important categories of psychiatric medications including anti-anxiety, antidepressant, and anti-psychotic medications around the milestones make it more likely that the changes reflect increases in rates of underlying psychological distress.

Findings for all four milestones consistently show that mental health prescribing increases during periods of elevated school stress and decreases once those stresses are relieved. At primary school entry, we observe increases in prescriptions for both ADHD medications and antidepressants. It is possible that the increase in prescriptions for ADHD reflects the identification of an underlying condition at school entry. However, this mechanism is less likely for depression.

When children transition from primary to middle school, we observe increases in the prescribing of all four types of psychiatric medications. It seems unlikely that increases in prescribing at precisely that point could reflect previously unidentified underlying conditions. Moreover, there is no presumption that antidepressants, anti-anxiety, or antipsychotic medications confer any academic advantage other than treating mental health conditions that may interfere with children's schooling, and many carry significant side effects.

Perhaps surprisingly, there is no run-up in the use of psychiatric medications prior to the high-stakes testing that determines high-school and college placements. But the use of psychiatric medications falls sharply following these stressful tests. These effects are stronger in counties where both parents and children are more likely to report that they expect the child to get a college education. Hence, use of psychiatric drugs increases at junctures when educational stresses can be expected to increase and falls when these stresses are relieved.

These results are consistent with previous evidence suggesting that schools are a major source of stress in the lives of many children.[2] In both the U.S. (Hansen and Lang, 2011; Hansen et al., 2024) and

[2] See Kouzma and Kennedy (2004) for a survey of Australian students, Hogberg et al. (2020) for a survey of Swedish students, and Bethune (2014) for a survey of U.S. students conducted by the American Psychological Association. A related literature asks whether increases school stresses are related to declines in children's mental health across countries, but this literature is much less conclusive in part because it is not clear that either school stress or mental health problems among children are actually increasing (see Cosma, 2020).

in Germany (Chandler, 2022), adolescent suicide rates peak during the school year and fall during school vacations, while those of young adults do not. Using Swedish data, Linder et al. (2023) report that conditional on standardized test scores, lenient classroom grading (which they call "over-grading") has a significant positive effect on student's mental health.[3] Using registry data from Norway, Beck et al. (2024) find that failing a high-stakes test is associated with a significant increase in psychiatric diagnoses while Bütikofer et al. (2023) find that children who score just above the cutoff to attend better high schools are less likely to be diagnosed with mental health conditions subsequently.[4] These observations suggest that greater attention to the mental health of students at high-stress points in the educational system may be warranted.

The rest of this paper laid out as follows. Section II provides some essential background about the educational and health insurance systems in Taiwan. Section III gives an overview of the data. Section IV describes our empirical methods, while section V lays out the results. A discussion and conclusion appear in section VI.

II. Background

a) The Educational System

Consistent with Confucian tradition, education is greatly valued in Taiwanese society and is perceived as a matter of profound importance for families with children. Since 1968, education through junior high school has been mandatory and compulsory education was extended through high school in 2014. The overall education level is high – for example, in the cohort born in 1990, 98 percent enrolled in high school and over 79 percent of students enrolled in 4-year universities, 4-year technical colleges, or 2-year vocational junior colleges.[5] Students complete six years of elementary school, three years of junior high

[4] Related work by Heissel et al. (2021) confirms that high stakes tests are stressful – they find that children's cortisol levels rise in the week of the test and that larger increases in cortisol level are associated with worse test performance.

[5] These rates are calculated using the number of 7th grade middle school students in the 2002 academic year, the number of entering high school students in the 2005 academic year, and the number of 1st year university students

school (middle school), and three years of high school. High schools can be academic, comprehensive, or technical/vocational.

Survey evidence from the Taiwan Education Panel Survey (TEPS), which was fielded biennially from 2001 to 2007,[6] suggests that students work hard. Data from the 2005 and 2007 waves, which focus on students who were in middle school in 2005, indicate that the average student spent eight to 12 hours at school every day, did one to four hours of homework every day, and also put in up to eight hours in additional tutoring time per week. Most rose before seven in the morning and reported getting less than eight hours of sleep. Sixty-one percent also took summer classes.

The timing of entry into elementary school hinges on the child's birthdate. Children must be 6 years old by Sept. 1 to start school. Children born after this threshold start school a year later. Sending children either early or late is rare. Parents face fines from the local educational authority if their child doesn't start school on time. To enter early, a child needs to obtain an IQ score two standard deviations higher than the mean. Most students attend public schools. For example, in the 1990 birth cohort only 1.3 percent of children attended private elementary schools and 9.6 percent attended private middle schools. Public school assignments in elementary and middle school are based on household residential registration areas.

In contrast, entry into high school and college is competitive and exam based, with higher scoring students able to match with higher ranking institutions through a centralized application system. Between 2001 and 2011, the pivotal exam for entry into high school was the Basic Competence Test (BCT) taken in May of the final year of middle school, with a second attempt possible in mid-July. In 2005, for example, 320,000 students took the May BCT out of a total of 330,000 in the eligible cohort, and 192,000 took the test in July. In 2012 and 2013, only one sitting was offered, in June. Since 2013, a new exam,

in 2008. This count of university students does not include those in 5-year post-junior-high vocational schools (五專) or 2-year post-junior-college vocational schools (二技). Data to make these computations was downloaded from: https://depart.moe.edu.tw/ed4500/News.aspx?n=5A930C32CC6C3818&page=1&PageSize=20.

[6] TEPS was a longitudinal study that surveyed 40,000 students (half in junior high school and half in high school) in 2001 and 2003. In 2005 and 2007 TEPS followed 4,200 high school students who had been in the original junior high school sample as well as 16,000 of their classmates.

the Comprehensive Assessment Program (CAP), plays a key role in high school admission although school admission reforms have also placed some emphasis on in-school academic performance.

University admissions are also managed through a centralized application system in which exam scores play a central role. For students on the academic track, two exams are administered during the final year of high school: the General Scholastic Ability Test (GSAT) in late January or early February and the Advanced Subjects Test (AST) in early July. Both are high-stakes exams. Colleges and majors set minimum GSAT scores that are necessary to apply for their programs. Students who missed the GSAT or were dissatisfied with their results can opt to take the AST and apply through a separate process.[7] The process is similar for students on the vocational track. A small fraction of these students take the GSAT (~5 percent), while most take the Technological and Vocational Joint College Entrance Examination (TVE JCEE) which is offered in April or May. In 2008, 150,014 students took the GSAT, 93,681 sat for the AST, and 169,974 attempted the TVE JCEE. Hence, students at all levels face high-stakes exams that determine the future avenues available to them.

In summary, due to the age cutoffs for school entry, children born in August and September experience milestone events one year apart. As Figure 1 shows, August-born children start primary school in September of the year they turn six, enter middle school in September after turning 12, take high school entrance exams between May and July before turning 15, and take college entrance exams between January and July before turning 18. In contrast, September-born children experience these milestones one year later: they start primary school in September of the year they turn seven, enter middle school in September after turning 13, take high school entrance exams between May and July before turning 16, and take college entrance exams between January and July before turning 19.

b) The Mental Health Care System

[7] There is also a third track called the "Stars" program that aims to increase the representation of students from remote areas at elite schools by considering high school grades as well as the GSAT, but students must be nominated by their high school and there is a quota. For further information see: https://www.ceec.edu.tw/en/xmdoc/cont?xsmsid=0J180519600611186512. Since we are using medical data we do not see the educational track each child is in.

Taiwan's has a universal, single-payer, government-run health insurance program that covers 99.9 percent of the population. The insurance offers an extensive benefits package with low out-of-pocket costs. Copayments for prescription medications are capped at TWD 200 (~6.2 USD) with no annual maximum.

Psychiatric treatment is available in general hospitals, psychiatric institutes, or community clinics. Costs for these services, as well as for psychiatric medications, are covered by the insurance.[8] Notably, copayments associated with chronic mental health care are entirely waived. Appendix A lists the most commonly prescribed psychiatric drugs in Taiwan, by indication, with their market share. Common drugs like methylphenidate (for ADHD), trazodone (an antidepressant), sulpiride (an anti-psychotic), and alprazolam (for anxiety) are approved for use in children and adolescents in Taiwan. As in the U.S. any doctor can prescribe these medications. Note that in Taiwan, sulpiride is commonly prescribed for anxiety and depression as well as for psychosis (Huang, 2019).

As in the U.S., doctors in Taiwan typically follow the Diagnostic and Statistics Manual (DSM) for the diagnosis of specific mental disorders. In 2015-2017, Taiwan's National Epidemiological Study of Child Mental Disorders screened 4816 3rd, 5th, and 7th grade children in 69 schools for mental health disorders. The study reported similar prevalence rates to those found in U.S. children (Kessler et al., 2012; Bozinovic et al., 2021). The most common disorders were anxiety, with a lifetime (6-month) prevalence 15.2 percent (12.0 percent), and ADHD with a lifetime prevalence of 10.1 percent (8.7 percent) (Chen, 2019). The lifetime incidence of depression (either major depressive disorder or persistent depressive disorder) was 2.5 percent (0.9 percent). Compared to these rates, the point in time prevalence of diagnosis and prescription drug treatment of mental health disorders is low in our data, especially for ADHD, suggesting that those children who are being treated may be displaying severe symptoms. Other studies have also found low rates of medication usage for ADHD in Taiwan relative to

[8] For psychotherapy, the insurance only covers services provided by psychiatrists and clinical psychologists, but not those provided by counseling psychologists or other types of therapists. This may create a bias towards prescribing psychiatric medication since that is always covered.

the U.S. (Liao, 2023), though Taiwanese rates are more comparable to other places in Europe and East Asia (Raman et al., 2018).

There are several important differences between ADHD and the other mental health conditions considered here. First, ADHD is thought to reflect an underlying neurological condition that is unlikely to be caused by school stress, though its symptoms may be exacerbated. Second, ADHD is often diagnosed at school entry because diagnostic criteria require symptoms to be observed in two or more settings. There is no similar requirement for the other diagnoses. Third, many people believe that the stimulant medications prescribed for ADHD can help students academically and so some parents might want their children to take them for that reason. There is no similar expectation that antidepressants, anti-anxiety medications, or anti-psychotics help children learn except by addressing their mental health conditions. Moreover, it is unlikely that parents would demand these psychiatric medications for children without mental health conditions since they carry the risk of significant side effects. Hence, while all four classes of medication are included in the analysis for the sake of completeness, the interpretation of changes in prescribing are clearer for antidepressants, anti-anxiety medications, and antipsychotics than for ADHD medications.

III. Data

The main source of data for this study is administrative insurance claims. These claims cover prescription drugs, as well as outpatient and inpatient claims for the years 2000 to 2020. We focus on children born in either August or September between 1982 and 2014, so that they were born in either the month before or the month after the school entry cutoff. In what follows we also consider the robustness of our findings to the inclusion of additional months on either side of the school entry cutoff. The data is aggregated at the birth year and birth-month by calendar-year and calendar-month level.

The first set of analyses rely on event studies which include up to 12 months prior to the event month and 11 months after the event for each event. Hence, not all cohorts can be included when considering the impacts of all milestones. Analyses of primary school entry start with children born in 1994. Those born in August are treated in Sept. 2000, and prescriptions for those children can be seen for eight months prior to school entry and for 11 months after school entry. These children can be compared to children born in Sept. 1994 who are "treated" by school entry in Sept. 2001. The two 1994 birth cohorts yield 20 months of data on two cohorts, or 40 observations.

For birth years between 1995 and 2013, a full 12 months pre and 11 months post the treatment month can be observed so that there are 24 months for each of two cohorts for 19 years, or 912 observations. Finally, for those born in Sept. 2014, prescriptions can be observed for 12 months before the event but only three months afterwards. There are 16 observations for each of two cohorts, or 32 observations. In total then, there are 984 cells for people born between 1994 and 2014 that allow the effects of primary school entry to be identified.

Turning to the college entry exams, for people born in 1982 only the post period is observed for the August-born and September-born cohorts (24 observations). For birth years 1983 to 2002, 12 months before and 11 months after the event can be observed for each of the two birth-month cohorts for 20 years, which yields 960 observations (24*2*20). However, as discussed above, some students may be treated between January and July of their senior year, so potentially partially treated months are dropped in order to focus on a clean post period in which no one is still writing exams. This leaves 690 observations for cohorts born between 1982 and 2002 to identify the effects of college entry exams.[9]

In summary, in the main analyses, the effect of primary school entry is identified using cohorts born from 1994 to 2014, the effect of middle school entry is identified using cohorts born from 1988 to 2008, the effect of high school entry exams is identified using cohorts born from 1985 to 2005, and the effect of college entry exams is identified using cohorts born from 1982 to 2002. We have also replicated the main results using cohorts born from 1995 to 2002, so that the same cohorts, observed for the full 24-month period, can be used to study all of the milestones. See Appendix B for further information about sample construction.

[9] Similarly, when considering the high school entry exam, we drop the partially treated months between May and July and end up with 858 observations for cohorts born between 1985 and 2005.

The main measure examined is the number of people with psychiatric drug claims per 1000 individuals in the birth cohort as well as the number of people who have either a drug claim or a current psychiatric diagnosis. However, we also examine the number of drug days prescribed per 1000 people in the birth cohort as a measure of the extensive margin.

Table 1 shows summary statistics for the underlying individual-level data. The first column shows data for all people born between 1982 and 2014, whereas columns two and three show the August-born and the September-born respectively. The top half of the table shows that the differences in family background are very small between all three columns, and especially between the August-born and the September-born suggesting that these two birth cohorts are good controls for each other.

The bottom half of the table shows outcomes for the four types of psychiatric medications. In contrast with the very small differences in family background between the August-born and the September-born, the number of people with an ADHD prescription and the number of people who have either an ADHD diagnosis or an ADHD prescription is almost twice as large for the August-born, as is the number of days of ADHD medications prescribed.[10] The raw differences for antidepressants and antipsychotics are less dramatic, though these levels are all higher for the August-born than for the September-born. For anti-anxiety medication there are no consistent differences between the two groups of children.

Figure 2 provides an overview of the data on prescriptions per 1,000 by child age for the August-born and September-born cohorts. Separate sub-figures are shown for ADHD, antidepressant, antipsychotic, and anti-anxiety medications, which have quite different profiles by child age. Going from left to right, red vertical lines indicate when the August-born cohorts entered primary school, entered middle school, began high school entrance exams, and began college entry exams. The blue vertical lines indicate when the September-born cohorts reached the same milestones.

[10] The number of drug days is measured per 1,000 population. With 3.32 persons per 1,000 population taking ADHD medication and 119.83 drug days per 1,000 population, on average, each person takes the medication for about 36 days per month. The number of drug days per month can be higher than 30 because doctors may prescribe multiple medications at once and in such cases, we only record the highest number of drug days for each visit.

Figure 2a shows that consistent with previous work, the August-born show consistently higher usage of ADHD medications until the end of high school. However, one can also see how medication usage changes around the key school milestones: For example, it rises at age six and age 12 for the August-born and falls with the completion of high school and college entrance exams. The same patterns are apparent for the September-born (though more muted) but occur one year later.

Turning to antidepressants, use among the August-born rises noticeably at age 12 with entry into middle school, while in the September-born cohorts the rise appears at age 13, consistent with their delayed entry into middle school. The figure also shows declines in antidepressant use following the high-stakes high school and college entry exams.

These patterns are less apparent in the raw data for the number of children taking antipsychotics and anti-anxiety medications. Figures 2c and 2d feature pronounced seasonal swings in the use of these medications, with the troughs corresponding to winter and summer vacation months. As discussed below, we do find statistically significant effects on the prescribing of these medications, particularly on antipsychotics for boys, and anti-anxiety medications for girls.

Similar figures for the number of children with either a prescription or a diagnosis and for the number of drug days prescribed are shown in Appendix Figures 1 and 2, for the four types of psychotic medications. These alternative outcome measures show similar patterns.

IV. Methods

The analyses that follow zoom in on each milestone using an event-study framework to control for time-invariant differences between birth cohorts, as well as for time-varying factors including age and season. The initial models take the following form:

$$(1)\quad DrugPerCapita_{cmt} = \delta_{cm} + \theta_{ct} + \sum_{\substack{\tau\in[-12,11] \\ \tau\neq -1}} \beta_{\tau} * 1(RT_{cmt} = \tau) + \epsilon_{cmt},$$

where an observation is defined at the birth year (c), birth month (m), and calendar year-month (t) level, the δ_{cm} are birth year and month fixed effects, and the θ_{ct} are birth year by calendar year-month fixed effects. These regressions are weighted by the population in each birth year-month group and the standard errors are clustered at the birth year-month level.

These controls are potentially important. First, there are clear age patterns in the prescribing of psychiatric medications, as shown in Figure 2. ADHD medications are commonly given to young children and usage tends to decline as children age. On the other hand, antidepressants and anti-anxiety medications are prescribed more commonly as children grow older. The interaction of birth year and calendar year-month could also be important if there are secular trends in prescribing and given changes in the educational system over time.[11] In these event studies, the August-born children are the treated group, and are compared to the not-yet-treated September-born children. Comparing August-born and September-born children in the same birth year and calendar year-month, focuses on treated and untreated children who faced the same prescribing and educational environments except for the time to key milestones. Moreover, since for each event window (12-month prior and 11-month post the event time for the August-born), the September-born children are not yet treated and can be seen as clean controls. Hence, it is not necessary to worry about staggered treatment timing and dynamic treatment effects that can bias the standard two-way fixed effect model.

To summarize the overall effects, we also estimate models with a single "*PostEvent*" indicator equal to one in the post period but zero otherwise. These models take the form:

$$(2) DrugPerCapita_{cmt} = \delta_{cm} + \theta_{ct} + \beta PostEvent_{cmt} + \epsilon_{cmt},$$

where the event is the date that the August-born cohort starts school or starts taking exams.

In both sets of models, only data for 12 months prior to the event and 11 months after the month of the event are included for each birth year and month cohort. In addition, in model (2) for the high school entry and college entry exams, we exclude data from the partially treated period between the

[11] For example, Keng et al. (2017) report that between 1990 and 2011 many two-year colleges were converted to four-year colleges, and the pass-rate required to enter a four-year college declined. While this change might have been expected to reduce educational stresses, they also show that over the same period inequality within education levels increased, so that the importance of getting into a better four-year college could actually have increased.

beginning and ending of the exam period, since some students might still have been studying for upcoming exams.

This first set of analyses consider August-born children as the treatment group and September-born children as the control group. While this approach avoids the staggered treatment timing issue discussed earlier, it raises the question of whether the observed treatment effect for the August-born reflects a "young-for-grade" effect as well as the general effect of changes in academic stress. It is possible, given the extensive literature on children who are "young-for-grade," that the August-born children are more vulnerable to academic stresses. In this case, the treatment effect estimated using equations (1) and (2) may represent upper bounds on the stress-induced use of psychiatric medication for all students.

Hence, in an additional set of analyses, we examine whether, or to what extent, ask whether September-born children experience similar changes in prescribing when they hit the same milestones one year later. To do this, we lengthen the post period in model (2) to 24 months. In this extended sample, the treatment date is still the date when the August-born either started school or began writing exams. Instead of a single *Postevent indicator*, we include two indicators, *PostEvent_0_11* for 0-11 months and *PostEvent_12_23.* The coefficient on *PostEvent_0_11* captures the same comparison as in (2): It measures the difference in responses between the treated August-born cohort and the as yet untreated September-born cohort. The "*PostEvent_12_23*" indicator captures the period in which the August-born have already been treated for a year, and the September-born are newly treated by reaching the milestone. To see how the differences in the two post-event indicators can be interpreted, consider the following examples. Suppose medication use jumped for the August-born cohort after a particular milestone and then stayed constant. If medication use jumped by the same amount after the September-born reached the same milestone, the coefficient on "*PostEvent_12_23*" would be zero because after 12 months there would be no difference between the two cohorts. At the opposite extreme, if medication use jumped for the August-born and stayed high, and if the September-born did not respond at all to hitting the milestone, then the two coefficients would be the same—i.e. there would be the same difference between the

August-born and the September-born cohorts even after the September-born hit the milestone. In the intermediate case in which the "young-for-age" children show a greater response than the September-born, but the latter group had a non-zero response, the coefficient on *PostEvent_12_23* would be greater than zero but less than the coefficient on *PostEvent_0_11*.. A fourth possibility is that there are only very short-term effects of hitting milestones. In this case, the coefficients should be opposite in sign. For example, if medication use initially jumped for the August-born, then fell to zero, and then jumped for the September-born, the difference between the August-born and the September born would first be positive and then negative. We consider all these possibilities below.

