Peer Effects of Mental Health

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Abstract

In this paper, we provide novel evidence of peer effects in and of mental health. Our study investigates the peer effects of mental health among adolescents using a comprehensive dataset of 230,000 Norwegian high school students. We explore how peers' prior mental health diagnosis influences individual healthcare use and educational outcomes. Our methodology exploits variations in peers' prior mental health diagnoses across different cohorts, utilizing a two-way fixed effects model to control for classroom and year fixed effects. We find that exposure to peers with prior mental health diagnoses increases the likelihood of mental health-related GP consultations and negatively impacts educational outcomes. The effects are more pronounced among students with a history of mental health issues and exhibit gender-specific patterns. Our results predominantly suggest the mechanism of emotional contagion, where peers' mental health directly influences individuals, rather than alternative mechanisms like classroom disturbances or changes in perceptions about treatment efficacy.

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1 Introduction

In recent years, there has been an alarming decline in adolescents' mental health across the OECD, with self-reported and clinically diagnosed conditions reaching critically low levels. In the United States, a report by the Centers for Disease Control and Prevention (CDC) highlights this trend: the percentage of high school students experiencing persistent feelings of sadness or hopelessness rose from 28% in 2011 to 42% in 2021. Similarly, those seriously considering suicide increased from 16% to 22% during the same period.(CDC, 2021).[1] This worrying pattern is not isolated to the US; similar trends are evident across various OECD countries, indicating a widespread mental health crisis among adolescents.

This widespread decline in mental health among youth is not only a pressing concern in itself but also raises critical questions about its broader impacts. There is a significant gap in understanding both the causes and the consequences of this crisis. One key area of concern is the role of peer effects in this context. The concept of peer effects, extensively studied in economics, suggests that the behaviors, attitudes, and health of an individual's peers can have a substantial impact on their own outcomes. This phenomenon is especially pertinent in educational settings, where students spend considerable time interacting with their classmates. Studies have shown that peer effects can influence a range of outcomes, including academic achievement(Golsteyn *et al.*, 2021). However, while there is a well-established link between mental health and own educational outcomes (Quiroga *et al.*, 2013; Bowman *et al.*, 2017; Andersen *et al.*, 2021), the influence of peers' mental health on academic achievement is less understood.

In this paper, we provide novel large-scale evidence on the peer effects of mental health among adolescents, leveraging rich Norwegian registry data and a sample of 230,000 high school students. Importantly, we link individual-level data from national education registers to detailed data on mental health-related symptoms and diagnoses from the universe of GP visits.[2] Our research question focuses on understanding the extent to which the mental health status of peers influences (mental health-related) healthcare use and educational outcomes among high school students. As such, our study provides insights not only into the mechanisms driving the negative trends in adolescents' mental health but also their broader consequences.

There are several hypothetical mechanisms through which peers' mental health diagnosis could influence own healthcare use and educational outcomes. A primary pathway is the direct impact of peers' mental health on an individual's own mental well-being. This direct effect can be understood

[1] https://www.cdc.gov/healthyyouth/data/yrbs/pdf/YRBS$_{D}ata - Summary - Trends_{R}eport2023_{5}08.pdf$.

[2] In Norway, around 75% of the population visit their GP each year, and the GP acts as a gatekeeper to other specialized health care services.

in the context of emotional contagion, the phenomenon where exposure to certain emotions can influence and alter one's own emotional state (Hatfield *et al.*, 1993). This direct impact on own mental well-being can, in turn, affect both the individual's healthcare utilization and their educational outcomes. However, an observed effect on own healthcare use could also be attributed to changes in attitudes and perceptions resulting from exposure to diagnosed peers, such as updated beliefs about the effectiveness of treatments or altered perceptions regarding the stigma associated with seeking mental health care. These shifts in perception and belief can influence an individual's decision to seek or avoid mental health services. Additionally, an observed effect on educational outcomes may not be due to direct mental health effects. It could also be a result of indirect factors such as classroom disruptions caused by peers with mental health diagnoses or the disproportionate consumption of limited teacher resources, which can affect the learning environment for all students.

To explore these mechanisms, our study develops a conceptual framework that delineates the relationship between peers' mental health diagnoses and the observed outcomes in terms of own healthcare usage and academic performance. Alongside this theoretical model, we also provide empirical evidence that offers suggestive insights into the underlying dynamics of these relationships. This dual approach allows us to begin disentangling the complex interactions at play.