To measure effect sizes in a broader sample of children, we also extend the analysis beyond August- and September-born children to include more months relative to the threshold. Specifically, we incorporate children born in June through August (or January through August) compared to those born in September through November (or September through December).

In addition, separate analyses are conducted by gender, and by income level. There are well-known gender differences in psychotropic prescribing, with boys more likely to be prescribed ADHD medications and anti-psychotics than girls, and girls more likely to be prescribed antidepressants and anti-anxiety medications. Hence, one might also expect to see gender differences in the impacts of educational milestones on prescribing practices. Educational pressures could also be greater for children from higher income backgrounds, leading to larger effects in this group. On the other hand, low-income children have been shown to be more likely to be prescribed psychotropic medications in some settings (Currie, Kurdyak, and Zhang, 2024).

Similarly, there could be regional differences in the competitive pressures facing school children. Although Taiwan is relatively small, survey evidence from the TEPS suggests that there are large regional differences in both parental and child expectations about whether a child will get a four-year degree. In Taipei, 73 (62) percent of parents (children) said that they expected their child to get a four-year degree compared to 46 (37) percent of parents (children) in Taitung. These differences in expectations may also be predictive of the impact of educational milestones on the use of psychiatric medications, a hypothesis that we investigate below.

One important question given our reliance on a comparison between those born just before the cutoff and just after the cutoff is whether there is evidence that birth timing is manipulated around the school entry cutoff. This concern is investigated in Appendix Figure 3, which shows the number of births from 60 days before the cutoff to 60 days afterwards. The figure does show a small spike in births just prior to the cutoff, suggesting that some people are timing their births early. If some parents give birth in August in order to enroll their children early and these parents also push their children more, then these children might face greater academic stress in which case we would over-estimate the impact of academic milestones. However, parents who time births so that their children can go to school early may actually be more concerned about the implications of school entry dates for childcare and parental employment than about academic attainment, which could lead to estimates that under-state the effects. In any case, the size of the uptick around the school entry date is minimal and comparable to the upticks seen for dates perceived as lucky, such as August 8th and October 10th.

The consistency of estimates obtained using slightly wider windows around the August/September cutoff suggest that any selection effects due to birth timing are quite small. The additional analysis that follows the both August-born and September-born children for 23 months after the August-born pass a milestone can also help to alleviate these concerns by examining the extent to which the September-born children experience the same increases in the use of psychiatric drugs once they are treated by hitting the school milestone.

V. Estimates

a) Event study estimates of effects of milestones on psychiatric prescribing

Estimates from the event study specification (1) are shown in Figures 3 through 6 for the number of people prescribed ADHD and antidepressant medications per 1000 individuals. Comparable figures for the number of days with ADHD or antidepressant medications and for the number of children with either a prescription or a diagnosis of one of these conditions are shown in Appendix Figures 6 and 7.

Figure 3 shows estimates for the effects of primary school entry. The raw data is shown on the left and the event study is shown on the right. The first pair of figures refer to ADHD, while the second pair refer to antidepressants. In all cases, the August-born are the “treated” group while the September-born children from the same birth year are the controls. Before the start of primary school, there is a slight upward trend in ADHD medication use, which may reflect parents' anticipation as they prepare their children for school. This trend is not observed for antidepressant use. Upon school entry, both types of medications show a clear jump, leading to the widening gap between the August-born and the September-born. This pattern could result either from heightened academic stress leading to more increases in mental health conditions and/or increased diagnosis of such conditions in the school setting. While we cannot rule out this diagnostic channel for primary school entry, it seems less likely to explain changes in medication use at middle school entry since children have already been observed in the school setting for some years at that point.

Figure 4 indicates that there is a further jump in medication use associated with middle school entry. We interpret this jump as evidence of the increasing pressure on children in middle school due to the importance of upcoming high school entry exams.

Turning to the high school entrance exams, Figure 5 shows that both ADHD medications and antidepressant use fall in the treatment group relative to the control group of September-born children who have not yet started these exams. For ADHD medications, the utilization rate among the August-born begins to decrease gradually during the last semester of middle school, potentially reflecting decisions by some students not to continue on an academic track. Following the end of the exam period, usage drops sharply and converges to the level observed among September-born children. For antidepressants, the September-born overtake the August-born after the exams, with no discernible pre-trend beforehand. Figure 6 shows that there is a similar drop in medication use associated with the end of college-entrance exams. Here the fall-off in medication use is more gradual consistent with the longer interval in which examinations are offered.

Event studies are shown for antipsychotics in Appendix Figure 4 and for anti-anxiety medications in Appendix Figure 5. These figures suggest that if anything prescriptions of these two types of medications fall at primary school entry, which may indicate some substitution away from them and towards the other two classes of medications. For example, preschool children with disruptive or aggressive behavior might be given antipsychotics or anti-anxiety medications (which are almost all benzodiazepines) in order to calm them since both types of medication are sedating. If they were diagnosed with ADHD at school entry, then their medications would be changed. For the other milestones the effects are similar in sign, though smaller in magnitude, than was described above for ADHD and antidepressant medications.

Estimates of equation (2), with a single "*PostEvent*" indicator are shown in Table 2. The first half of the table focuses on changes in ADHD and antidepressant prescribing around each event, while the second half of the table considers anti-psychotic and anti-anxiety prescribing. Each pair of columns corresponds to a different outcome variable, with columns 1 and 2 showing effects on the number of children with a prescription per 1000, columns 3 and 4 showing the number of children with either a prescription or a diagnosis per 1000, and columns 5 and 6 showing the number of days prescribed per 1000. The results are strikingly similar to those of the event studies across outcomes.

Primary school entry is associated with an over 400 percent increase in the number of children who have a prescription of ADHD medication and in the number of drug days prescribed relative to the pre-period means. The number of children who have either a prescription for ADHD or a diagnosis shows a smaller increase of 28.7 percent, suggesting that many children who have a diagnosis of ADHD are not started on medications until they enter school. The start of formal schooling is also associated with a significant 29.7 percent increase in the number of children with an antidepressant medication and a 50.8 percent increase in antidepressant days prescribed, although the baseline level of utilization is low in this age group. The estimates for anti-anxiety medications and antipsychotics are not consistent across outcomes—for example, primary school entry seems to be associated with an increase in diagnoses of anxiety but a reduction in the number of children receiving prescriptions for it (mostly benzodiazepines). The number of days prescribed rises for antipsychotics, but the number of children receiving them falls, suggesting perhaps that children who do receive them take them more intensively upon entering school.

Panel B shows that middle school entry is associated with increases in prescribing of all four medications. For example, the number of children receiving medications rises by 22.5 percent for ADHD, 39.7 percent for antidepressants, 8.5 percent for anti-anxiety medications, and 11.1 percent for antipsychotics. The results are similar for the number of children receiving either prescriptions or diagnoses, and for the number of drug days per child.

In contrast to the results above, Panel C shows that the use of psychiatric medications falls across the board following the high school entrance exams. The declines in psychiatric medications following high school entrance exams are remarkably similar to the increases in the use of such medications following middle school entry. For instance, the number of children receiving ADHD medications falls by 29.7 percent; the number of children receiving antidepressant medications falls by 28.1 percent; the number of children receiving anti-anxiety medications falls by 10.1 percent, and the number of children receiving antipsychotics falls by 8.7 percent. Hence, the picture that emerges is one in which entry into middle school ramps up the stress as students work towards the critical high school entrance exams. Finishing with those exams relieves that stress.

Panel D shows that the same is true at the completion of college entry exams. The figures indicate that the number of children prescribed ADHD medications falls by 42.8 percent; number of children with antidepressant medications falls by 39.9 percent; number of children with anti-anxiety medications falls by 13.4 percent, and number of children with antipsychotics falls by 8.7 percent. It is important to note that only approximately 80 percent of students go to college and so the treatment-on-the-treated effects may be larger.

Table 3 shows estimates for the effects of milestones on ADHD and antidepressant use in models in which cohorts are followed for 23 months after the event, rather than only for 11 months. The models are similar to equation (2) except that in addition to one indicator for the first 11 months after the event, a second indicator is added for the period months 12 to 23 after the event. The event itself is still defined as the date that the August-born children from that birth year reached the relevant milestone. Hence, the first indicator shows the difference between the August-born and the September-born in the year when the August-born have passed the milestone but the September-born have not. The second indicator compares the September-born who have just passed the milestone to the August-born who passed it a year ago. Appendix Figure 8 show event studies corresponding to this specification for the number of children with medication.

Reassuringly, the estimates on the 0-11 months post entry period are virtually identical to those shown in Table 2. Recall that if the September-born are affected in the same way as the August-born when they reach a milestone, then the coefficient on the indicator for post months 12-23 should be insignificant. In contrast, if the post 12–23-month indicator is significant and either similar in size or larger than the post 0-11 months indicator, then it suggests a "young-for-grade" effect in that the August-born continue to be more highly affected.

The estimates for primary school entry are suggestive of a strong "young-for-grade" effect. However, for all of the other milestones, the effects on the September-born are either similar to the August born (i.e. the post 12-23 month indicator is statistically insignificant), or smaller (i.e. the indicator is statistically significant but smaller than the estimate on the post 0-11 month indicator). Hence, these estimates suggest that while those who are young-for-grade are more vulnerable to mental health disorders at milestones, the September-born are also affected.

These estimates also suggest that the effects of reaching the milestones are not particularly short-lived. For example, if medication use initially jumped for the August-born but then fell to zero in the next 12 months, and if medication use then jumped for the September-born when they hit the milestone, the difference between the August-born and the September born would be first positive and then negative. However, these types of sign reversals do not occur.

To probe the robustness of the estimates, Appendix Table 1 shows estimates of equation (2) using a larger number of birth months in the comparison. For example, the first two columns of this table compare cohorts born in June through August of a given birth year with those born in September through November. The estimates are very similar to those in Table 2.

Appendix Table 2 shows estimates of equation (2) for the cohorts born between 1995 and 2002—the set of cohorts who experienced all four of the educational milestones. The point estimates are somewhat different than those shown in Table 2, but this is largely because the baseline levels of utilization of psychiatric medications are changing over time (which is another reason to focus this robustness check on similar cohorts). The percent effects are more very close to those discussed above. For example, middle school entry was associated with an increase of 20.7 percent in the number of children with ADHD medication prescribed and 39.3 percent in the number of children with antidepressants prescribed, compared to an estimated 22.5 percent increase in ADHD medications and a 39.7 percent increase in antidepressants in the full sample.

b) Heterogeneity in the effects by gender, income, and region

Figure 6 highlights differences in the estimated effects of educational milestones on boys and girls. The figure focuses on the number of children with prescriptions, but Appendix Figure 9 shows that the patterns are similar when either the number of children with either a prescription or a diagnosis or the number of days of drugs prescribed are considered. The figure shows that the overall qualitative pattern is similar for boys and girls: Prescriptions rise both with primary school entry and with middle school entry, and fall following high school entrance exams and college entrance exams.

However, effects on the types of medications prescribed differ sharply by gender. The effects on ADHD medications are larger for boys than for girls, consistent with boys being more likely to be treated for ADHD. Boys also seem to be somewhat more likely to be prescribed antipsychotics in middle school. In contrast, the estimated effects on antidepressants and anti-anxiety medications tend to be fairly similar for boys and girls until after the college entry exams, when girls show much sharper declines in the use of both types of medications.

Figure 7 explores heterogeneity in the estimated effects by family income. In order to conduct these analyses, children were linked to their parents based on data from the health insurance register. Only children who could be linked to both parents are used in this analysis, resulting in a smaller sample size. Parental income was measured during the year before each event, e.g. at age 5, 11, 14, and 17. Figure 7 indicates that children in the bottom quintile of family income are much more likely to be prescribed ADHD medications at school entry. However, children in the top quintile are more likely to receive prescriptions for ADHD at middle school entry and are more likely to reduce their use after high school and college entrance exams. Antidepressant use shows much less of a gradient by income.

Consistent with using a smaller sample size in these models, and with the smaller estimated effects on anti-psychotics and anti-anxiety medications in the full sample, we find that the pattern of signs for these two medications is consistent with what has been discussed – increases at primary and middle school entry and decreases after high stakes exams are over. However, the estimates by income quintile are not statistically significant for antipsychotics. For anti-anxiety medications we find significant positive effects for low-income children at middle school entry and significant negative effects after high school entry exams in the same group. For high-income children, there is a large negative effect on anti-anxiety medications after the college entry exams, suggesting that only at that point is the pressure relieved for them.

As discussed above, students in some parts of Taiwan experience much greater educational stress than in other areas. Hence one test of whether the effects we find represent educational stresses, is to look at variation in the estimated effects by region.

Figure 8 shows the correlation between county-level measures of parent's and children's educational expections from the 2011 wave of the TEPS. The measure is the share of parents (students) who expect to get a Bachelor degree. County-level measures of the effects of the milestones are obtained by estimating equation (2) separately for each county.

The figure shows that areas that have higher expectations for educational success have increased use of ADHD, antidepressant, and antipsychotic use at primary and middle school entry. These areas also show declines in the use of the same three medications after high school entry and college entry exams. For ADHD medications, all of the estimates are statistically significant, while for antidepressants, only the post-exam estimates are significant. The estimates for antipsychotics and anti-anxiety medications are not statistically significant.[12] These results are consistent with the idea that higher expectations for educational attainment amplify the effects of milestones on student's stress levels and use of mental health drugs, the small sample size (20 counties) makes it difficult to draw definitive conclusions.

VI. Discussion and Conclusions

This paper presents evidence that school milestones lead to significant changes in the use of psychiatric medications in Taiwan. We compare children born in August who enter school at age 6 to those born in September, who enter school at age 7. Hence, September-born children hit all educational milestones one year later. We find that entry into both primary school and middle school is associated with increases in mental health prescribing, not only for ADHD but also for antidepressants. Anti-anxiety and antipsychotic prescriptions also rise at middle school entry. Conversely, after high-stakes tests for high school entry and college entry, the use of psychiatric medications decreases, consistent with the relief of pressure leading to better mental health. Patterns of antipsychotic and anti-anxiety use are similar for middle school entry and post high-stakes tests. Hence, use of psychiatric medications increases at times when educational stressors increase and fall when the pressure is alleviated.

We find gender differences in these effects, with larger increases in ADHD and antipsychotic medications for boys, and larger effects on antidepressant and antianxiety medications for girls. Differences by parental income are less precisely estimated but suggest that children with parents in the lowest income quintile are more likely to be prescribed ADHD medications on primary school entry, but

[12] Appendix Figure 11 shows similar results for the number of days of medication use. For this outcome, the drop in the use of antipsychotics and anti-anxiety medications after high-school entrance exams is statistically significant.

for middle school entry and high school and college exams, children with parents in the top income quintile are most affected and most likely to be prescribed both ADHD medications and antidepressants.

An important question is whether these results represent a real effect of stressful school environments on mental health, or simply families trying to give their children an advantage in the high-stakes school environment through medication or treatment. We do find some evidence that, consistent with previous studies, the large rise in ADHD medications at primary school entry for the August-born is most severe among "young for grade" children. However, the fact that we also find changes in antidepressant, anti-anxiety, and antipsychotic medication use suggests that the mental health effect is real since these medications are not known to or thought to confer any academic advantage. Moreover, we also jumps in medication use among the September-born when they hit critical milestones. We find similar effects both for medications and diagnoses, suggesting that children faced with stressful milestones are being diagnosed as well as medicated at higher rates.

These results are consistent with previous survey evidence suggesting that schools are a major source of stress in the lives of many children. They suggest that parents and school administrators should pay particular attention to the mental health of children around stressful educational milestones, and consider more holistic and forgiving ways to assess children's educational progress.

References

Akee, Randall, William Copeland, and Emilia Simeonova. 2024. "Child Behavioral and Mental Health, Family Circumstance, and Long-Term Success: The Effect of Household Income," Journal of Human Resources, forthcoming.

Almond, Douglas. "Is the 1918 Influenza Pandemic Over? Long-Term Effects of *In Utero* Influenza Exposure in the Post-1940 U.S. Population." Journal of Political Economy, vol. 114, no. 4, 2006

Almond, Douglas, and Bhashkar Mazumder. 2011. "Health Capital and the Prenatal Environment: The Effect of Ramadan Observance during Pregnancy." American Economic Journal: Applied Economics, 3 (4): 56-85.

Allcott, Hunt, Luca Braghieri, Sarah Eichmeyer, and Matthew Gentzkow. 2020. "The Welfare Effects of Social Media." American Economic Review, 110 (3): 629-76.

Anniko, MK, Boersma K and Tillfors, M. 2019. Sources of stress and worry in the development of stress-related mental health problems: A longitudinal investigation from early- to mid-adolescence, Anxiety, Stress, and Coping, 32:2, 155-167.

Baird, S., J. de Hoop, and B. Özler. 2013. "Income shocks and adolescent mental health," Journal of Human Resources 48(2), 370–403.

Beck, Kathryn, Røhr, Helene, Reme, Bjorn-Atle, & Flatø, Martin. (2024). Distressing testing: A propensity score analysis of high-stakes exam failure and mental health. Child Development, 95, 242–260. https://doi.org/10.1111/cdev.13985

Bedard, Kelly, and Elizabeth Dhuey. "The Persistence of Early Childhood Maturity: International Evidence of Long-Run Age Effects." The Quarterly Journal of Economics, vol. 121, no. 4, 2006, pp. 1437–72.

Bethune, Sophie. 2014. "Teen Stress Rivals that of Adults," Monitor on Psychology, 45(4) 20 https://www.apa.org/monitor/2014/04/teen-stress.

Bharadwaj, Prashant, Manudeep Bhuller, Katrine Loken and Mirjam Wentzel. 2021. "Surviving a mass shooting," Journal of Public Economics, Elsevier, vol. 201(C).

Bhuller, Manudeep, Gordon Dahl, Katrine Loken, and Magne Mogstad. 2024. "The Effects of Domestic Violence on the Mental Health and Well-being of Victims and their Children," Journal of Human Resources, forthcoming.

Black, Sandra, Paul Devereux, and Kjell Salvanes. 2011. Too young to leave the nest? The effects of school starting age. The Review of Economics and Statistics, 93(2), 455-467.

Black, Sandra, Paul Devereux, and Kjell Salvanes. 2016. "Does Grief Transfer across Generations? Bereavements during Pregnancy and Child Outcomes, American Economic Journal: Applied Economics, 8(1)

Bozinovic, Kesten, Flannery McLamb, Katherine O'Connell, Natalie Olander, Zuying Feng, Sora Haagensen, and Goran Bozinovic. 2021. "US national, regional, and state-specific socioeconomic factors correlate with child and adolescent ADHD diagnoses pre-COVID-19 pandemic." Scientific reports 11, no. 1: 22008.

Braghieri, Luca, Ro'ee Levy, and Alexey Makarin. 2022. "Social Media and Mental Health." American Economic Review, 112 (11): 3660-93.

Bütikofer, Aline, Rita Ginja, Krzysztof Karbownik, and Fanny Landaud. 2024. "(Breaking) intergenerational transmission of mental health," Journal of Human Resources, forthcoming.

Bütikofer, Aline, Rita Ginja, Katrine Loken and Fanny Landaud. 2023. "Higher-Achievement Schools, Peers and Mental Health," The Economic Journal 133(655): 2580-2613.

Chandler, Vincent, Dörte Heger, Christiane Wuckel. 2022. "The perils of returning to school—New insights into the impact of school holidays on youth suicides," Economics of Education Review, 86

Chen, Mu-Hong, Wen-Hsuan Lan, Ya-Mei Bai, Kai-Lin Huang, Tung-Ping Su, Shih-Jen Tsai, Cheng-Ta Li, Wei-Chen Lin, Wen-Han Chang, Tai-Long Pan, Tzeng-Ji Chen, Ju-Wei Hsu. 2016. "Influence of Relative Age on Diagnosis and Treatment of Attention-Deficit Hyperactivity Disorder in Taiwanese Children," The Journal of Pediatrics, 172: 162-167.

Chen Yi-Lung, Chen Wei, Lin Kuon-Chia, Shen Lih-Jong, Gau Susan. Prevalence of DSM-5 mental disorders in a nationally representative sample of children in Taiwan: methodology and main findings. Epidemiol Psychiatr Sci. 2019 Jan 30;29:e15. doi: 10.1017/S2045796018000793.

Cosma Alina, Gonneke Stevens, Gina Martin, Eliza Duinhof, Sophia Walsh, Irene Garcia-Moya, Andras Költő, Inese Gobina, Natale Canale, Carolina Catunda, Jo Inchley, Margaretha de Looze. 2020. "Cross-National Time Trends in Adolescent Mental Well-Being From 2002 to 2018 and the Explanatory Role of Schoolwork Pressure." J Adolesc Health. Jun; 66(6S):S50-S58.