Our methodology for identifying the causal peer effects of mental health is centered on exploiting the idiosyncratic variations in the proportion of peers with *previously* diagnosed mental health disorder across different student cohorts. In line with the extensive literature on peer effects in economics (Hoxby, 2000), we utilize a two-way fixed effects model. This model specifically controls for both classroom and year fixed effects, thus accounting for unobserved, time-invariant characteristics that are unique to each school or classroom within schools, as well as broader temporal factors that are uniform across schools. The key identifying assumption is that, within a given classroom and year, the composition of peers in terms of prior mental health diagnosis is conditionally random. In our context, 'classrooms' are proxied by groups of students enrolled in the same secondary language courses within a given school and cohort. It's noteworthy that students make their secondary language course selections at the end of lower secondary school, and those who choose the same language tend to share some classes. In some instances, the secondary language course even forms the basis for class formation. Our approach also addresses the reflection problem (Manski, 1993) by focusing on prior mental health diagnoses. This ensures that our peer effect estimation is not contaminated by simultaneous influences of a student's current mental health status on their peers.

We present several novel insight into into the peer effects of mental health. Firstly, we show that exposure to high school peers with a (prior) mental health diagnosis in high school increases own likelihood of having a mental health-related GP consultation while in high school. The effect is relatively small: a one standard deviation increase in the share of peers with a prior diagnosis

corresponds to a 0.010 standard deviation rise in the probability of such consultations. This pattern holds true not only for consultations related to mental health symptoms, but also for consultations related to a clinical diagnosis of a mental health disorder. Secondly, our analysis reveals that the presence of peers with mental health disorders has a negative impact on educational outcomes. A one standard deviation increase in the share of peers with a mental health disorder decreases the likelihood of completing high school on time by 0.011 of a standard deviation. Moreover, for students who do graduate, a one standard deviation increase in the share of peers with a mental health disorder decreases high school GPA by 0.011 of a standard deviation. Thirdly, we observe that the effects on mental health-related healthcare use and on-time high school completion are predominantly driven by peers suffering from depression and/or anxiety, as opposed to those with ADHD-related diagnoses. However, in the context of GPA, it is the peers with ADHD that exert a more significant influence, rather than those with depression or anxiety. Fourthly, we find that the peer effects on both healthcare use and on-time graduation are much more pronounced among students who themselves have a history of mental health-related symptoms or disorders. Fifthly, the peer effects we identify are gender specific. The impact on mental health-related healthcare use is primarily observed among female students. Furthermore, girls' mental health-related healthcare use and on-time graduation are influenced only by the share of female peers with a prior mental health diagnosis. For girls, there is no discernible effect from male peers with a prior mental health diagnosis. Conversely, the educational outcomes of boys are influenced by the mental health status of both male and female peers.

In conclusion, our research lend support to the theory of emotional contagion as the primary driver of the peer effects we observe. The simultaneous positive influence on healthcare utilization and negative impact on educational outcomes more compellingly align with a direct effect of peers' mental health on individual mental health. This is in contrast to other potential mechanisms such as classroom disturbances, teacher resource constraints, or changes in students' perceptions regarding stigma and treatment efficacy. Firstly, while the presence of peers with mental health issues could theoretically lead to classroom disturbances or strain teacher resources, thereby negatively affecting educational outcomes, we posit that these factors are less likely to have an impact on students' propensity to seek healthcare. Moreover, if classroom disturbances or resource constraints were the primary drivers, we would anticipate a more generalized impact across all students, irrespective of gender. Additionally, one might expect the effects to be more pronounced for peers with diagnoses typically associated with behavioral issues, such as ADHD. However, our findings predominantly point to the influence of peers with anxiety or depression, and that the peer effects exhibit pronounced gender-specific patterns. These nuances are not readily explained by the alternative explanations of classroom dynamics or resource limitations. Secondly, the possibility that

exposure to peers with diagnosed mental health issues might lead students to revise their beliefs about treatment effectiveness or stigma does not adequately explain the observed negative effects on educational outcomes. Assuming that mental health issues negatively impact academic performance and that healthcare can alleviate these effects, an uptick in healthcare utilization prompted by changed perceptions should logically improve educational outcomes. Furthermore, the more pronounced effect on healthcare use among students with a history of mental health consultations suggests limited scope for belief revision in this group. These students are presumably already familiar with the healthcare system, reducing the likelihood that their increased healthcare use is a result of altered beliefs due to peer influence.