Currie, Janet. forthcoming. "Child Mental Health as Human Capital," Advances in Economics and Econometrics: Twelfth World Congress, Victor Chernozhukov, Emmanuel Farhi, Johannes Hörner, Eliana La Ferrara (eds.) (Cambridge University Press: Cambridge).

Currie, Janet, Paul Kurdyak, and Jonathan Zhang. "Socioeconomic Status and Access to Mental Health Care: The Case of Psychiatric Medications for Children in Ontario Canada," Journal of Health Economics, 93, 2024, 102841 doi: https://doi.org/10.1016/j.jhealeco.2023.102841

Dhuey, Elizabeth, and Stephen Lipscomb. 2010. "Disabled or young? Relative age and special education diagnoses in schools." Economics of Education Review, 29.5: 857-872.

Elder, Todd E. 2010. "The importance of relative standards in ADHD diagnoses: Evidence based on exact birth dates," Journal of Health Economics, 29, 641–656.

Evans, William, Melinda Morrill, and Stephen Parente. 2010. "Measuring inappropriate medical diagnosis and treatment in survey data: The case of ADHD among school-age children," Journal of Health Economics 29(5):657-673.

Fredriksson, Peter, Björn Öckert. 2014. Life-cycle Effects of Age at School Start, The Economic Journal, 124(579):977–1004

Furzer, Jill, Lauren Jones, and Mark Stabile. 2024. "Recessionary Impacts on Child Mental Health Designations in School: Evidence from New Data Linkages," Journal of Human Resources, forthcoming.

Golberstein, Ezra, Gilbert Gonzales, and Ellen Meara. 2019. "How Do Economic Downturns Affect the Mental Health of Children? Evidence from the National Health Interview Survey," Health Economics, 28 (8): 955–70.

Hansen, Benjamin and Matthew Lang. 2011. "Back to school blues: Seasonality of youth suicide and the academic calendar," Economics of Education Review 30(5): 850-861.

Hansen**,** Benjamin, Matthew Lang, Jessamyn Schaller, and Joseph Sabia. 2024. "Suicidality, Bullying, School Calendars, and Remote Education," Journal of Human Resources.

Heissel, Jennifer, Emma Adam, Jennifer Doleac, David Figlio, Jonathan Meer; Testing, Stress, and Performance: How Students Respond Physiologically to High-Stakes Testing. Education Finance and Policy 2021; 16 (2): 183–208. doi: https://doi.org/10.1162/edfp_a_00306

Holland, Josephine, and Kapil Sayal. 2019. "Relative age and ADHD symptoms, diagnosis and medication: a systematic review." European Child & Adolescent Psychiatry 28.11: 1417-1429.

Högberg, Björn M. Strandh, C. Hagquist. 2020. "Gender and secular trends in adolescent mental health over 24 years – the role of school-related stress," Soc. Sci. Med. p. 112890

Huang, Chih-Wan, Chiu, Yu-Wen, Chen, Pei-Jung, Yu, Nan-Wen, Tsai, Hui-Ju, and Chang, Chia-Ming. 2019. Trends and factors in antipsychotic use of outpatients with anxiety disorders in Taiwan, 2005–2013: A population-based study. Psychiatry Clin. Neurosci., 73: 501-507. https://doi.org/10.1111/pcn.12861

Keng, Shao-Hsun, Chun-Hung Lin, and Peter F. Orazem. 2017. "Expanding College Access in Taiwan, 1978-2014: Effects on Graduate Quality and Income Inequality," Journal of Human Capital 11(1):1-34

Kessler RC, Avenevoli S, Costello EJ, Georgiades K, Green JG, Gruber MJ, He J-P, Koretz D, McLaughlin KA and Petukhova M (2012) Prevalence, persistence, and sociodemographic correlates of DSM-IV disorders in the National Comorbidity Survey Replication Adolescent Supplement. Archives of General Psychiatry 69, 372–380.

Kouzma, Nadya M., and Gerard A. Kennedy. 2004. "Self-reported sources of stress in senior high school students," Psychological Reports, 94, 314-316.

Ching Liao, Fang-Ju Lin, Chien-Ning Hsu, Susan Shur-Fen Gau, Chi-Chuan Wang. 2023. Prescribing patterns for attention deficit hyperactivity disorder among children and adolescents in Taiwan from 2004 to 2017, Journal of the Formosan Medical Association, 122(6): 514-517.

Linder Anna, Martin Nordin, Ulf Gerdtham, Gawain Heckley. 2023. "Grading bias and young adult mental health," Health Economics, Mar;32(3):675-696. doi: 10.1002/hec.4639.

Peng, Sydney and Matthew Hsiao. 2023. "Why are Taiwanese school kids exhausted and afraid of failure?" Commonwealth Magazine, Nov. 7 https://english.cw.com.tw/article/article.action?id=3557#:~:text=The%20Child%20Welfare%20League%20Foundation,to%2028%20percent%20this%20year

Persson, Petra and Maya Rossin-Slater (2018). “Family ruptures and intergenerational transmission of stress.” American Economic Review 108(4), 1214–1252.

Persson, Petra, Xinyao Qiu and Maya Rossin-Slater. 2021. “Family Spillover Effects of Marginal Diagnoses: The Case of ADHD,” NBER Working Paper 28334, Jan.

Raman, Sudha R., Kenneth KC Man, Shahram Bahmanyar, Anick Berard, Scott Bilder, Takoua Boukhris, Greta Bushnell et al. 2018. “Trends in attention-deficit hyperactivity disorder medication use: a retrospective observational study using population-based databases.” The Lancet Psychiatry 5, no. 10: 824-835.

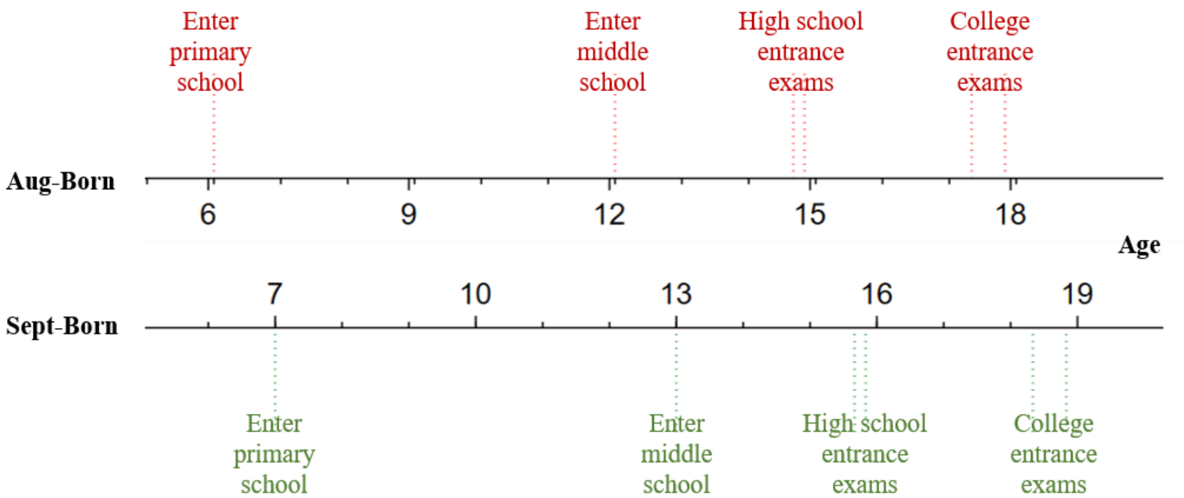
Rossin-Slater, Maya, Schnell, Molly, Schwandt, Hannes, Trejo, Sam, and Uniat, Lindsey. 2020. “Local Exposure to School Shootings and Youth Antidepressant Use.” Proceedings of the National Academy of Sciences, 117(38): 23484-23489, September.

Schwandt, Hannes, and Amelie Wuppermann. 2016. “The youngest get the pill: ADHD misdiagnosis in Germany, its regional correlates and international comparison.” Labour Economics, 43: 72-86.

Wilens, T.E.; Kaminski, T.A. 2019. “Prescription Stimulants: From Cognitive Enhancement to Misuse,” Pediatr. Clin. N. Am. 66: 1109–1120.

World Health Organization. 2021. “Mental Health of Adolescents,” Nov. 17, https://www.who.int/news-room/fact-sheets/detail/adolescent-mental-health

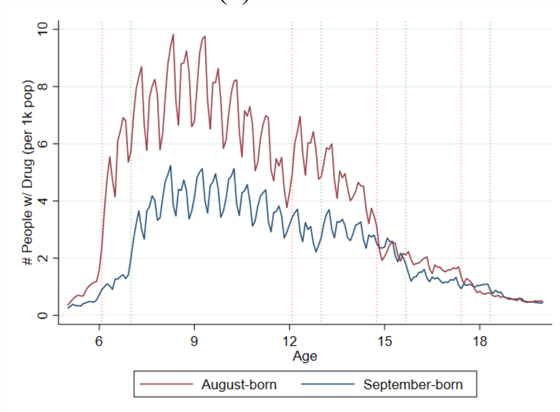
Figure 1: Timeline of School Milestones for August-Born and September-Born



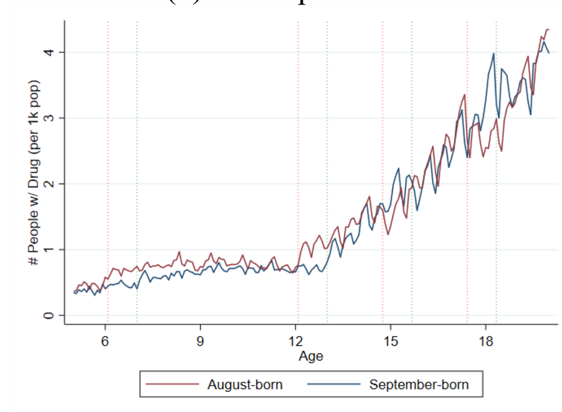
Notes: This figure shows the timelines for August-born (upper) and September-born (lower) cohorts as they experience four school milestones: primary and middle school entry, and high-stakes testing for high school and college entry. Labels on the timeline indicate the age in years for each cohort. The minor ticks represent September of each year, aligning with the age labels for September-born children, while being one month apart from the age labels for August-born children. Both primary and middle school entry occur in September. High school entrance exams take place between May and July, while college entrance exams are between January and July.

Figure 1: Number of Children with Drug Claims per 1,000 by Age for August-Born and September-Born Cohorts

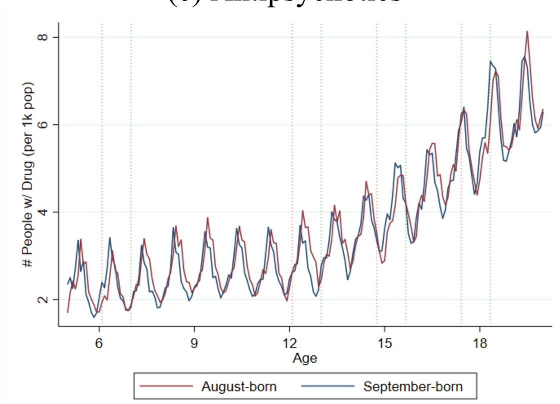
(a) ADHD



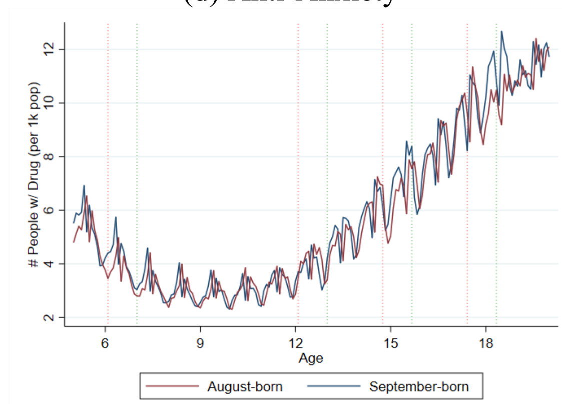
(b) Antidepressants



(c) Antipsychotics



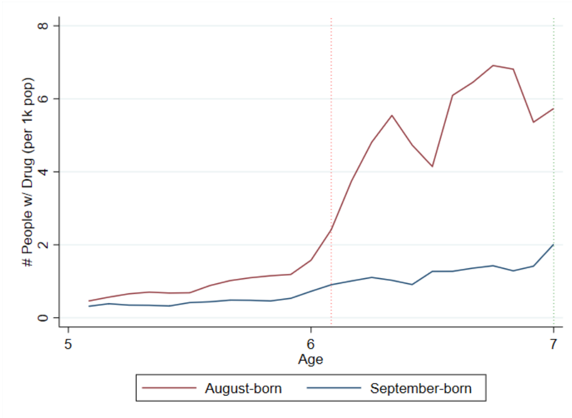
(d) Anti-Anxiety



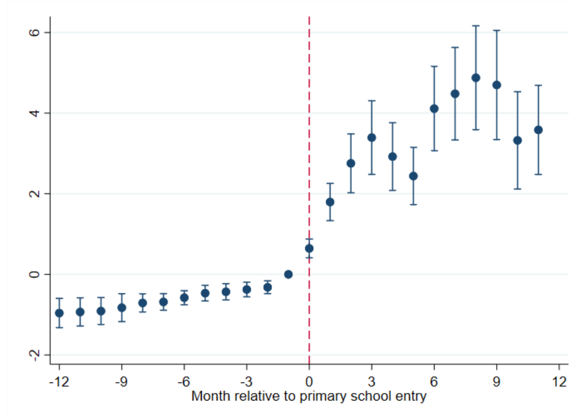
Notes: These figures present the number of people per 1,000 population with (a) ADHD, (b) antidepressants, (c) antipsychotics, and (d) anti-anxiety medications by age. The sample consists of children aged 5 to 20, born between 1984 and 2014. August-born are shown in red and September-born are shown in blue over calendar years 2000 to 2020. From left to right, the red vertical lines indicate when the August-born cohorts entered primary school, entered middle school, began high school entrance exams, and began college entry exams, while the blue vertical lines indicate when the September-born cohorts reached the same milestones.

Figure 2: Counts and Event Studies of the Effects of Primary School Entry on the Number of People with Drug Claims per 1,000 for the August-born and September-born

Panel A: ADHD

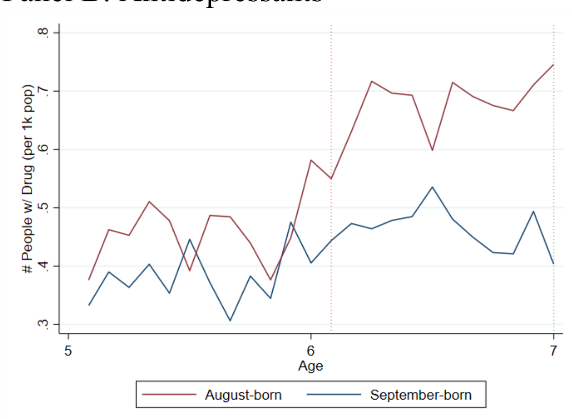


(a) Counts

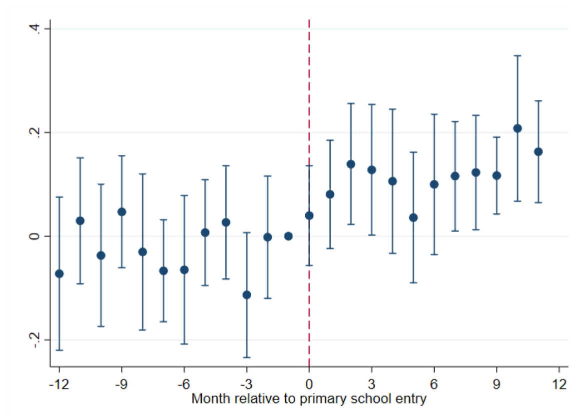


(b) Event Study

Panel B: Antidepressants



(a) Counts

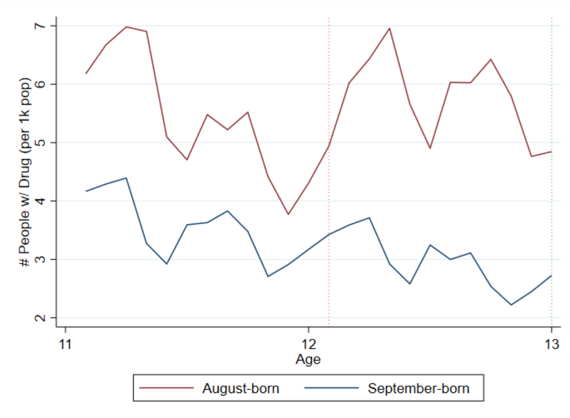


(b) Event Study

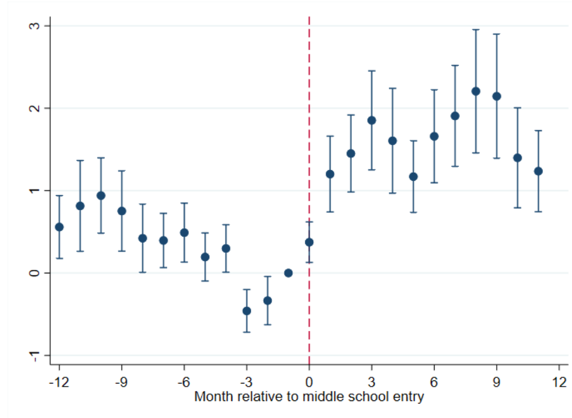
Notes: These figures show (a) the raw data and (b) the event study figures for the number of people prescribed ADHD medication (Panel A) and antidepressants (Panel B) per 1,000 individuals. The event study estimates are from Equation (1). The treated group consists of those born in August, and the control group consists of those born in September. The sample period is [-12, 11] months relative to the event time, i.e., the September of the year the child turned six.

Figure 3: Counts and Event Studies of the Effects of Middle School Entry on the Number of People with Drug Claims per 1,000 for the August-born and September-born

Panel A: ADHD

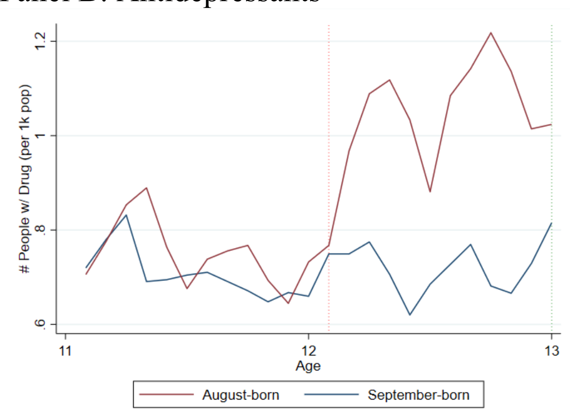


(a) Counts

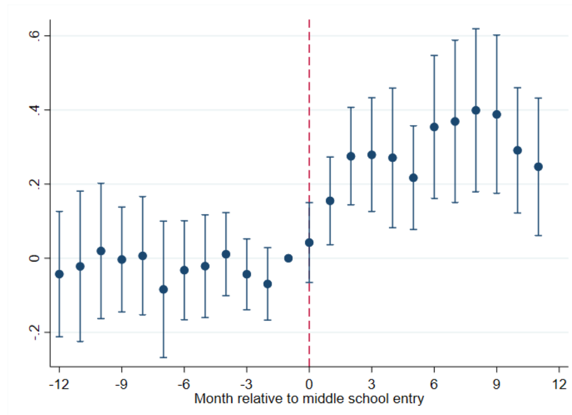


(b) Event Study

Panel B: Antidepressants



(a) Counts

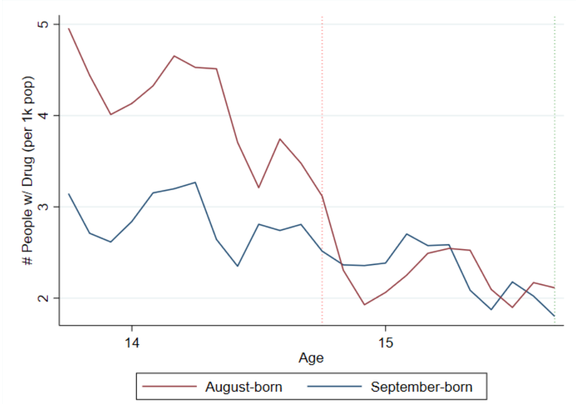


(b) Event Study

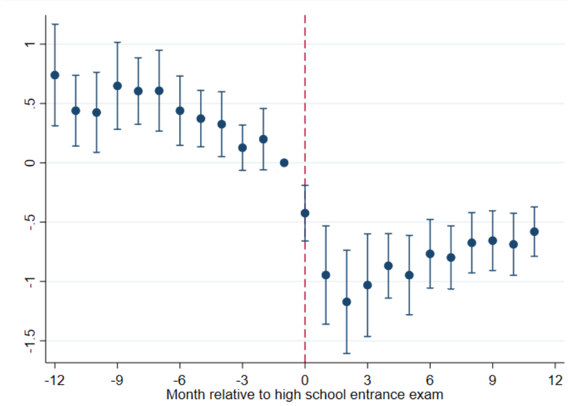
Notes: These figures show (a) the raw data and (b) the event study figures for the number of people prescribed ADHD medication (Panel A) and antidepressants (Panel B) per 1,000 individuals. The event study shows estimates from Equation (1). The treated group consists of those born in August, and the control group consists of those born in September. The sample period is [-12, 11] months relative to the event time, i.e., the September of the year the child turned 12.