2 Conceptual Framework

To meaningfully interpret the empirical model of peer effects in this paper, it is prudent to first think about the underlying behavioral model. The assumed channel of effects is that the behavior and experiences of one's peers can affect one's own behavior. In their paper on mental health spillovers among college roommates, Golberstein *et al.* (2016) conclude, based on slight evidence of effects on self-reported outcomes, that treatment-seeking behavior for mental health issues among hallmates affects students through improved beliefs about treatment effectiveness. Another potential reason is that social stigma is a concern (Barney *et al.*, 2006; Pescosolido *et al.*, 2010) and that having peers with experience in receiving treatment for mental health troubles can normalize treatment seeking. A third potential reason is that close connections struggling mentally can affect students' own mental health negatively, as suggested by the emotional contagion literature (Poijula *et al.*, 2001; Barsade, 2002; Kramer *et al.*, 2014). Moreover, it is likely that students who have gone to the GP before due to a mental health disorder will have a lower threshold for visiting the GP for such concerns in the future due to their own experiences, a higher baseline probability of having mental health concerns, and potentially lower marginal social stigma connected to visiting the GP an additional time.

In this model section, we make a theoretical argument for emotional contagion being a pathway to healthcare use and dropout from school. We model emotional contagion as an exogenous shock to a student's mental health that is dependent on the share of students in their peer group with prior diagnoses. The model is simply formulated, using A_i as an indicator of visiting one's GP, and shows that a general comparison between perceived benefits and costs[3] will mean that factors such as social stigma can explain why some groups will respond less in terms of healthcare use. In fact, although there are several potential deterrents to seeking treatment for mental health issues, social

[3]This should be a valid setup for investigating almost any action.

stigma is of particular interest in later heterogeneity analyses. This is because stigma, which is defined by its components of prejudice, discrimination and stereotypes tied to distinguishing traits viewed as negative, such as mental illness (Corrigan and Watson, 2002), explicitly operates and varies on the group level (Cheon and Chiao, 2012; Bracke *et al.*, 2019). This implies that variation in behavioral outcomes, conditional on stigma being a deterrent, may be expected depending on differences in background factors. Following the model of GP visits, we show that the act of staying in school or dropping out can be dependent on mental health without being affected by the social deterrents of healthcare use in the same way. This would imply that dropout is correlated with mental health regardless of whether one's mental health issues are documented or not, and it provides an argument for dropout being a valuable indicator of undocumented mental health issues.

Whether the peer effects stem from improved beliefs about treatment effectiveness or emotional contagion matters for the interpretation of the results, but not for the existence and direction of a peer effect. Ultimately, we can only rely on the reduced form model of outcomes regressed on the share of peers with prior diagnoses from a GP, and any effects found are due to variations in this peer share between cohorts. An underlying model is useful, however, in terms of structuring arguments regarding how this peer share affects different outcomes. In terms of interpretation, the absence of a negative mental health shock would mean that an increase in the number of GP visits tied to mental health diagnoses is interpreted as purely positive. For certain mental health diagnoses, such as clinical depression and anxiety, this seems a bit naive. Although it is possible that some students may visit the GP for depression or anxiety due to peers sharing information about their experiences with mental health treatment, receiving such diagnoses should, in part, reflect one's real mental health situation. Importantly, a peer effect operating solely through beliefs about treatment effectiveness, social stigma, or the personal cost of going to a GP is not sufficient to explain any effects on dropout.

The social effect of peer behavior should be derived from knowing peers well enough to be affected by either their attitudes toward going to the GP for mental health concerns or their current mental state. In this respect, the share of peers with prior diagnoses functions as a proxy for the probability that a student has a friend with a history of mental health issues. Assuming that the average student has more than one close friend in their peer group, it is trivial to assume that the probability that an average student knows someone with a prior diagnosis is higher than the share of peers with a prior diagnosis if the share is less than one. Additionally, the relationship between the probability of having at least one friend with a prior diagnosis and the peer share should be positive and monotonically increasing. Having a friend with a prior mental health diagnosis could cause a negative mental health shock (because past mental health should predict current mental

health and, we assume, potential infectiousness), changed beliefs about treatment effectiveness, and reduced social stigma.

In the next few equations, we describe a general model of behavior explaining why students who experience a negative mental health shock ϵ might choose to go to the GP. In this simple model, a student i of type k compares the expected utility of going to the GP ($A_i == 1$) given a negative mental health shock ϵ to the expected utility of not going to the GP ($A_i == 0$). This comparison is shown in Equation 3, with the expected utilities of choosing to visit the GP or not being presented in Equations 2 and 1, respectively. The well-being of a student is assumed to be a function of their current mental health M_i, which we treat as a stock variable for which a high M_i indicates good mental health and a low M_i indicates poor mental health. Furthermore, well-being is assumed to be increasing and concave in M_i such that the marginal utility of treatment is higher for individuals who experience mental health issues. The mental health shock ϵ is assumed to affect M_i additively. Thus, one's shock-dependent well-being can be written as $U(M_i - \epsilon)$ if treatment is not sought. ψ_{ik} denotes student i's perception of their marginal utility of mental health care, and c_{ik} is the utility cost of going to the GP[4]. The subscript k indicates that we allow for type-specific perceptions of treatment effectiveness and costs of going to the GP, with types k representing various levels of prior personal experience. We allow for three groups of k in the empirical analysis, with potentially heterogeneous peer effects on mental health outcomes. These three groups are (1) students who did not receive any mental health diagnoses in the three years prior to high school enrollment, (2) students who have prior GP-registered symptoms, and (3) students who have prior GP-registered clinical diagnoses. We assume that the utility cost of treatment and baseline mental health are lower for students with more experience with mental health treatment. This will lead to heterogeneity in peer effect estimates for mental health outcomes depending on past experiences.

$$E(U_i(A_i == 0) \mid \epsilon) = U_i(M_i - \epsilon) \tag{1}$$

$$E(U_i(A_i == 1) \mid \epsilon) = U_i(M_i - \epsilon) + \psi_{ik}(\frac{\partial U_i(M_i - \epsilon)}{\partial A_i}) - c_{ik} \tag{2}$$

$$A_i == 1 \rightarrow E(U_i(A_i == 1) > E(U_i(A_i == 0) \rightarrow \psi_{ik}(\frac{\partial U_i(M_i - \epsilon)}{\partial A_i}) > c_{ik} \tag{3}$$

With minimal assumptions about functional form, the prerequisite for a student to visit the GP given a mental health shock ϵ is that the perceived benefit of doing so, ψ_{ik}, is larger than the utility cost c_{ik}. In the described model, one can also allow for peers' ongoing or past mental health

[4]This mainly represents the social stigma involved in seeking treatment, but it could be seen as a combination of this, the effort cost of seeking treatment, and any self-stigma involved in seeing a GP for mental health reasons.

concerns improving beliefs about treatment effectiveness and decreasing the social cost of seeking treatment for a given mental state M_i. Both would increase the probability of a student seeking mental health care.

Potential effects through the perception of treatment effectiveness or social stigma reduction non-withstanding, differential results between groups based on prior treatment are sufficiently and better described by an external mental health shock given that utility is increasing and concave in a student's mental health state $U_i(M)$. A higher shock ϵ increases the perceived marginal utility of seeking treatment for students with underlying mental health concerns because the marginal utility would be higher for students with lower baseline mental health. Meanwhile, the effect of peers on perceived treatment effectiveness or social stigma should be negatively related to own past experience. One would expect a stronger peer effect on healthcare use for students with higher baseline aversion to seeking treatment if changed beliefs are the main mechanism in this regard. However, this does not seem to be the case.

Descriptively, as seen in Figures 3 and 4, there is a link between mental health and dropout. In the following model, we argue that whether a student stays in school or not is dependent on current mental health. A shock ϵ through emotional contagion will then unambiguously increase the probability of dropout, whereas factors deterring healthcare use are only marginally involved through actual treatment effectiveness on well-being after the fact. We assume that the utility of staying in school ($S_i == 1$) is a separable sum of the perceived utility of a high school diploma ($U_i(HS)$) and the utility of staying in school, which depends on one's current mental state M_i:

$$E(U_i(S_i == 1)) = E_i(U_i(HS)) + U_i(M_i) \tag{4}$$

$$E(U_i(S_i == 0)) = E_i(U_i(B)) + E(U_i(M_i \mid B)) \tag{5}$$

$$S_i == 1 \rightarrow E_i(U_i(HS)) - E_i(U_i(B)) > E(U_i(M_i \mid B)) - U_i(M_i) \tag{6}$$

The first equation simply states that the expected value of staying in school is the sum of the expected utility of a high school diploma and the current utility of going to school, which depends on one's current mental state. The second equation indicates that the expected value of not staying in school is equal to the expected utility of the first-best alternative B[5] plus the expected well-being one would have in that situation. This is unknown and allowed to differ from the current utility or well-being at school. The third equation states that staying in school must mean that the difference between the expected utility of graduating and the alternative is higher than the utility one expects to gain in terms of well-being by not going to school. If a mental health shock ϵ occurs, this could

[5]The first-best alternative could, for example, be work not requiring a high school diploma.