Figure 4: Counts and Event Studies of the Effects of the Commencement of High School Entrance Exams on the Number of People with Drug Claims per 1,000 for the August-born and September-born

Panel A: ADHD

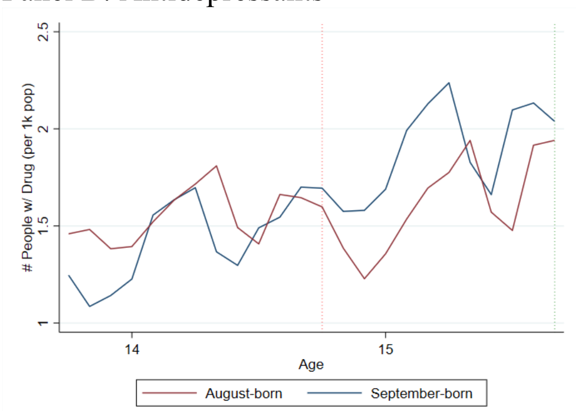


(a) Counts

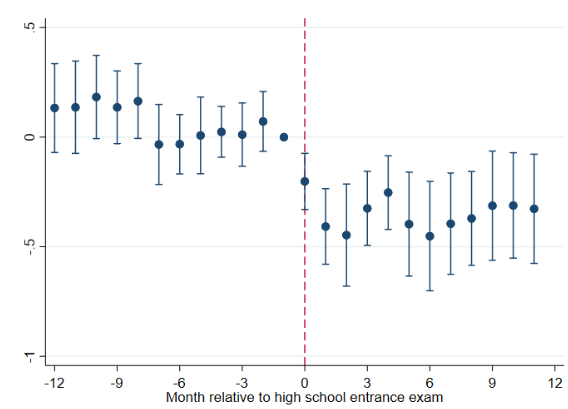


(b) Event Study

Panel B: Antidepressants



(a) Counts

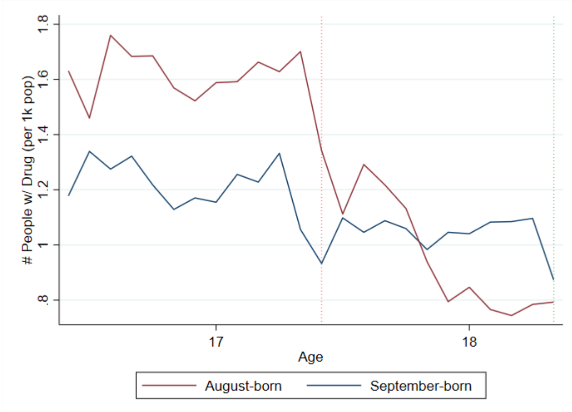


(b) Event Study

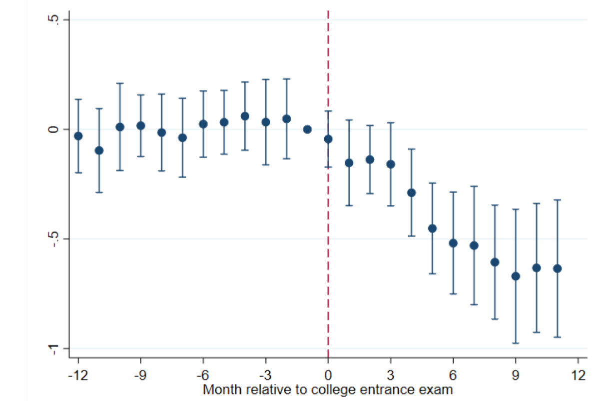
Notes: These figures show (a) the raw data and (b) the event study figures for the number of people prescribed ADHD medication (Panel A) and antidepressants (Panel B) per 1,000 individuals. The event study shows estimates from Equation (1). The treated group consists of those born in August, and the control group consists of those born in September. The sample period is [-12, 11] months relative to the event time, i.e., the May of the year the child turned 15.

Figure 5: Counts and Event Studies of the Effects of the Commencement of College Entrance Exams on the Number of People with Drug Claims per 1,000 for the August-born and September-born

Panel A: ADHD

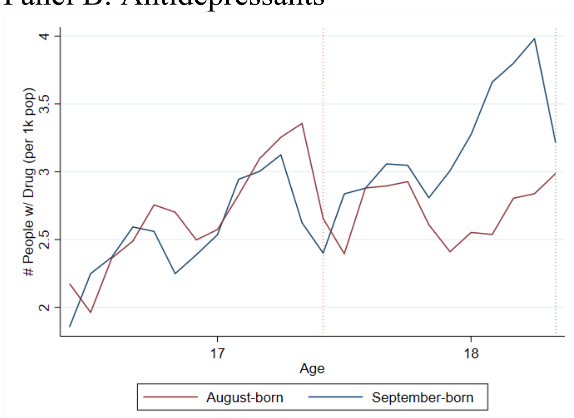


(a) Counts

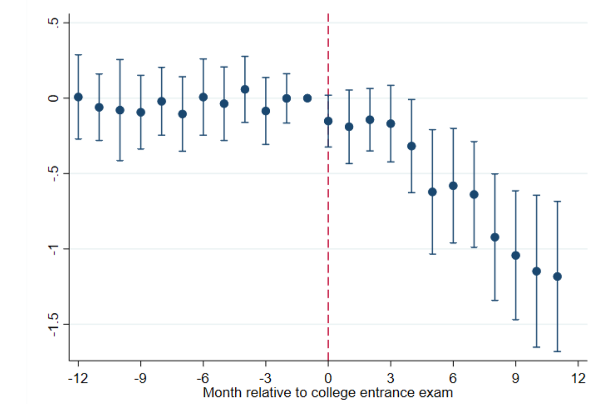


(b) Event Study

Panel B: Antidepressants



(a) Counts

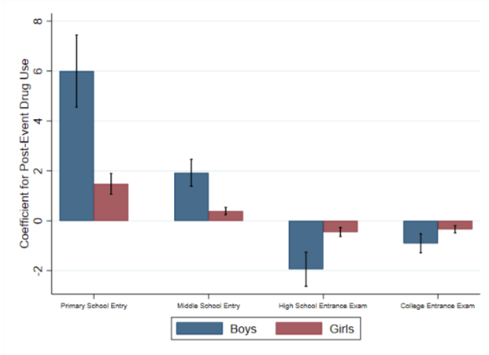


(b) Event Study

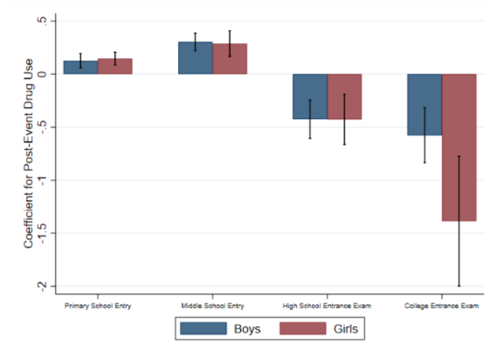
These figures show (a) the raw data and (b) the event study figures for the number of people prescribed ADHD medication (Panel A) and antidepressants (Panel B) per 1,000 individuals. The event study shows estimates from Equation (1). The treated group consists of those born in August, and the control group consists of those born in September. The sample period is [-12, 11] months relative to the event time, i.e., the January of the year the child turned 18.

Figure 6: Effects on the Number of People with Drug Claims per 1,000, by Gender

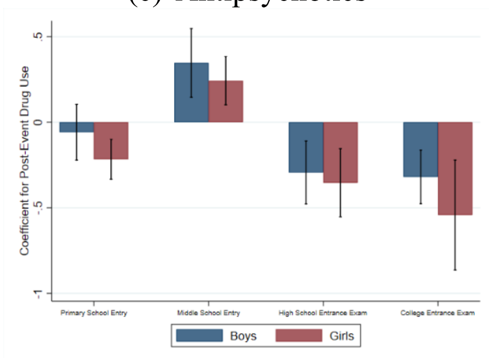
(a) ADHD



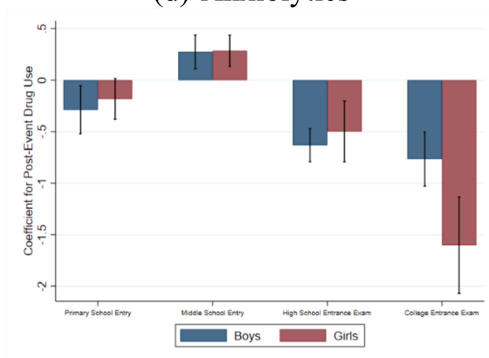
(b) Antidepressants



(c) Antipsychotics

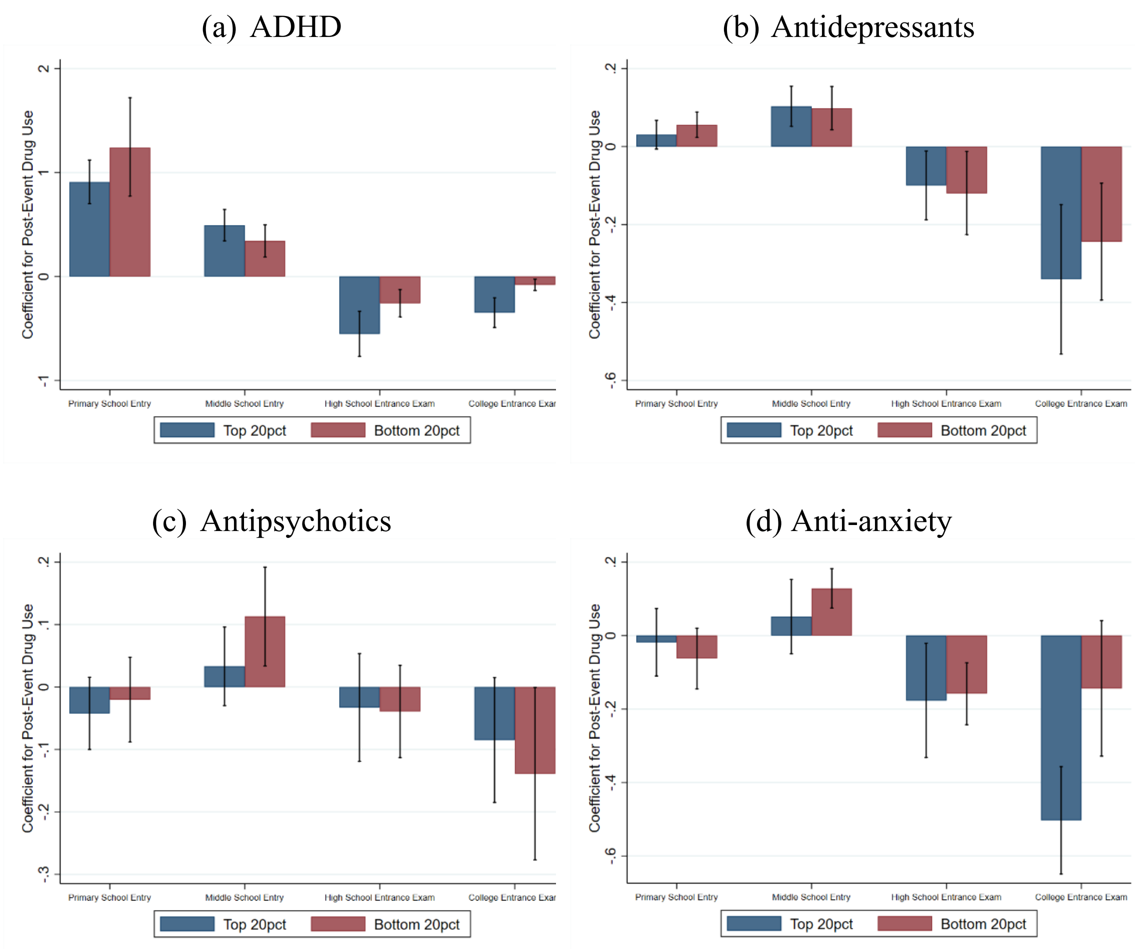


(d) Anxiolytics



Notes: These figures show estimated coefficients on "*PostEvent*" from models similar to (2) estimated separately by gender. 95 percent confidence intervals are indicated by black vertical bars.

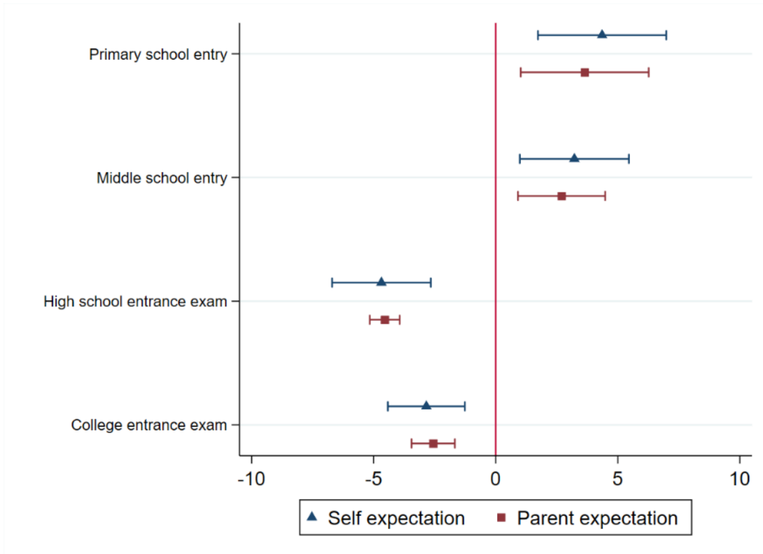
Figure 7: Effects on the Number of People with Drug Claims per 1,000, Top and Bottom Quintiles of Family Income



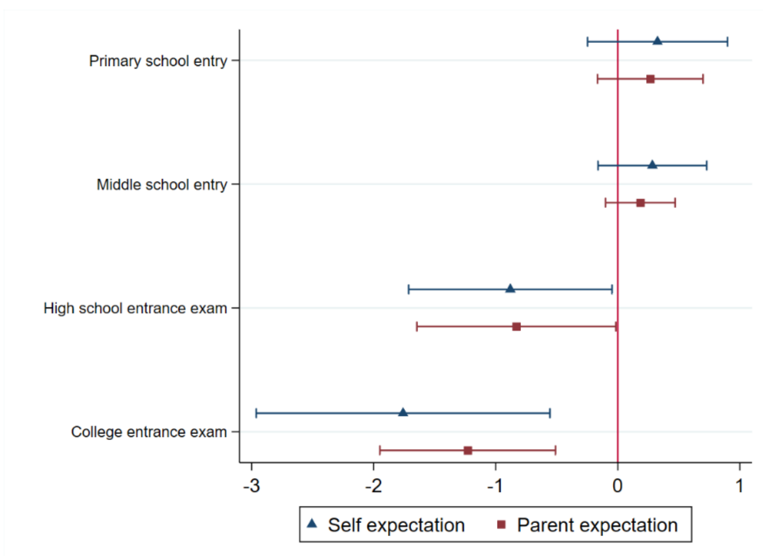
Notes: These figures show coefficient estimates for "*PostEvent*" from models similar to (2) estimated separately by whether family income (measured in the year before each event) is above the top or below the bottom quintiles. 95 percent confidence intervals are indicated by black vertical bars.

Figure 8: Correlation between Regional Difference in Education Expectations and the Effects of Milestones on the Number of People with Drug Claims per 1,000

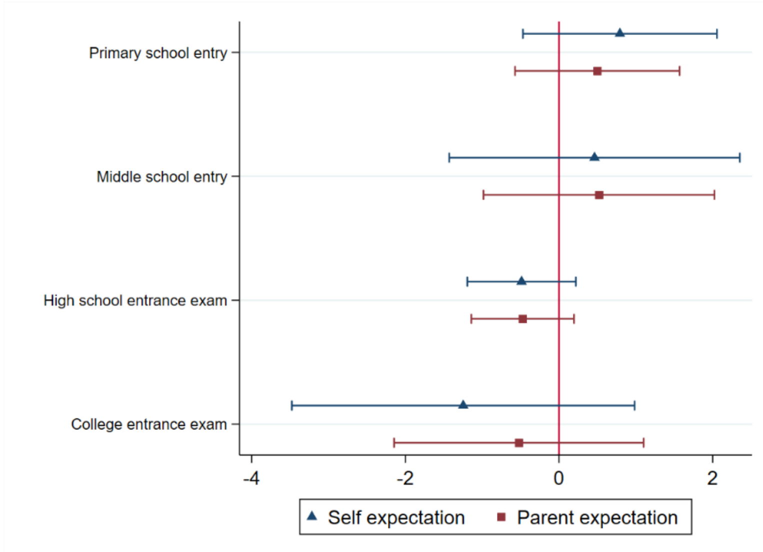
(a) ADHD



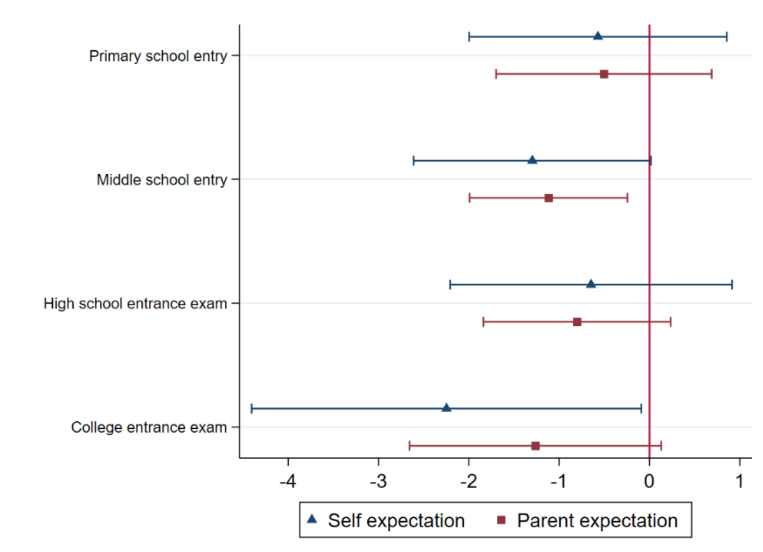
(b) Antidepressants



(c) Antipsychotics



(d) Anti-anxiety



Notes: These figures show the correlation between regional average education expectations and the effect of school milestones on psychiatric medication prescriptions. Education expectations, collected from TEPS 2011, measure the share of middle school students (and their parents) who aspire to a bachelor's degree or above. The effects of milestones are constructed based on regression (2) for each of 20 counties separately. All correlations are weighted by the number of children in each county used in estimating the milestone effect. The horizontal bars represent the 95% confidence interval based on robust standard errors.

Table 1: Summary Statistics

Individual and Family Characteristics	All	Aug-born	Sept-born
Age (in 2020)	23.9	24.1	24.1
Female (%)	47.98	48.1	48.0
Born in urban area (%)	68.7	68.6	68.7
Birth weight (g)	3,054.5	3,040.0	3,050.2
Medical spending (at age 5)	13,057	13,681	13,111
Parental income (at age 5)	668,273	665,209	660,777
Single parent (at age 5, %)	5.19	5.16	5.27
# Siblings (at age 5)	0.65	0.66	0.65
Outcomes (monthly per 1k pop)			
ADHD			
Number of people w/ drug	3.32	4.44	2.38
Number of people w/ drug or diagnosis	6.32	8.04	5.17
Number of drug covered days	119.83	160.96	85.53
Antidepressants			
Number of people w/ drug	1.43	1.45	1.35
Number of people w/ drug or diagnosis	1.73	1.73	1.62
Number of drug covered days	36.47	36.85	34.44
Anti-anxiety			
Number of people w/ drug	5.80	5.74	5.84
Number of people w/ drug or diagnosis	6.64	6.73	6.57
Number of drug covered days	52.60	52.17	51.88
Antipsychotics			
Number of people w/ drug	3.60	3.62	3.49
Number of people w/ drug or diagnosis	3.63	3.65	3.52
Number of drug covered days	53.96	54.31	50.12
Population	9,324,627	809,093	806,752

Notes: Sample includes individuals born in 1982-2014 unless otherwise specified. Birth weight and family characteristics (parental income, single parent status, and number of siblings) are only observed for cohorts born after 2004. Medical spending at age 5, which includes insurance payments and out-of-pocket spending, is only observed for cohorts born after 1995. Spending and income are in real 2020 NTD where one NTD = 0.034 USD. Income is calculated on a smaller sample in which children could be matched to both parents. Single-parent households are defined as a household with child(ren) under 18 and one unmarried adult who is the bio-parent of the child(ren). Outcome variables are measured in year 2000-2020, when sampled individuals are 5-20 years old.