change things. Here, we assume for the sake of simplicity that the mental health shock is social and will disappear if the student drops out.[6]

$$E(U_i(S_i == 1) \mid \epsilon) = E_i(U_i(HS)) + U_i(M_i - \epsilon) + \mathbb{1}A_i(\frac{\partial U_i(M_i - \epsilon)}{\partial A_i} - c_{ik}) \tag{7}$$

$$S_i == 0 \mid \epsilon \rightarrow E(U_i(M_i \mid B)) - U_i(M_i - \epsilon) - \mathbb{1}A_i(\frac{\partial U_i(M_i - \epsilon)}{\partial A_i} - c_{ik}) > E_i(U_i(HS)) - E_i(U_i(B)) \tag{8}$$

For dropping out to be the preferred course of action, the expected well-being in alternative situation B must be higher than the current well-being in school. Whether this is the case is affected by baseline mental state M_i, the size of the shock ϵ, the functional form of the utility function, and whether any treatment sought for mental health reasons has been effective[7]. The difference must be higher than the perceived utility of graduating in comparison to the best alternative. Because U_i is increasing in M, a negative mental health shock ϵ will directly increase the dropout rate. The perceived and actual treatment effectiveness and social stigma only enter the equation through the act of going to the GP. For students who do not seek treatment, the dropout rate is unambiguously negatively affected by a mental health shock ϵ. A consequence of this, which is relevant to the discussion below, is that effective treatment can lower the probability of dropping out. This has the potential policy implication that investing in treatment and reducing utility costs[8] of seeking treatment for high school students can affect drop-out. As a further note, it would be trivial to argue that learning outcomes can be negatively affected by such a shock as well, both through personal motivation and potential classroom dynamics.

The simple argument for a causal peer effect is then that ϵ is increasing in the peer share of the previously diagnosed. It is also possible for the perceived effectiveness of treatment and the utility cost of seeking treatment to be causally changed by the peer share of the previously diagnosed, but this cannot explain any potential negative effects on educational outcomes[9]. However, it could explain students seeking mental health care given a latent mental health issue. If the perceived utility of treatment (the utility cost of seeking treatment) is increasing (decreasing) in the share

[6] A more realistic model would include the notion that a social mental health shock persists to a degree on average but is alleviated by dropping out. Ultimately, the degree to which this happens does not matter much for the intuition about the relative dynamics of staying in school versus dropout, so the model is formulated in the simplest form possible.

[7] The actual marginal utility of treatment must be larger than the felt effect of any social stigma and other utility costs

[8] Utility costs can potentially be reduced through informational campaigns or attempts to increase awareness and acceptance of mental health disorders.

[9] It can only explain positive effects due to receiving treatment when one otherwise would not. See Aizer (2008) on diagnoses of ADHD.

of peers with a prior diagnosis, one would primarily expect a change in the behavior of students with low prior perceived utility of treatment and high prior utility cost of treatment. This would be an argument for an increase in treatment seeking among students who have no history of going to the GP for mental health concerns. On the other hand, students with no prior mental health diagnoses likely have a higher baseline level of M_i[10] on average, which explains why any change in the perceived utility of treatment would have a higher effect on the previously diagnosed. Regarding the proposed link between the negative health shock and the peer share of prior diagnoses, consider the following:

$$\epsilon = f(Q_i) \tag{9}$$

$$\frac{\partial \epsilon}{\partial Q_i} > 0 \tag{10}$$

$$E(Q_i) = h(s_j) \tag{11}$$

$$s_j = \frac{\sum_{j!=i} D_j}{\sum_{j!=i}} \tag{12}$$

$$\frac{\Delta Q_i}{\Delta s_j} > 0 \tag{13}$$

The set of equations above simply posits that a negative health shock will be a function of the number of friends one has which have a prior mental health diagnosis. This function is assumed to be increasing in this number of friends. Additionally, the expected number of friends[11] with a prior mental health diagnosis is a direct (and increasing) function of the share of peers with such diagnoses.

Finally, it can easily be shown that the causal interpretations of later β-coefficients does not overly depend on whether the between-cohort variation in peer shares exists because of variation in cohort size or variation in the number of students with a prior diagnosis. An illustrative example demonstrating this is detailed in Appendix E.

[10] A higher M_i translates into a lower baseline probability of having latent or ongoing mental health concerns.

[11] In the example of mental health, especially for clinical diagnoses, this is almost perfectly equivalent with the probability of having at least one friend with a prior mental health diagnosis due to the low average share of peers with a diagnosis.