Table 2: Estimated Effect of Events on Psychiatric Prescribing

	(1)	(2)	(3)	(4)	(5)	(6)
	# People w/ drug per 1k population		**# People w/ drug/diagnosis per 1k population**		**# Drug days per 1k population**	
	ADHD	Antidepressant	ADHD	Antidepressant	ADHD	Antidepressant
Panel A: Primary School Entry						
Post	3.819*	0.136*	2.662*	0.168*	123.0*	3.652*
	(0.464)	(0.0209)	(0.278)	(0.0232)	(15.57)	(0.624)
Observations	984	984	984	984	984	984
Dep. mean	1.972	0.485	8.903	0.512	61.65	8.126
Dep. Mean (pre)	0.895	0.458	9.287	0.480	26.41	7.193
Panel B: Middle School Entry						
Post	1.183*	0.296*	1.319*	0.344*	45.01*	7.630*
	(0.165)	(0.0414)	(0.184)	(0.0447)	(6.746)	(1.118)
Observations	984	984	984	984	984	984
Dep. mean	4.447	0.807	5.495	0.949	165.5	20.55
Dep. Mean (pre)	5.264	0.746	6.494	0.875	196	18.51
Panel C: High School Entrance Exam						
Post	-1.178*	-0.414*	-1.058*	-0.481*	-48.89*	-12.52*
	(0.204)	(0.0862)	(0.178)	(0.0843)	(8.511)	(2.508)
Observations	858	858	858	858	858	858
Dep. mean	2.929	1.588	3.406	1.945	115.3	41.88
Dep. Mean (pre)	3.960	1.472	4.483	1.783	157.5	38.76
Panel D: College Entrance Exam						
Post	-0.633*	-0.969*	-0.584*	-1.046*	-26.32*	-27.78*
	(0.125)	(0.179)	(0.115)	(0.200)	(5.125)	(5.853)
Observations	690	690	690	690	690	690
Dep. mean	1.196	2.604	1.441	3.167	46.47	68.83
Dep. Mean (pre)	1.479	2.427	1.741	2.947	58.11	64.09

Table 2: Estimated Effect of Events on Psychiatric Prescribing, continued

	(7)	(8)	(9)	(10)	(11)	(12)
	# People w/ drug per 1k population		**# People w/ drug/diagnosis per 1k population**		**# Drug days per 1k population**	
	Anxiolytics	Antipsychotics	Anxiolytics	Antipsychotics	Anxiolytics	Antipsychotics
Panel A: Primary School Entry						
Post	-0.238	-0.135	0.327*	-0.128	-1.616	2.274
	(0.0892)	(0.0591)	(0.0803)	(0.0589)	(0.876)	(1.007)
Observations	984	984	984	984	984	984
Dep. mean	4.500	2.282	5.018	2.288	29.43	18.21
Dep. Mean (pre)	5.092	2.325	5.475	2.331	32.60	15.89
Panel B: Middle School Entry						
Post	0.279*	0.297*	0.504*	0.302*	3.006*	3.465
	(0.0572)	(0.0676)	(0.0640)	(0.0676)	(0.734)	(1.739)
Observations	984	984	984	984	984	984
Dep. mean	3.561	2.779	4.526	2.790	25.46	38.76
Dep. Mean (pre)	3.273	2.679	4.321	2.688	23.69	37.43
Panel C: High School Entrance Exam						
Post	-0.569*	-0.312*	-0.855*	-0.311*	-5.925*	-4.307*
	(0.0861)	(0.0651)	(0.125)	(0.0647)	(1.557)	(1.463)
Observations	858	858	858	858	858	858
Dep. mean	6.166	3.807	7.120	3.836	51.96	54.62
Dep. Mean (pre)	5.655	3.583	6.747	3.612	46.80	51.45
Panel D: College Entrance Exam						
Post	-1.171*	-0.427*	-1.464*	-0.432*	-17.18*	-6.808
	(0.153)	(0.0997)	(0.179)	(0.100)	(3.231)	(2.745)
Observations	690	690	690	690	690	690
Dep. mean	9.225	4.993	10.21	5.037	90.07	76.33
Dep. Mean (pre)	8.764	4.898	9.791	4.938	83.95	73.12

Notes: This table shows estimates of the coefficient on "PostEvent" from equation (2). The sample includes data from 12 months before the event to 11 months after the event. In the case of high school entrance and college entrance exams, partially treated post months are dropped so that Panel C include data for post months 2 to 11 while Panel D includes data for post months 7 to 11. An asterisk indicates that the results are statistically significant at the 95 percent level of confidence.

Table 3: Estimated Effect of Events on Psychiatric Prescribing, with a 23 month "Post Event" Window

	(1)	(2)	(3)	(4)	(5)	(6)
	# People w/ drug per 1k population		# People w/ drug/diagnosis per 1k population		# Drug days per 1k population	
	ADHD	Antidepressant	ADHD	Antidepressant	ADHD	Antidepressant
Panel A: Primary School Entry						
Post 0-11	3.834*	0.137*	2.673*	0.169*	123.6*	3.666*
	(0.462)	(0.0210)	(0.274)	(0.0232)	(15.50)	(0.625)
Post 12-23	4.143*	0.109*	2.686*	0.156*	149.7*	3.777*
	(0.577)	(0.0381)	(0.344)	(0.0375)	(21.60)	(0.952)
Observations	1,448	1,448	1,448	1,448	1,448	1,448
Dep. mean	3.218	0.532	9.593	0.571	105.1	9.808
Dep. Mean (pre)	0.895	0.458	9.287	0.480	26.41	7.193
p-value	0.0447	0.402	0.962	0.694	0.000618	0.899
Panel B: Middle School Entry						
Post 0-11	1.182*	0.298*	1.317*	0.346*	44.96*	7.643*
	(0.165)	(0.0415)	(0.185)	(0.0447)	(6.765)	(1.119)
Post 12-23	0.474*	0.195*	0.389*	0.208*	21.65*	6.101*
	(0.133)	(0.0642)	(0.140)	(0.0709)	(5.857)	(1.709)
Observations	1,448	1,448	1,448	1,448	1,448	1,448
Dep. mean	4.424	0.949	5.364	1.134	166.4	24.50
Dep. Mean (pre)	5.264	0.746	6.494	0.875	196	18.51
p-value	1.46e-07	0.0209	1.26e-08	0.0121	8.41e-06	0.200
Panel C: High School Entrance Exam						
Post 3-11	-1.175*	-0.407*	-1.056*	-0.474*	-48.76*	-12.43*
	(0.204)	(0.0871)	(0.179)	(0.0849)	(8.523)	(2.512)
Post 15-23	-0.597*	-0.0198	-0.585*	-0.00426	-25.16*	-0.705
	(0.138)	(0.0852)	(0.132)	(0.0965)	(5.516)	(2.458)
Observations	1,210	1,210	1,210	1,210	1,210	1,210
Dep. mean	2.575	1.805	3.008	2.198	101.2	47.79
Dep. Mean (pre)	3.960	1.472	4.483	1.783	157.5	38.76
p-value	2.39e-06	8.75e-05	1.47e-05	9.62e-05	1.60e-06	5.47e-05
Panel D: College Entrance Exam						
Post 7-11	-0.621*	-0.947*	-0.574*	-1.021*	-25.87*	-27.07*
	(0.123)	(0.175)	(0.114)	(0.196)	(5.063)	(5.739)
Post 19-23	-0.336*	-0.0117	-0.341*	-0.00840	-14.11*	-1.204
	(0.0686)	(0.103)	(0.0691)	(0.110)	(2.962)	(2.985)
Observations	890	890	890	890	890	890
Dep. mean	1.053	2.824	1.280	3.439	40.75	74.62
Dep. Mean (pre)	1.479	2.427	1.741	2.947	58.11	64.09
p-value	0.000178	7.85e-07	0.000304	2.63e-06	8.85e-05	1.34e-05

Table 3: Estimated Effect of Events on Psychiatric Prescribing, with a 23 Month "Post Event" Window, continued

	(7)	(8)	(9)	(10)	(11)	(12)
	# People w/ drug per 1k population		**# People w/ drug/diagnosis per 1k population**		**# Drug days per 1k population**	
	Anxiolytics	Antipsychotics	Anxiolytics	Antipsychotics	Anxiolytics	Antipsychotics
Panel A: Primary School Entry						
Post 0-11	-0.245*	-0.134	0.322*	-0.127	-1.676	2.308
	(0.0888)	(0.0590)	(0.0811)	(0.0587)	(0.860)	(1.003)
Post 12-23	0.150	0.234*	0.722*	0.238*	1.083	5.798*
	(0.0939)	(0.0775)	(0.102)	(0.0773)	(1.023)	(1.864)
Observations	1,448	1,448	1,448	1,448	1,448	1,448
Dep. mean	3.975	2.303	4.667	2.309	26.48	22.23
Dep. Mean (pre)	5.092	2.325	5.475	2.331	32.60	15.89
p-value	0.000206	2.25e-07	0.000271	2.80e-07	0.00123	0.00678
Panel B: Middle School Entry						
Post 0-11	0.276*	0.297*	0.502*	0.301*	2.993*	3.465
	(0.0566)	(0.0678)	(0.0640)	(0.0678)	(0.738)	(1.745)
Post 12-23	-0.0922	0.0793	0.0329	0.0811	-0.740	1.281
	(0.0908)	(0.0693)	(0.111)	(0.0685)	(1.281)	(1.922)
Observations	1,448	1,448	1,448	1,448	1,448	1,448
Dep. mean	3.968	2.945	4.963	2.959	29.52	41.90
Dep. Mean (pre)	3.273	2.679	4.321	2.688	23.69	37.43
p-value	7.35e-05	9.61e-06	1.83e-06	9.36e-06	0.00142	0.0317
Panel C: High School Entrance Exam						
Post 3-11	-0.571*	-0.313*	-0.856*	-0.312*	-5.976*	-4.257*
	(0.0852)	(0.0651)	(0.125)	(0.0648)	(1.549)	(1.449)
Post 15-23	0.0289	0.0776	-0.0876	0.0830	-0.767	1.782
	(0.0917)	(0.0744)	(0.100)	(0.0735)	(1.399)	(1.951)
Observations	1,210	1,210	1,210	1,210	1,210	1,210
Dep. mean	6.665	4.059	7.624	4.088	58.60	59.04
Dep. Mean (pre)	5.655	3.583	6.747	3.612	46.80	51.45
p-value	3.26e-07	4.26e-06	4.58e-09	4.37e-06	0.00139	0.00512
Panel D: College Entrance Exam						
Post 7-11	-1.156*	-0.403*	-1.439*	-0.409*	-17.20*	-6.506
	(0.149)	(0.0995)	(0.175)	(0.0996)	(3.147)	(2.699)
Post 19-23	-0.282	-0.0747	-0.405*	-0.0674	-2.137	2.022
	(0.123)	(0.0829)	(0.116)	(0.0846)	(2.664)	(2.079)
Observations	890	890	890	890	890	890
Dep. mean	9.637	5.202	10.63	5.253	97.33	81.56
Dep. Mean (pre)	8.764	4.898	9.791	4.938	83.95	73.12
p-value	2.84e-05	0.0132	8.18e-06	0.0120	0.000206	0.00262

Notes: This table shows estimates of equation (2) where two post indicators are included. *PostEvent_0_11* is an indicator for 0-11 months after the event and *PostEvent_12_23* is an indicator for 12-23 months after the event. The sample includes data from 12 months before the event to 23 months after the event. In the case of high school entrance and college entrance exams, partially treated post months are dropped so that Panel C include data for post months 2 to 11 and months 14 to 23 while Panel D includes data for post months 7 to 11 and months 19 to 23. An asterisk indicates that the results are statistically significant at the 95 percent level of confidence.

Appendix A: Counts of Drug Prescriptions for Particular Indications, Adults and Children

ATC Code	Generic Name	All Population	Children
Indication: ADHD			
N06BA04	METHYLPHENIDATE HCL	94.6%	94.1%
N06BA09	ATOMOXETINE (HYDROCHLORIDE)	5.4%	5.9%
Indication: Depression			
N06AX05	TRAZODONE HYDROCHLORIDE	21.7%	4.9%
N06AA02	IMIPRAMINE HCL	13.3%	17.5%
N06AB10	ESCITALOPRAM (AS OXALATE)	10.1%	11.1%
N06AB06	SERTRALINE (AS HYDROCHLORIDE)	7.9%	14.8%
N06AB03	FLUOXETINE (HCL)	7.4%	19.7%
N06AB05	PAROXETINE HYDROCHLORIDE	5.5%	4.2%
FN06AX11	MIRTAZAPINE	5.2%	1.3%
N06AX16	VENLAFAXINE (HCL)	5.1%	4.0%
N06AA09	AMITRIPTYLINE HCL	4.2%	1.6%
N06AX21	DULOXETINE (HYDROCHLORIDE)	3.4%	2.1%
N05AN01	LITHIUM CARBONATE	2.7%	3.0%
N06AB04	CITALOPRAM HYDROBROMIDE	2.5%	2.2%
N06AX12	BUPROPION HYDROCHLORIDE	2.3%	5.6%
N05AF01	FLUPENTIXOL (2HCL)	2.2%	0.9%
N06AA12	DOXEPIN (HCL)	2.1%	2.0%
N06AB08	FLUVOXAMINE MALEATE	1.6%	2.4%
N06AG02	MOCLOBEMIDE	1.1%	0.7%
N06AX22	AGOMELATINE	0.9%	0.7%
N06AA21	MAPROTILINE HCL	0.3%	0.1%
N06AA04	CLOMIPRAMINE HCL	0.2%	0.6%
N06AX26	VORTIOXETINE HYDROBROMIDE	0.1%	0.2%
N06AX17	MILNACIPRAN HYDROCHLORIDE	0.1%	0.1%
N06AA16	DOTHIEPIN HCL	0.1%	<0.1%
N06AX01	OXITRIPTAN	<0.1%	0.3%
Indication: Psychosis			
N05AL01	SULPIRIDE	23.8%	16.2%
N05AB04	PROCHLORPERAZINE	23.6%	47.5%
N05AH04	QUETIAPINE FUMARATE	17.7%	2.9%
N05AX08	RISPERIDONE	9.2%	10.4%
N05AD01	HALOPERIDOL	5.3%	4.4%
N05AH03	OLANZAPINE	3.6%	1.4%
N05AH02	CLOZAPINE	3.3%	0.4%
N05AX12	ARIPIPRAZOLE	2.9%	11.4%

N05AA01	CHLORPROMAZINE	2.4%	2.1%
N05AL05	AMISULPRIDE	1.7%	0.7%
N05AH06	CLOTIAPINE	1.3%	0.2%
N05AB06	TRIFLUOPERAZINE (2HCL)	1.2%	0.6%
N05AX11	ZOTEPINE	1.2%	0.3%
N05AX13	PALIPERIDONE	0.9%	0.4%
N05AC02	THIORIDAZINE HCL	0.8%	0.4%
N05AE04	ZIPRASIDONE HYDROCHLORIDE	0.3%	0.2%
N05AF05	CLOPENTHIXOL-CIS(Z)	0.2%	<0.1%
N05AB02	FLUPHENAZINE (2HCL)	0.2%	<0.1%
N05AH01	LOXAPINE (SUCCINATE)	0.1%	<0.1%
N05AE05	LURASIDONE HCL	0.1%	0.1%
N05AF03	CHLORPROTHIXENE HCL	0.1%	<0.1%
N05AF02	CLOPENTHIXOL DEANOATE	0.1%	<0.1%
N05AG02	PIMOZIDE	0.1%	<0.1%
N05AB03	PERPHENAZINE	0.1%	0.2%
N05AF04	THIOTHIXENE	<0.1%	<0.1%
N05AD04	MOPERONE HCL	<0.1%	<0.1%
N05AA02	METHOTRIMEPRAZINE (MALEATE)	<0.1%	<0.1%
N05AX16	BREXPIPRAZOLE	<0.1%	<0.1%
N05AD08	DROPERIDOL	<0.1%	0.1%
N05AC04	PIPOTIAZINE	<0.1%	<0.1%
N05AA	CHLORPROMAZINE HCL+NIACINAMIDE	<0.1%	<0.1%

Indication: Anxiety

N05BA12	ALPRAZOLAM	23.8%	7.3%
N05BA06	LORAZEPAM	18.1%	10.0%
N05BX01	MEPHENOXALONE+	15.3%	21.4%
N05BA01	DIAZEPAM	14.2%	23.2%
N05BA17	FLUDIAZEPAM	9.2%	5.6%
N05BA91	OXAZOLAM	8.0%	7.6%
N05BA08	BROMAZEPAM	5.4%	2.4%
N05BB01	HYDROXYZINE PAMOATE	2.5%	18.2%
N05BA02	CHLORDIAZEPOXIDE	1.4%	1.1%
N05BE01	BUSPIRONE (HCL)	0.5%	0.7%
N05BA04	OXAZEPAM	0.5%	0.2%
N05BA16	NORDAZEPAM	0.5%	0.1%
N05BA09	CLOBAZAM	0.3%	1.7%
N05BA03	MEDAZEPAM	0.1%	0.3%
N05BA05	CLORAZEPATE DIPOTASSIUM	0.1%	0.1%
N05BC01	MEPROBAMATE	<0.1%	0.2%
N05BA22	CLOXAZOLAM	<0.1%	<0.1%

+ This is the only anti-anxiety drug in this list that is not a benzodiazepine.

Appendix B: Sample Construction

Here we list the samples used for the main analysis of each event. The event time is based on the month when the August-born experience each milestone, specifically, the September in the year when the individual reaches age 6 for primary school entry; the September in the year when the individual reaches age 12 for middle school entry; the May in the year when the individual reaches age 15 for high school entrance exams; and the January of the year when the individual reaches age 18 for college entrance exams. The baseline sample period covers from the 12 months before to the 11 months after the event month, except that the earliest and latest cohorts may not be observed for the full 24 months. This baseline sample is used in the event-study regressions. In the difference-in-difference setup, we exclude data from the partially treated period between the beginning and ending of the exam period, i.e., May to July (January to July) for high school (college) entrance exams, since some students might still have been studying for upcoming exams. Specific cohorts and sample periods are listed below:

Sample for primary school entry

Birth cohort	Event time	Observed period	# Observation
1994.8&9	2000.9	2000.1-2001.8	40
1995.8&9	2001.9	2000.9-2002.8	48*19=912
…	…	…	
2013.8&9	2019.9	2018.9-2020.8	
2014.8&9	2020.9	2019.9-2020.12	32
Total			984

Sample for middle school entry

Birth cohort	Event time	Observed period	# Observation
1988.8&9	2000.9	2000.1-2001.8	40
1989.8&9	2001.9	2000.9-2002.8	48*19=912
…	…	…	
2007.8&9	2019.9	2018.9-2020.8	
2008.8&9	2020.9	2019.9-2020.12	32
Total			984

Sample for high school entrance exam

Birth cohort	Event time	Observed period	# Observation	# Observation (drop partially treated period)
1985.8&9	2000.5	2000.1-2001.4	32	26
1986.8&9	2001.5	2000.5-2002.4	48*19=912	42*19=798
…	…	…		
2004.8&9	2019.5	2018.5-2020.4		

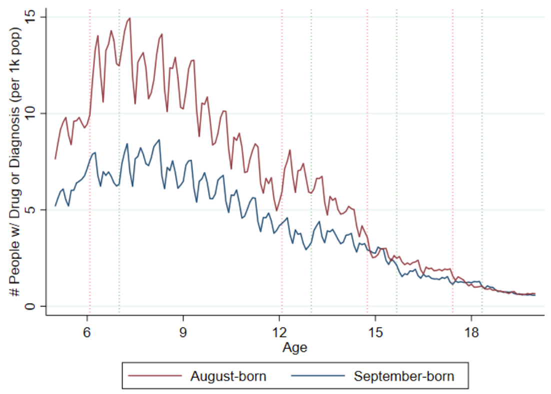
2005.8&9	2020.5	2019.5-2020.12	40	34
Total			984	858

Sample for college entrance exam

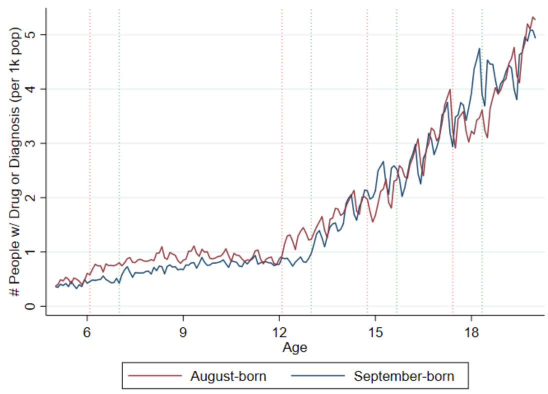
Birth cohort	Event time	Observed period	# Observation	# Observation (drop partially treated period)
1982.8&9	2000.1	2000.1-2000.12	24	10
1983.8&9	2001.1	2000.1-2001.12	48*19=912	34*19=646
…	…	…		
2001.8&9	2019.1	2018.1-2019.12		
2002.8&9	2020.1	2019.1-2020.12	48	34
Total			984	690

Appendix Figure 1: Number of children with either a prescription or a diagnosis by age for August-born and September-born

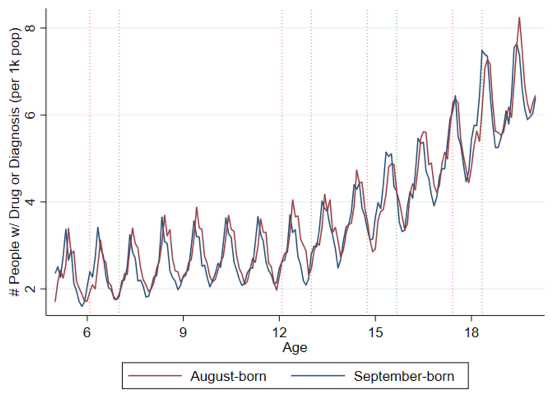
(a) ADHD



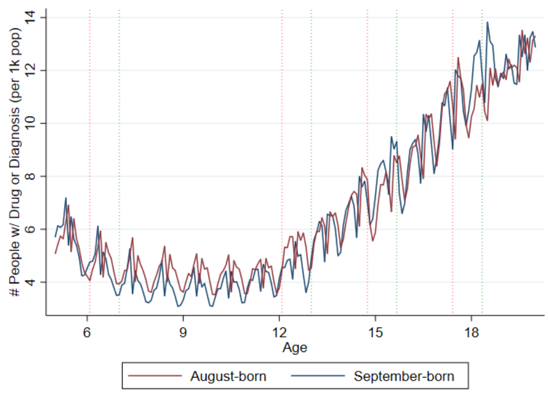
(b) Antidepressants



(c) Antipsychotics



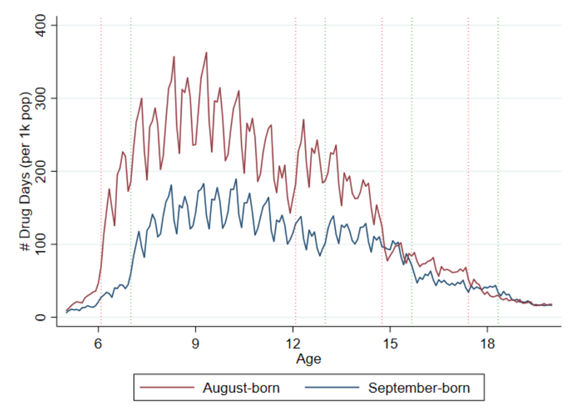
(d) Anti-Anxiety



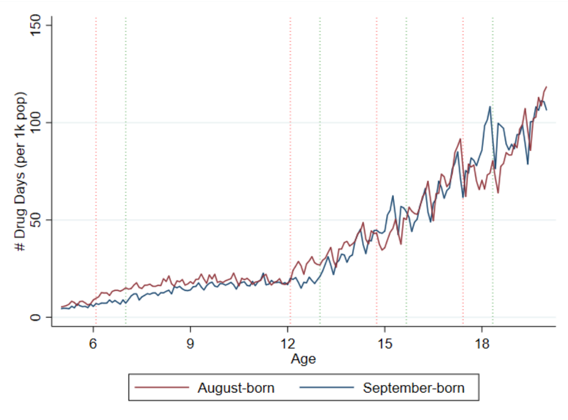
Notes: These figures correspond to Figure 1 in the main text and present the number of people per 1,000 with (a) ADHD, (b) antidepressant, (c) antipsychotic, and (d) anti-anxiety medications or a corresponding diagnosis. The sample consists of children aged 5 to 20, born between 1984 and 2014. August born are shown (in red) and September born are shown (in blue) over calendar years 2000 to 2020. From left to right, the red vertical lines indicate when the August-born cohorts entered primary school, entered middle school, began high school entrance exams, and began college entry exams, while the blue vertical lines indicate when the September-born cohorts reached the same milestones.

Appendix Figure 2: Number of drug days by age for August-born and September-born

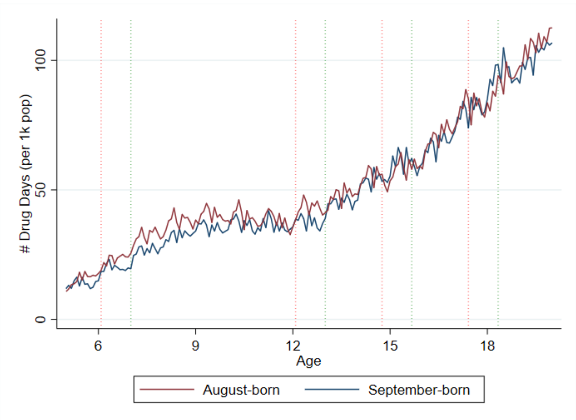
(a) ADHD



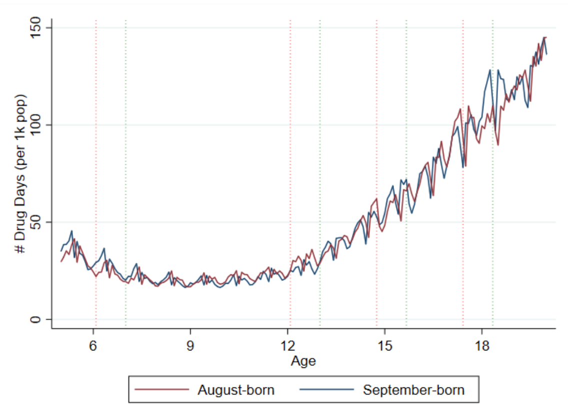
(b) Antidepressants



(c) Antipsychotics

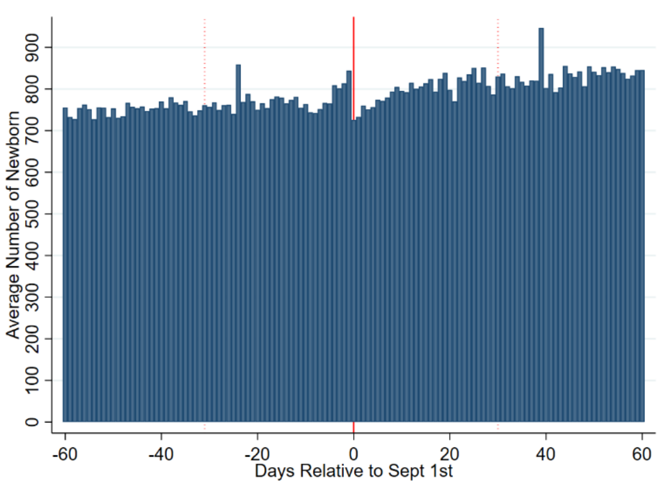


(d) Anti-Anxiety



Notes: These figures present the number of drug days prescribed per 1,000 population by age for (a) ADHD, (b) antidepressants, (c) antipsychotics, and (d) anti-anxiety medications. The sample consists of children aged 5 to 20, born between 1984 and 2014. August born are shown (in red) and September born are shown (in blue) over calendar years 2000 to 2020. From left to right, the red vertical lines indicate when the August-born cohorts entered primary school, entered middle school, began high school entrance exams, and began college entry exams, while the blue vertical lines indicate when the September-born cohorts reached the same milestones.

Appendix Figure 3: Number of births in the interval [-60,60] days around the school cutoff threshold (Sept 1st)

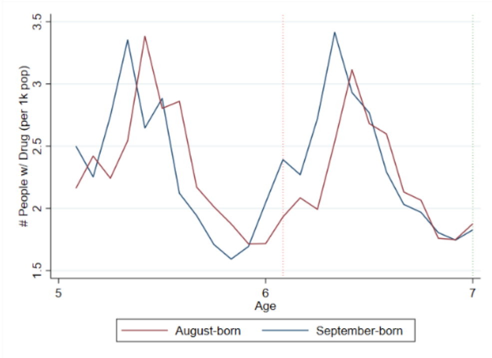


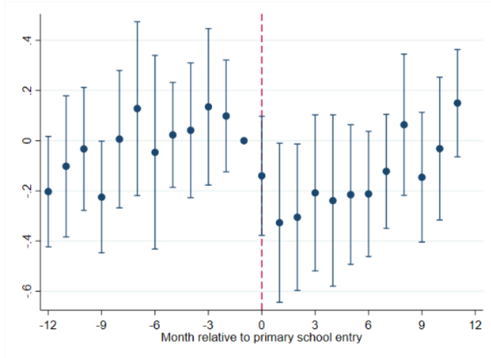
Note: This figure presents the number of births by date during the 60 days around the school cutoff threshold (Sept 1st). The red line shows the peak in births just prior to Sept. 1. The other obvious peaks in the figure are on August 8 (Father's day) and October 10th (a lucky "double tenth" day).

Appendix Figure 4: Number of children with antipsychotic prescriptions

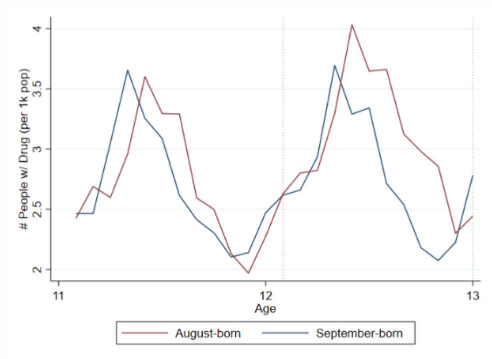
(a) Counts (b) Event Study

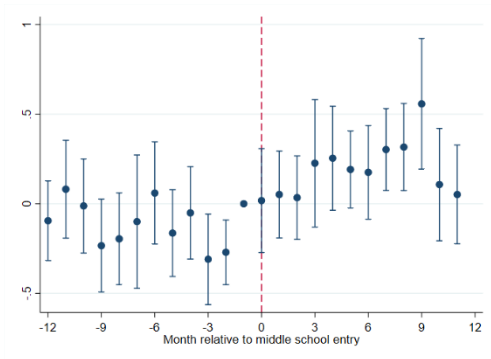
Event 1: Primary school entry



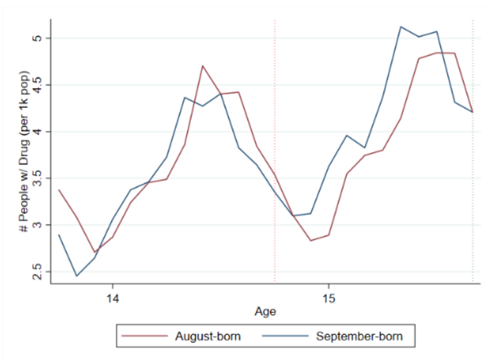


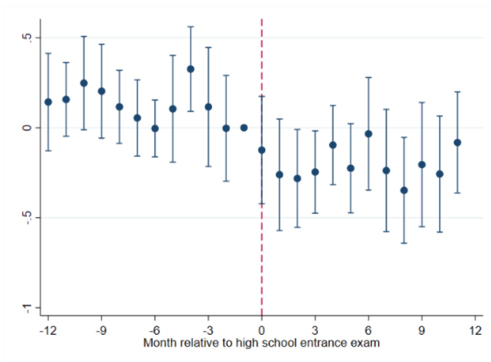
Event 2: Middle school entry



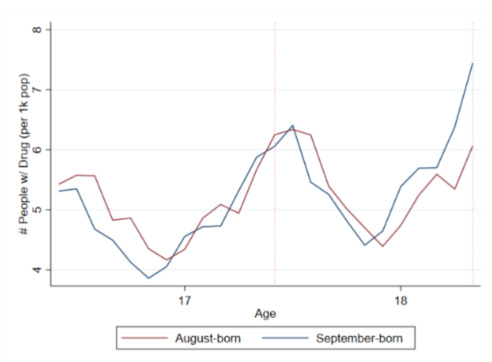


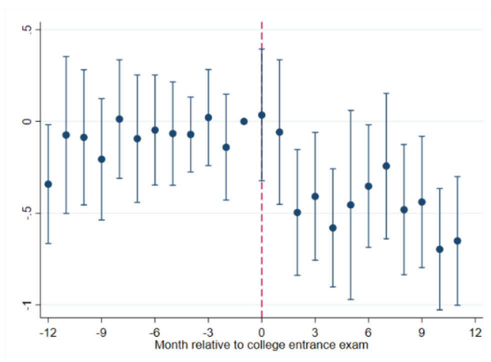
Event 3: High school entrance exam





Event 4: College entrance exam



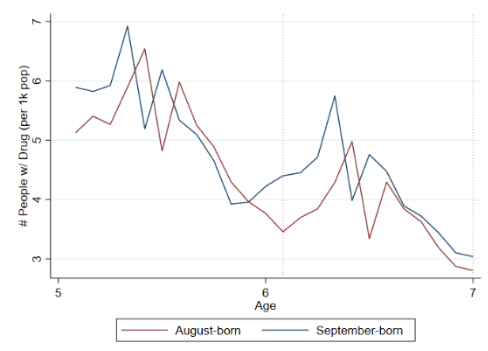


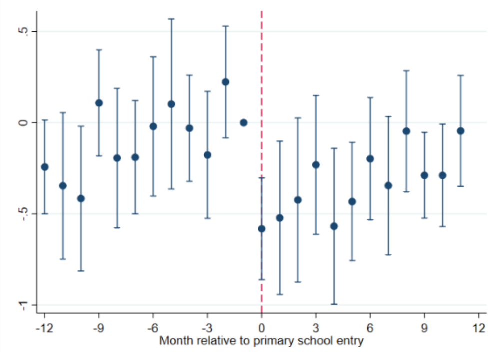
Notes: These figures show (a) the raw plot and (b) the event study figures for the number of people prescribed with antipsychotics. See notes for Figures 2-5 for details.

Appendix Figure 5: Number of children with anti-anxiety prescriptions

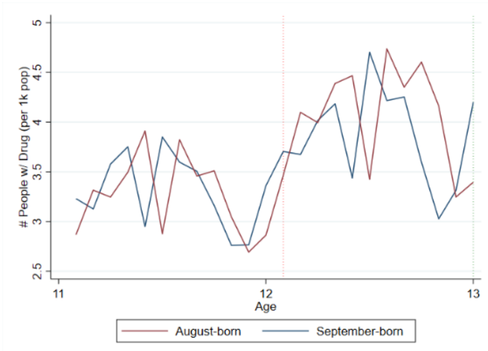
(a) Count (b) Event Study

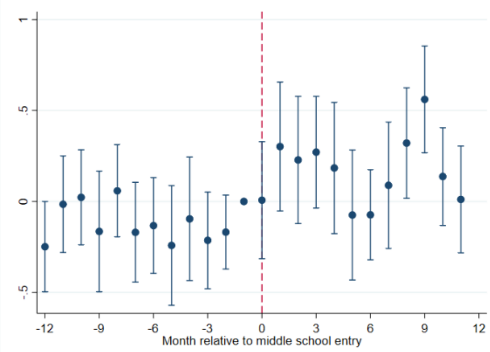
Event 1: Primary school entry



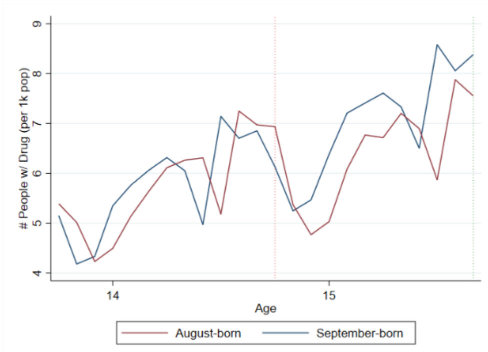


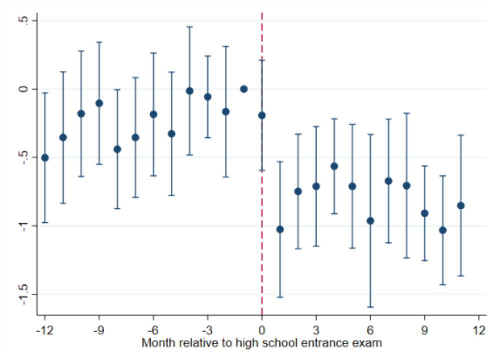
Event 2: Middle school entry



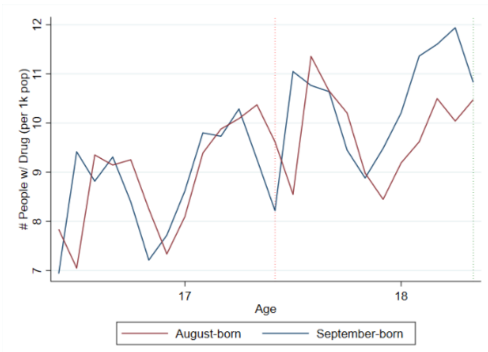


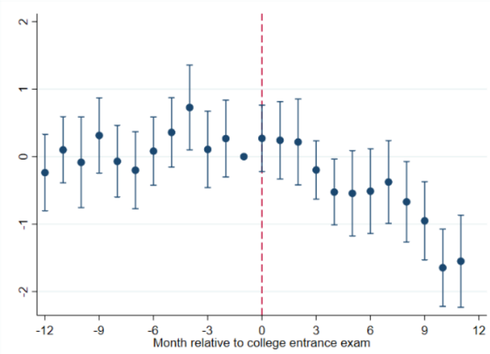
Event 3: High school entrance exam





Event 4: College entrance exam



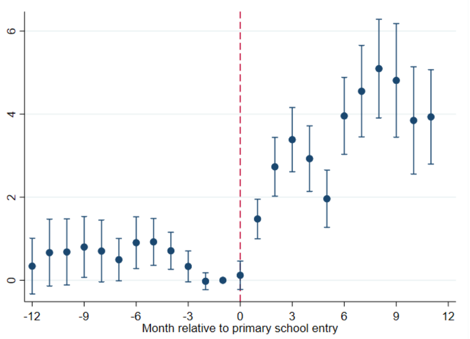


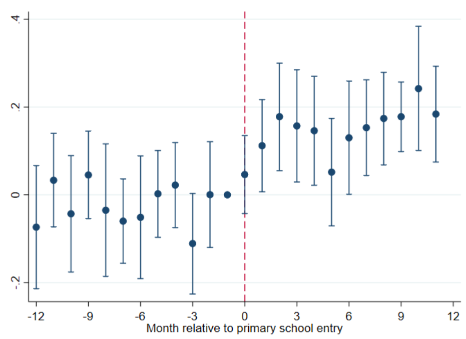
Notes: These figures show (a) the raw plot and (b) the event study figures for the number of people with anti-anxiety medications. See notes for Figures 2-5 for details.