3 Data and Descriptive Statistics

Data

Our study utilizes a comprehensive dataset drawn from individual-level administrative registries covering the entire population of Norway. We specifically focus on high school students, selecting our sample from the Norwegian educational registers, known as the "Nasjonal utdanningsdatabase". Managed by Statistics Norway, these registers provide exhaustive individual-level data, including school enrollment details, courses taken, academic progression, and grades spanning from primary school through to higher education. While high school is not mandatory in Norway, around 98% of students who finish lower secondary school enroll in a high school program.[12] High school students can choose between academic tracks which last three years and are meant to prepare students for higher education or vocational tracks which typically last for four years and focus on preparing students for the workforce. The admissions process is either location- or grades-based.

In our dataset, explicit classroom identifiers are not available. Therefore, we define "classrooms" as groups of students who are enrolled in the same second language course at the same school, track, and year. For the purpose of our analysis, these groups of students will be referred to as classmates or peers. This definition necessitates focusing our sample on students in academic tracks, as they, unlike their counterparts in vocational tracks, are required to choose a second foreign language—Spanish, French, or German—in addition to English.[13] This selection is made during the high school application process in the spring, before the students enroll in the autumn. Using the second language course as a proxy for classroom composition is an imperfect but more precise measure than defining peer groups at the school-cohort level, particularly in larger schools where choosing the same foreign language is likely indicative of students sharing language classes. However, it's important to acknowledge that this approach to defining peer groups is an approximation and will not capture the actual classrooms. Consequently, the peer effects estimated in our study should be interpreted as a lower bound of the true effects that would be observed among actual classmates.

To enable our analysis of peer effects of mental health among high school students, we link the educational data with the Norwegian Control and Distribution of Health Reimbursement (KUHR)

[12] High school education in Norway is predominantly public and tuition-free. Prior to high school, Norwegian law mandates that children aged 6 to 16 attend elementary school (grades 1 to 7) and lower secondary school (grades 8 to 10).

[13] While there are other language options, they are less common, representing less than 5% of students; hence, we exclude these from our sample. Among our focus group, Spanish is the most popular choice, selected by approximately 46% of students, followed by German (38%) and French (16%).

database. The KUHR database is a rich resource that includes detailed individual-level data on all consultations with General Practitioners (GPs). In Norway, GPs serve as the gatekeepers to specialized health services, meaning that access to specialist care requires a referral from a GP. Children above the age of 16 can consult with their GP on their own and without the GP having to notify the parents about the consultation.[14] Each consultation in the KUHR registers is coded with a diagnosis or multiple diagnoses, following the International Classification of Primary Care (ICPC-2). [15]. The data available to us from the KUHR registers spans from 2006 to 2019. Therefore, to ensure that we can track students' mental health-related GP consultations during their high school years and for at least three years prior to their high school enrollment, we focus our analysis on students who enrolled in high school between 2009 and 2016.

The central measure of healthcare use in this study is mental-health-related GP consultations. According to the ICPC framework, this includes all consultations in which the GP has used the diagnoses with the "P"-prefix, which covers all psychological symptoms and disorders as defined by the ICPC.[16]. We define a peer with a prior clinical diagnosis of a mental health disorder as someone who had a at least one GP consultation in the three years prior to high school enrollment with a ICPC diagnosis code of "P70" through "P99". For a closer investigation of the peer effect mechanism, we use the clinical diagnoses of depression and anxiety ("P76" and "P74") in addition to clinical ADHD ("P81"). For health outcomes, we use whether a student visits the GP in connection with a mental health diagnosis within three years of enrolling in high school. We use the broadest indicator, as described above, for the general outcome but also the subset of clinical diagnoses and, specifically, depression or anxiety as outcomes in the empirical analysis.[17]

Descriptive Statistics

Table 1 presents summary statistics at the student level. A majority of students are female, non-immigrant, and have college-educated parents. The share of students who had at least one mental health-related GP consultation prior to enrolling in high is 14%, while 4% had been diagnosed with a mental health disorder. A further subset of 0.6% have a prior clinical diagnosis of depression

[14] This is unless withholding such information threatens the parents' ability to fulfill parental duties. When in lower secondary school, children can also consult their GP on their own accord, but doctors are lawfully obliged to tell their parents about appointments and health issues.

[15] In cases where a few diagnoses were originally recorded using the International Classification of Diseases (ICD)-10, we converted these to their corresponding ICPC-2 codes for consistency.

[16] Additionally, we include consultations with the diagnosis code A04, which represents chronic tiredness/stress, a commonly considered factor in mental health studies. The inclusion or exclusion of A04 does not significantly alter our findings, ensuring the robustness of our results.