Appendix Table 6: Event studies of the number of people with either a prescription or a diagnosis for ADHD or depression

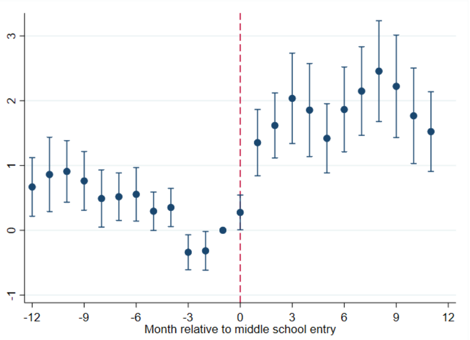
(a) ADHD (b) Antidepressants

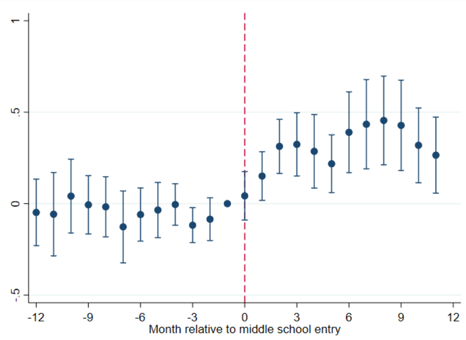
Event 1: Primary school entry



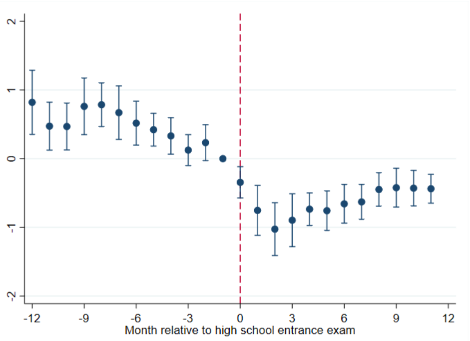


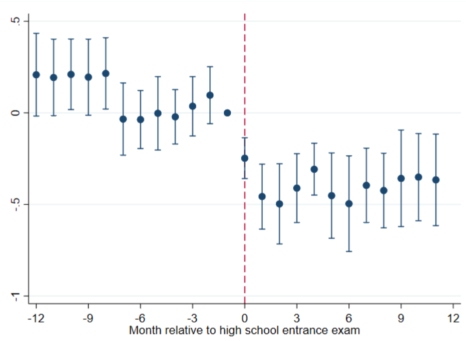
Event 2: Middle school entry



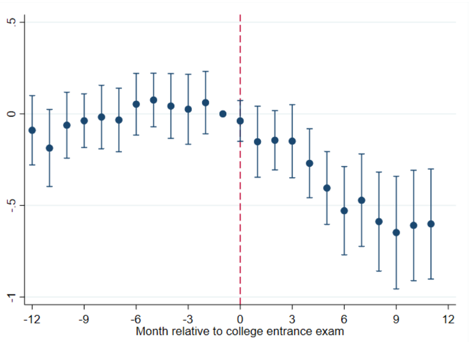


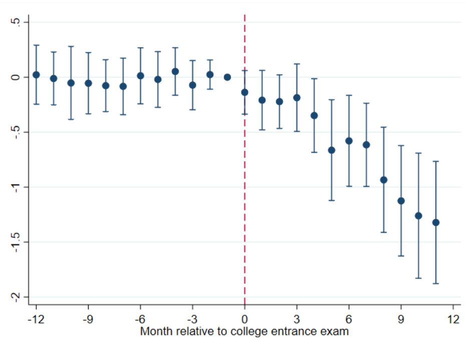
Event 3: High school entrance exam





Event 4: College entrance exam



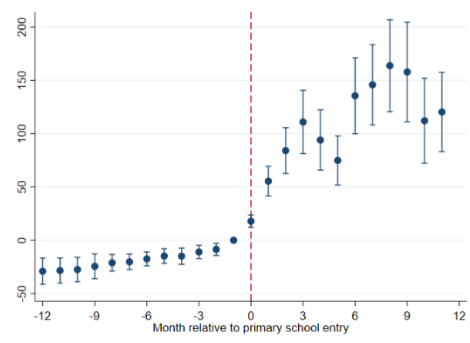


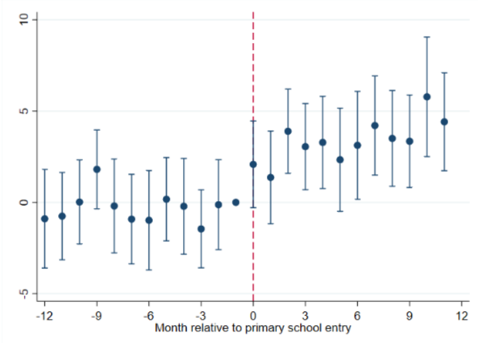
Notes: The figures show event study figures for the number of people with either a prescription or a diagnosis for ADHD or depression. See notes for Figures 2-5 for details.

Appendix Figure 7: Event studies of the number of days with ADHD or antidepressant medications

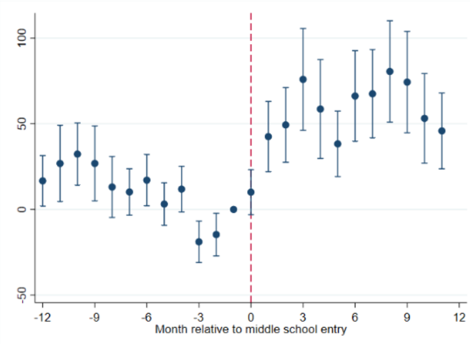
(a) ADHD (b) Antidepressants

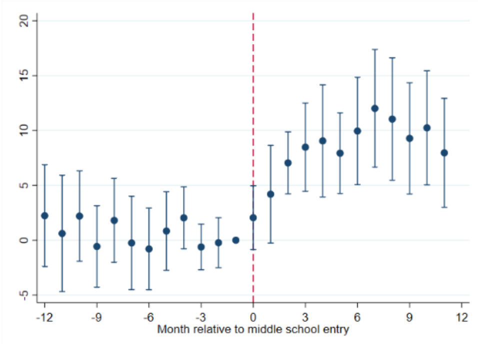
Event 1: Primary school entry



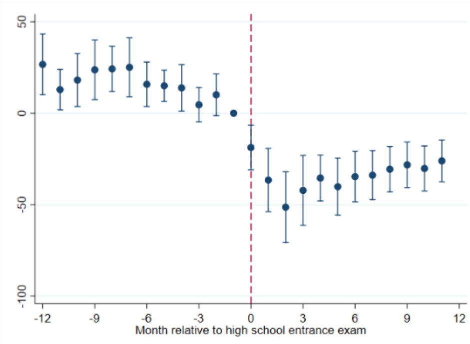


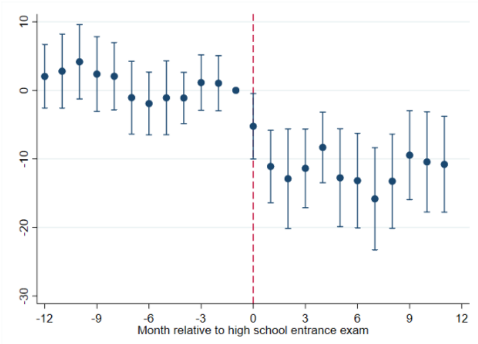
Event 2: Middle school entry



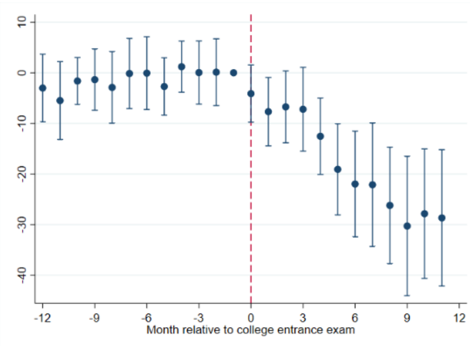


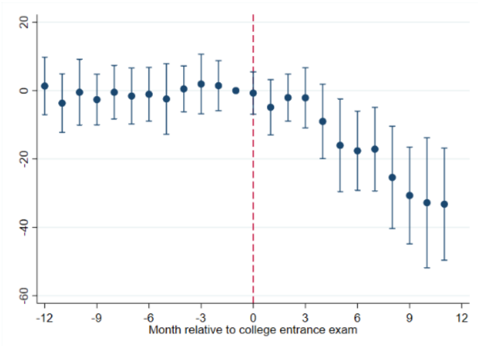
Event 3: High school entrance exam





Event 4: College entrance exam



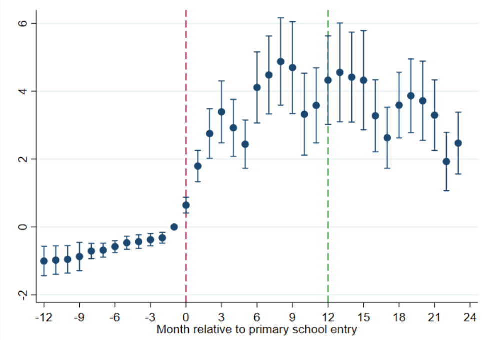


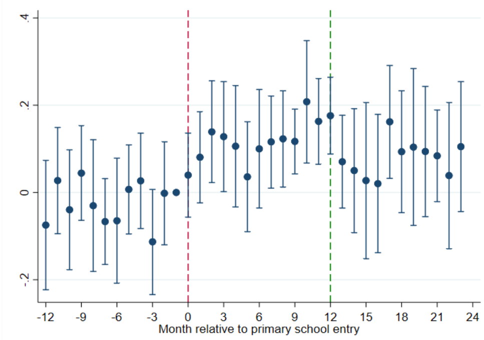
Notes: The figures show event study figures for the number of days with ADHD or antidepressant medications. See notes for Figures 2-5 for details.

Appendix Figure 8: Event studies of the number of people with prescriptions for ADHD or antidepressants, with a 23 month follow up window

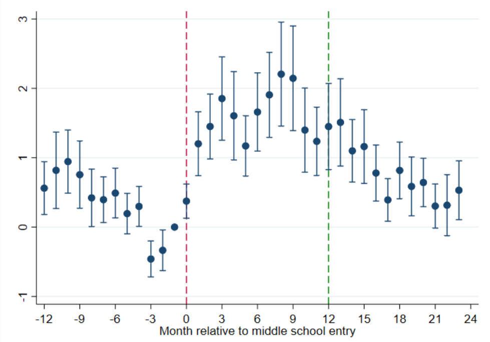
(a) ADHD (b) Antidepressants

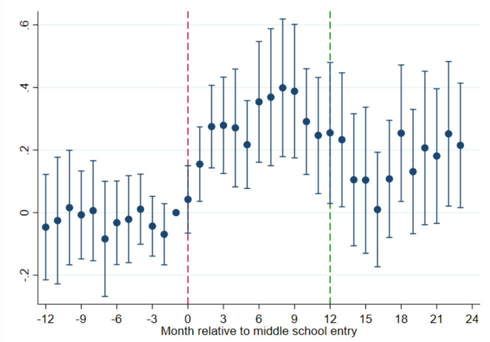
Event 1: Primary school entry



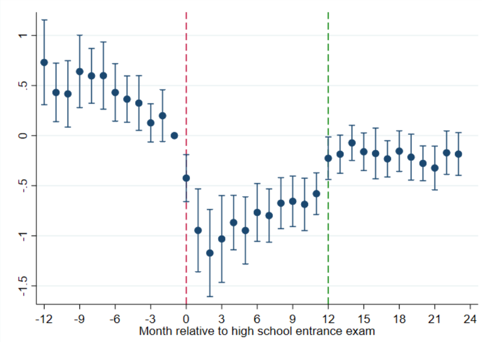


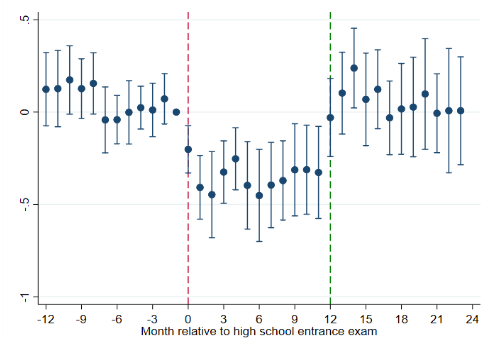
Event 2: Middle school entry



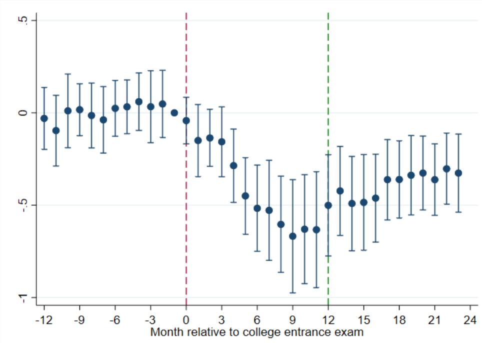


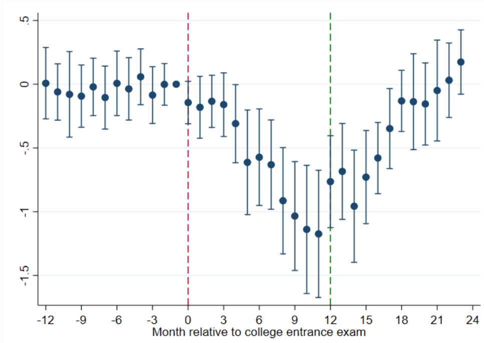
Event 3: High school entrance exam





Event 4: College entrance exam

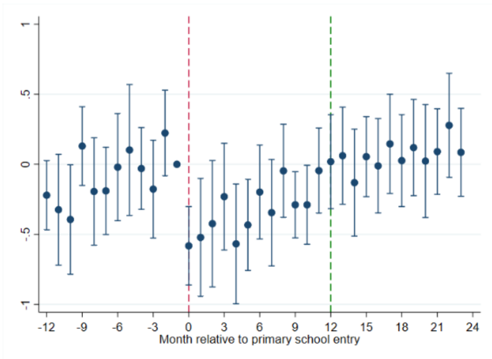


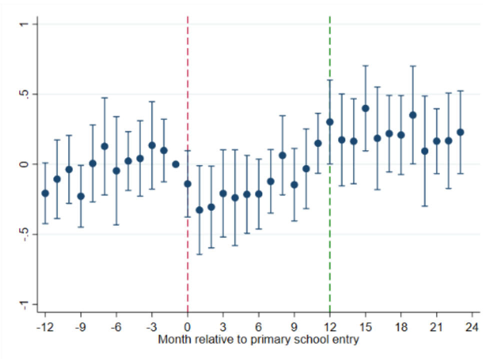


Appendix Figure 8: Event studies of the number of people with prescriptions for anti-anxiety or antipsychotic medications, with a 23 month follow up window

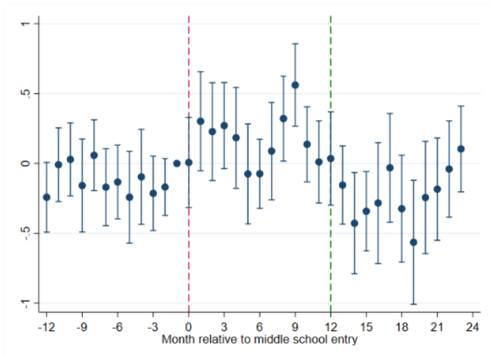
(c) Anxiolytics (d) Antipsychotics

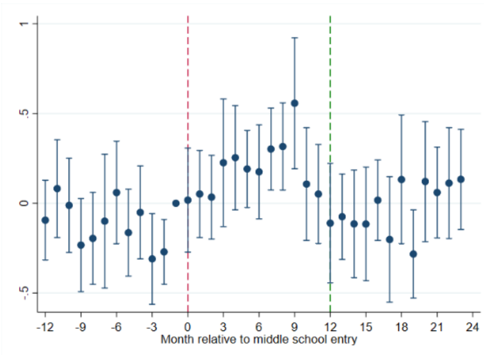
Event 1: Primary school entry



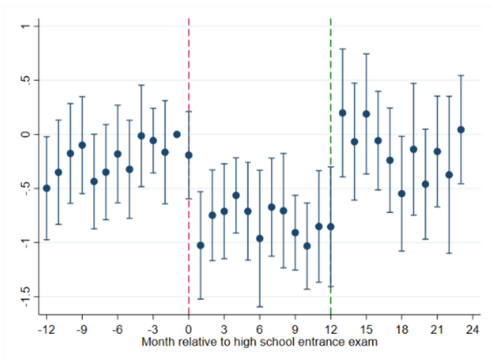


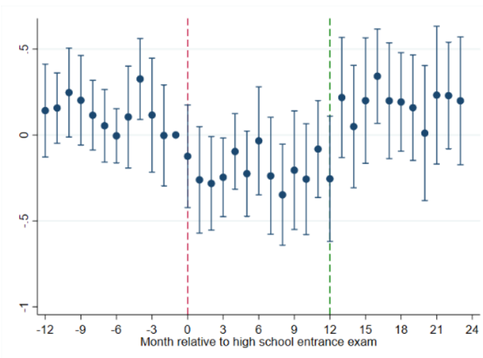
Event 2: Middle school entry



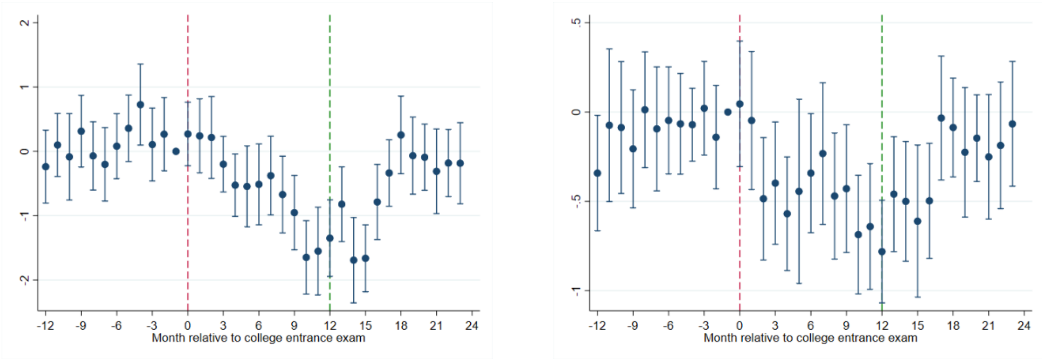


Event 3: High school entrance exam





Event 4: College entrance exam

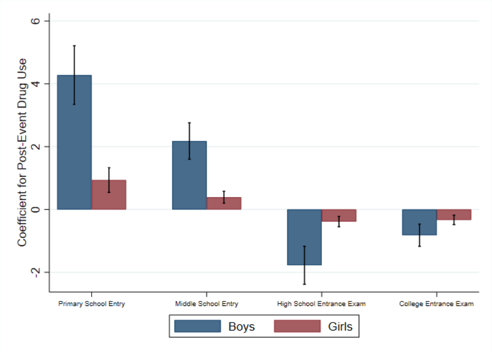


Notes: The panels show estimates from equation (1). The treated group is the August-born and the control group is the September-born. The sample period is [-12, +23] months relative to the event time.

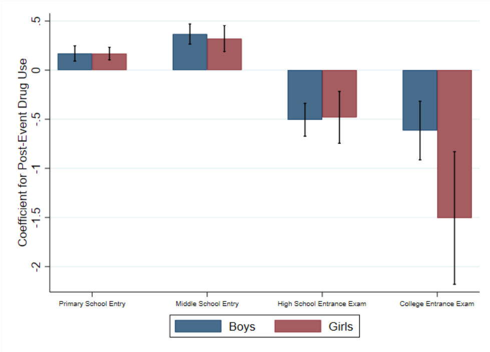
Appendix Figure 9: Heterogeneity in effects by Gender

a) Number of people with a prescription or a diagnosis

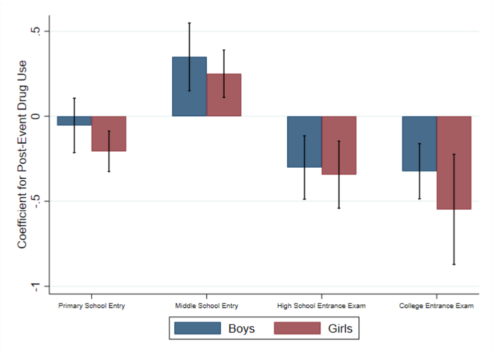
(a) ADHD



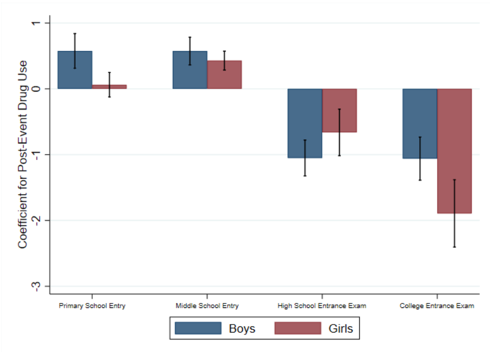
(b) Antidepressant



(c) Antipsychotics

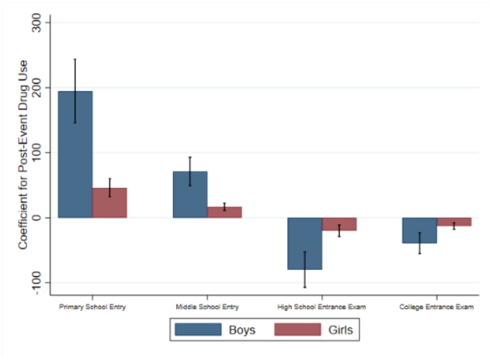


(d) Anti-anxiety

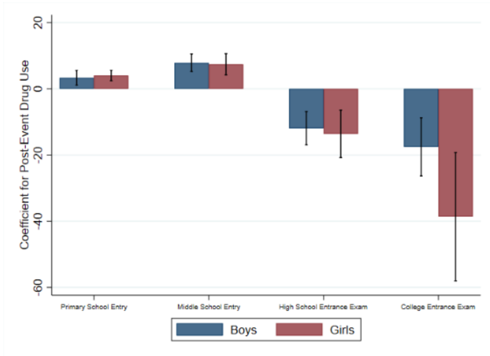


b) Number of days with medications

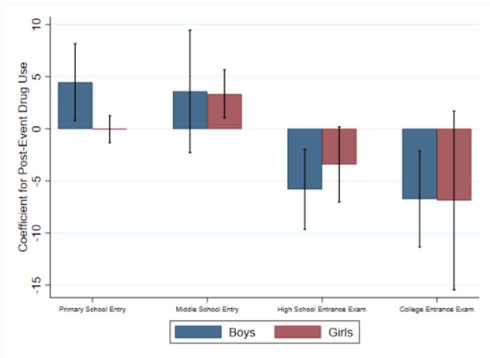
(a) ADHD



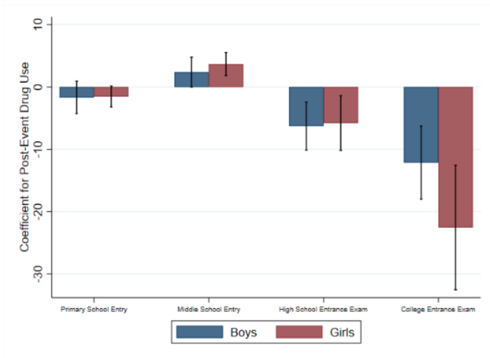
(b) Antidepressants



(c) Antipsychotics



(d) Anxiolytics

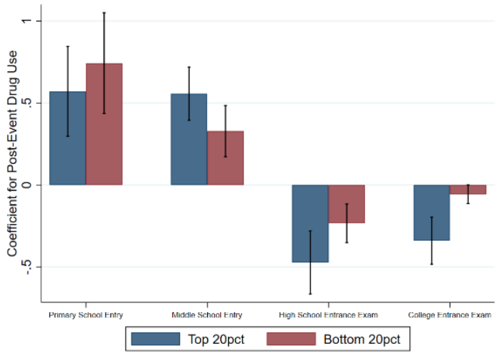


Notes: These figures show estimates of the coefficient on "*PostEvent*" from models similar to equation (2) separately by gender. 95 percent confidence intervals are indicated by black vertical bars.