[17] In addition to the National education and KUHR registers, we make use of the National Register which provides information on relevant background variables such as gender and immigrant status.

or anxiety, whereas 0.4% have a prior clinical diagnosis related to ADHD. Although these shares are small, the large sample means that 0.4% corresponds to around 1,000 students and 0.6% to 1,500. The share of students receiving any mental health diagnosis is much larger in the students' high school years as compared to the three previous years. In the three years following enrollment in high school, around 24% of students had at least one mental health-related GP consultation, almost ten percentage points higher than in the three preceding years.[18] In terms of the share that had at least one consultation related to a clinical diagnosis of a mental health disorder, this doubled to 8% from lower secondary to high school. Figure A1, in Section A of the Appendix, shows that the difference between the likelihood of receiving either any or a clinical mental health diagnosis in high school, as compared to lower secondary school, is quite stable between cohorts and that around twice as many students are diagnosed while in high school as compared to while in lower secondary school. In an international context, the prevalence of mental health issues among Norwegian students is not atypical (Pluddemann *et al.*, 2014; Deighton *et al.*, 2019; Li *et al.*, 2022).

A key contextual aspect of the paper is on-time graduation and its connection with mental health. In the sample, around one-fifth of all students do not complete the three-year academic program within three years. Figures 1 and 2 present evidence on the correlation between (the timing of) being diagnosed with mental health disorder and on-time graduation from high school. Around 40% of students with a clinical mental health diagnosis do not complete high school, which is similar to what is found in other contexts by Bowman *et al.* (2017). Furthermore, it is evident that being diagnosed with a mental health disorder is more closely linked with dropout if the most recent and/or consultation related to the disorder occurs further into the high school period. The difference between the figures indicates that some mental health issues are transient, as students who stop going to the GP have better graduation outcomes on average. This may be due to either the effectiveness of treatment or other factors that can cause mental health to improve over time. Students with long-lasting mental health concerns seem to have the worst outcomes in terms of educational attainment. The figures are, of course, all descriptive, and we use prior mental health disorder as the peer effect instrument, both to avoid the reflection problem (Manski, 1993) and because there is potential two-way causation in the relationship between struggling at school and having mental health concerns.

Table 2 presents summary statistics at the classroom level. The average classroom has 26

[18]Between the two periods of lower secondary school and high school, we do not impose a diagnosisto be an absorbing state (meaning that we do not automatically define students diagnosed in the pre-period as diagnosed in high school), and only 48% of students with a mental health diagnosis in lower secondary school will visit the GP for mental health reasons during high school. The corresponding overlap for students with a prior clinical diagnosis is 38%. For depression or anxiety, the overlap is 28%, whereas only 8% of students with a prior ADHD diagnosis are registered with an ADHD-related GP visit during high school.

Table 1: Descriptive statistics on the student level for the Norwegian student population in academically oriented study programs between 2009 and 2016. Note: 'Prior' means in the three years preceding high school enrollment and 'HS' is short for high school. 'During' high school exclusively refers to the period within three years after high school enrollment.

Descriptive statistics: Student characteristics	Mean
Average number of peers	41.48
Is female	0.551
Has four Norwegian grandparents	0.722
Has college-educated parents	0.640
Prior mental health diagnosis	0.140
Prior clinical mental health diagnosis	0.040
Prior clinical ADHD diagnosis	0.004
Prior depression or anxiety diagnosis	0.006
Any mental health diagnosis during HS	0.237
Receiving clinical mental health diagnosis during HS	0.076
Receiving diagnosis indicating depression or anxiety during HS	0.023
Receiving diagnosis indicating clinical ADHD during HS	0.005
Graduating HS within three years	0.796
Graduating HS within four years	0.855
Enrolled in higher education within three years of HS enrollment	0.327
Enrolled in higher education within four years of HS enrollment	0.608
Junior high school GPA	4.47
High school GPA	4.21
N	230699

students, but there is considerable variation in classroom size.[19] In a robustness check, provided in Appendix Section D, we restrict the sample by excluding all language classrooms with more than 30 students[20]. This is meant to maximize the probability that students in a defined cohort are attending class together. Overall, the results are highly robust to this restriction. The majority of classrooms have at least one student with a prior mental health-related GP consultation. The density function of the share of peers in a classroom that have a prior mental health-related GP consultation is depicted in Figure 3. The figure shows that almost 95% of high school students have at least one peer with a prior mental health-related symptom or disorder. Figure 4 present the corresponding graph for the density function for the share of peers in a classroom that have a prior clinical diagnosis of a mental health disorder, showing that 70% of students have at least one such peer. The figure shows that there is significant variation in our main explanatory variable.