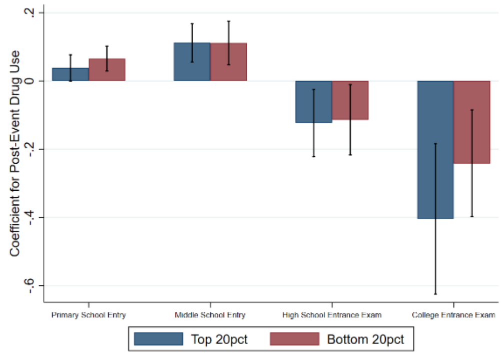
Appendix Figure 10: Heterogeneity in effects by family income

Panel A: Number of people with a prescription or a diagnosis

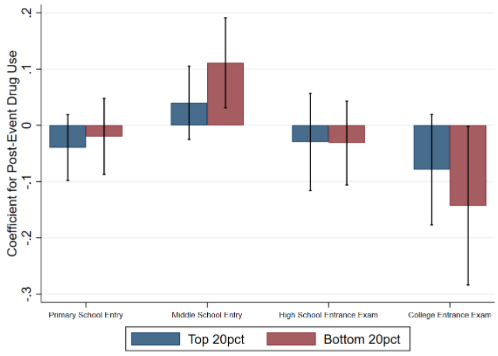
(a) ADHD



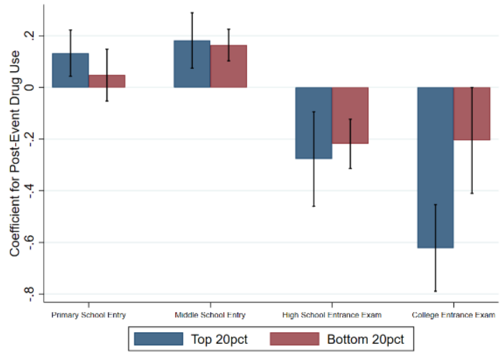
(b) Antidepressants



(c) Antipsychotics

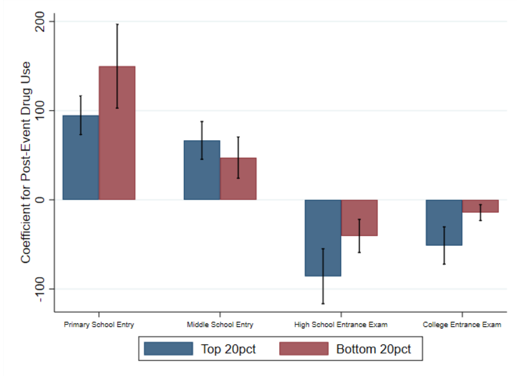


(d) Anxiolytics

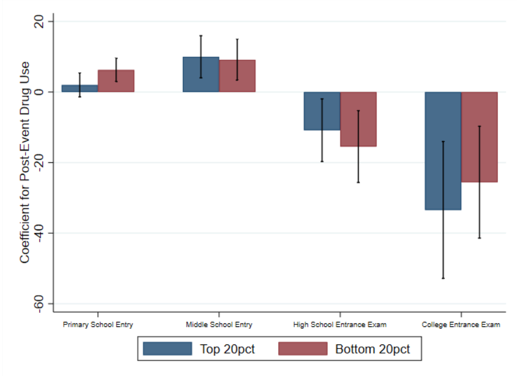


Panel B: Number of days with medication

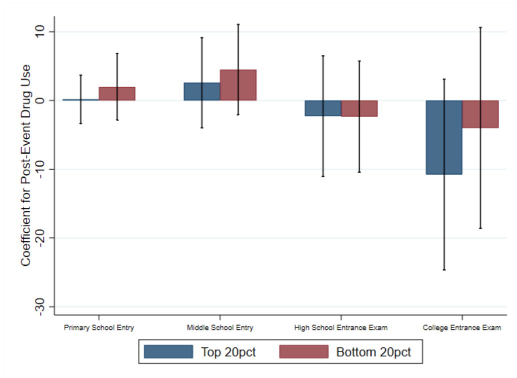
(a) ADHD



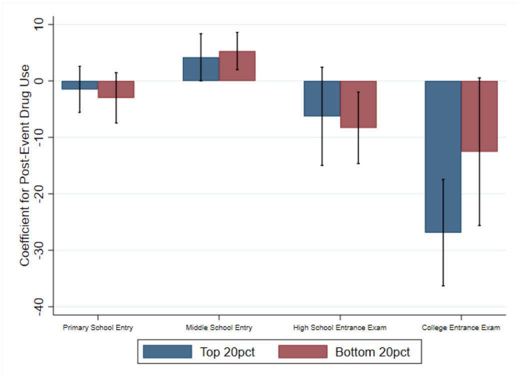
(b) Antidepressant



(c) Antipsychotics



(d) Anti-anxiety

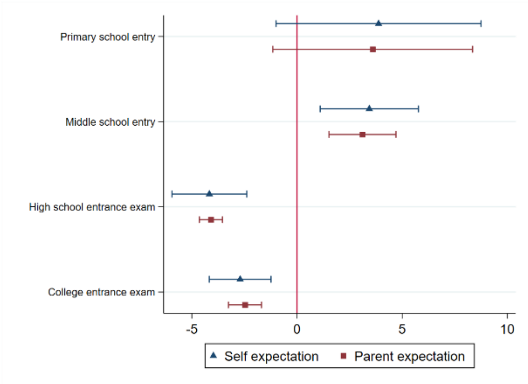


Notes: These figures show estimates of the coefficient on "*PostEvent*" from models similar to (2) separately by family income above the top or below the bottom quintiles. 95 percent confidence intervals are indicated by black vertical bars.

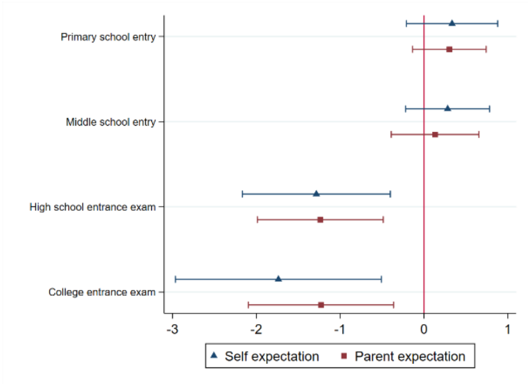
Appendix Figure 11: Correlation between regional difference in education expectation and the effects of milestones

Panel A: Number of people with a prescription or a diagnosis

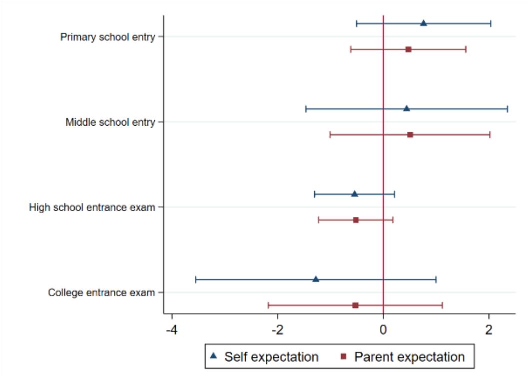
(a) ADHD



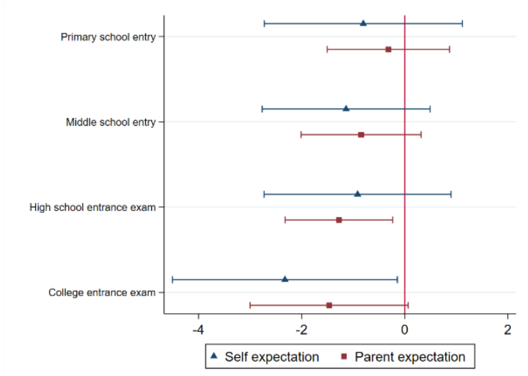
(b) Antidepressants



(c) Antipsychotics

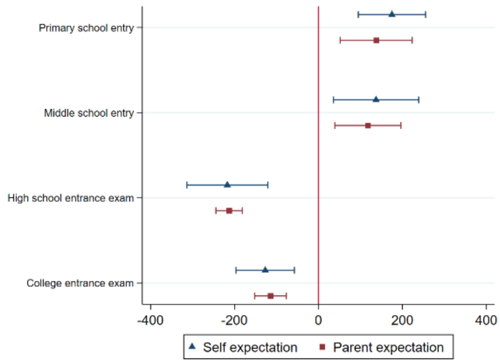


(d) Anxiolytics

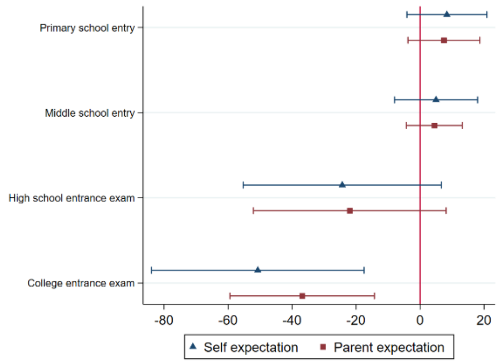


Panel B: Number of days with medication

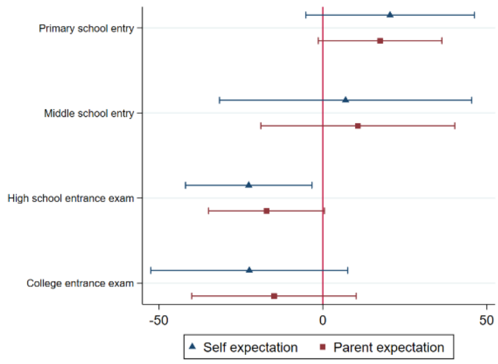
(a) ADHD



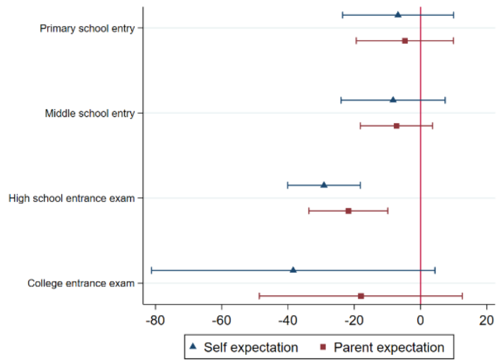
(b) Antidepressants



(c) Antipsychotics



(d) Anxiolytics



Notes: These figures show the correlation between regional average education expectations and the effect of school milestones on psychiatric medication usage. Education expectations, collected from TEPS 2011, measure the share of students (and their parents) who aspire for a bachelor's degree or above. The effects of milestones are constructed based on regression (2) for each county separately. All correlations are weighted by the number of children in each county used in estimating the milestone effect. The horizontal bars represent the 95% confidence interval based on robust standard errors.

Appendix Table 1: Including more cohorts in the comparisons

	(1)	(2)	(3)	(4)
	June-Aug vs. Sept-Nov		**Jan-Aug vs. Sept-Dec**	
	ADHD	Antidepressant	ADHD	Antidepressant
Panel A: Primary School Entry				
Post	3.748*	0.133*	3.145*	0.105*
	(0.214)	(0.0142)	(0.153)	(0.0125)
Observations	2,952	2,952	5,904	5,904
Dep. mean	1.837	0.467	2.030	0.476
Dep. Mean (pre)	0.895	0.458	0.895	0.458
Panel B: Middle School Entry				
Post	1.128*	0.338*	1.080*	0.367*
	(0.0730)	(0.0262)	(0.0570)	(0.0191)
Observations	2,952	2,952	5,904	5,904
Dep. mean	4.356	0.795	4.286	0.819
Dep. Mean (pre)	5.264	0.746	5.264	0.746
Panel C: High School Entrance Exam				
Post	-1.104*	-0.366*	-0.912*	-0.322*
	(0.0864)	(0.0411)	(0.0592)	(0.0327)
Observations	2,574	2,574	5,148	5,148
Dep. mean	2.913	1.597	2.772	1.643
Dep. Mean (pre)	3.960	1.472	3.960	1.472
Panel D: College Entrance Exam				
Post	-0.625*	-0.991*	-0.567*	-1.035*
	(0.0608)	(0.0856)	(0.0441)	(0.0684)
Observations	2,070	2,070	4,140	4,140
Dep. mean	1.215	2.641	1.169	2.718
Dep. Mean (pre)	1.479	2.427	1.479	2.427

Appendix Table 1: Including more cohorts in the comparisons, continued

	(1)	(2)	(3)	(4)
	June-Aug vs. Sept-Nov		**Jan-Aug vs. Sept-Dec**	
	Anxiolytics	Antipsychotics	Anxiolytics	Antipsychotics
Panel A: Primary School Entry				
Post	-0.176*	-0.0595	-0.0873	-0.0751*
	(0.0456)	(0.0314)	(0.0366)	(0.0242)
Observations	2,952	2,952	5,904	5,904
Dep. mean	4.534	2.304	4.353	2.295
Dep. Mean (pre)	5.092	2.325	5.092	2.325
Panel B: Middle School Entry				
Post	0.353*	0.349*	0.419*	0.373*
	(0.0294)	(0.0312)	(0.0238)	(0.0236)
Observations	2,952	2,952	5,904	5,904
Dep. mean	3.546	2.767	3.631	2.795
Dep. Mean (pre)	3.273	2.679	3.273	2.679
Panel C: High School Entrance Exam				
Post	-0.594*	-0.356*	-0.628*	-0.341*
	(0.0492)	(0.0402)	(0.0357)	(0.0300)
Observations	2,574	2,574	5,148	5,148
Dep. mean	6.129	3.779	6.231	3.830
Dep. Mean (pre)	5.655	3.583	5.655	3.583
Panel D: College Entrance Exam				
Post	-1.235*	-0.421*	-1.304*	-0.431*
	(0.0768)	(0.0543)	(0.0602)	(0.0392)
Observations	2,070	2,070	4,140	4,140
Dep. mean	9.200	5.004	9.301	5.091
Dep. Mean (pre)	8.764	4.898	8.764	4.898

Note: This table replicates columns 1 and 2 of Table 2 using sample with an extended birth month. Columns 1 and 2 of this table show results comparing children born in June through August to those born in September through November of a given birth year. In columns 3 and 4 those born in January through August are compared to those born in Sept. through Dec. of a given birth year.

Appendix Table 2: Estimates Using Only the 1995-2002 Birth Cohorts

	(1)	(2)	(3)	(4)	(5)	(6)
	# People w/ drug per 1k population		**# People w/ drug/diagnosis per 1k population**		**# Drug days per 1k population**	
	ADHD	Antidepressant	ADHD	Antidepressant	ADHD	Antidepressant
Panel A: Primary School Entry						
Post	2.493*	0.134*	2.619*	0.184*	77.23*	4.029*
	(0.446)	(0.0310)	(0.414)	(0.0271)	(14.84)	(0.806)
Observations	384	384	384	384	384	384
Dep. mean	1.468	0.630	4.857	0.659	44.28	10.13
Dep. mean (pre)	0.822	0.602	4.657	0.620	23.29	8.841
Panel B: Middle School Entry						
Post	1.318*	0.274*	1.417*	0.352*	50.26*	7.326*
	(0.107)	(0.0457)	(0.154)	(0.0534)	(3.968)	(1.356)
Observations	384	384	384	384	384	384
Dep. mean	5.517	0.775	6.754	0.978	206.6	20.29
Dep. mean (pre)	6.379	0.698	7.858	0.887	237.2	17.78
Panel C: High School Entrance Exam						
Post	-1.598*	-0.441*	-1.455*	-0.512*	-67.77*	-12.94*
	(0.128)	(0.0897)	(0.128)	(0.0962)	(5.406)	(2.581)
Observations	336	336	336	336	336	336
Dep. mean	4.285	1.649	4.969	2.072	171.2	44.25
Dep. mean (pre)	5.699	1.487	6.439	1.866	229.3	39.91
Panel D: College Entrance Exam						
Post	-1.229*	-1.706*	-1.129*	-1.880*	-49.96*	-51.53*
	(0.146)	(0.355)	(0.126)	(0.391)	(5.040)	(11.88)
Observations	272	272	272	272	272	272
Dep. mean	2.445	3.886	2.916	4.576	97.03	106.6
Dep. mean (pre)	2.956	3.457	3.443	4.119	117.6	94.33

Appendix Table 2: Estimates Using Only the 1995-2002 Birth Cohorts, continued

	(1)	(2)	(3)	(4)	(5)	(6)
	# People w/ drug per 1k population		**# People w/ drug/diagnosis per 1k population**		**# Drug days per 1k population**	
	Anxiolytics	Antipsychotics	Anxiolytics	Antipsychotics	Anxiolytics	Antipsychotics
Panel A: Primary School Entry						
Post	-0.392*	-0.321*	0.208	-0.314*	-2.472	0.182
	(0.122)	(0.0616)	(0.0780)	(0.0602)	(0.941)	(0.751)
Observations	384	384	384	384	384	384
Dep. mean	5.293	2.725	5.785	2.733	32.45	15.74
Dep. mean (pre)	6.166	2.992	6.525	3.001	37.70	16.32
Panel B: Middle School Entry						
Post	0.193	0.411*	0.527*	0.412*	3.126*	5.851
	(0.0732)	(0.121)	(0.0635)	(0.123)	(0.986)	(2.962)
Observations	384	384	384	384	384	384
Dep. mean	3.281	2.695	4.663	2.707	23.74	37.04
Dep. mean (pre)	3.005	2.460	4.486	2.473	22.97	32.90
Panel C: High School Entrance Exam						
Post	-0.536*	-0.301	-0.929*	-0.306	-5.972	-5.926
	(0.126)	(0.111)	(0.187)	(0.110)	(2.413)	(3.209)
Observations	336	336	336	336	336	336
Dep. mean	5.717	3.884	7.030	3.908	48.63	59.99
Dep. mean (pre)	5.185	3.672	6.771	3.703	43.91	56.72
Panel D: College Entrance Exam						
Post	-1.686*	-0.759*	-2.210*	-0.766*	-29.41*	-14.31
	(0.278)	(0.196)	(0.266)	(0.193)	(5.429)	(5.917)
Observations	272	272	272	272	272	272
Dep. mean	8.959	5.330	10.36	5.366	103.2	97.32
Dep. mean (pre)	8.441	5.192	9.891	5.225	94.40	92.09

Note: This table replicates Table 2 using sample of birth cohorts 1995-2002. See Table 2 for more details.