[19]The classroom-level average peer group size is naturally smaller than the individual-level average number of peers because the number of students in the larger peer groups is higher and an average of peer groups does not take that into account.

[20]This essentially excludes all larger schools from the sample.

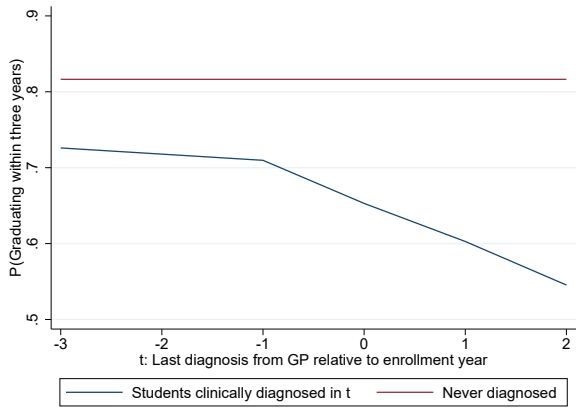

Figure 1: Average graduation rate if the most recent visit to the GP in connection with a clinical diagnosis happens in year t relative to HS enrollment (t=0). The red line indicates the baseline graduation rate of students with no visits to the GP prior to enrollment.

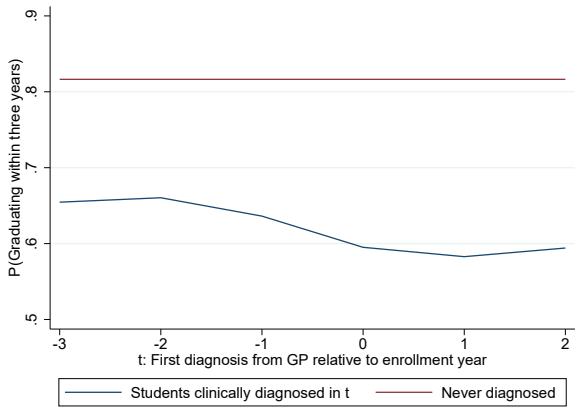

Figure 2: Average graduation rate if the initial visit to the GP in connection with a clinical diagnosis happens in year t relative to HS enrollment (t=0). The red line indicates the baseline graduation rate of students with no visits to the GP prior to enrollment.

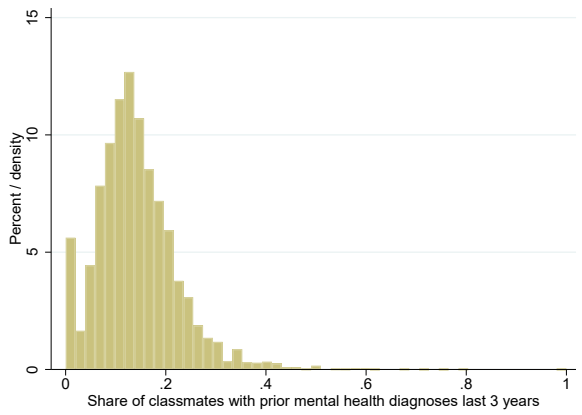

Figure 3: Density function of the share of classmates with any prior mental health diagnosis in the three years before enrolling in high school

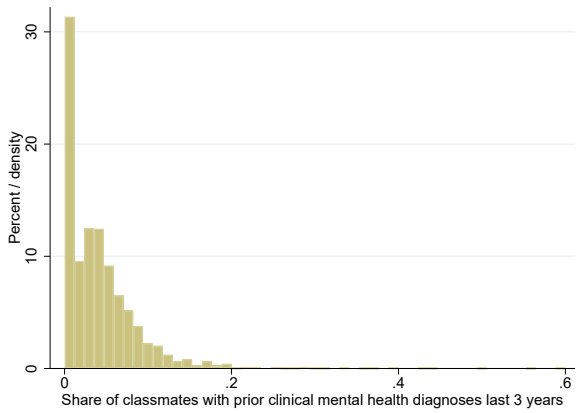

Figure 4: Density function of the share of classmates with a prior clinical mental health diagnosis in the three years before enrolling in high school

Table 2: Descriptive statistics on the classroom level for the Norwegian student population in academically oriented study programs between 2009 and 2016. Classrooms are here defined as groups on the school-track-language-year level and is a specific cohort of an approximate foreign language class.

Descriptive statistics: Classroom characteristics	Mean	SD
Cohort size	26.06	20.69
Share of students with prior mental health symptom/disorder	0.144	0.103
Share of students with prior mental health disorder	0.043	0.058
N	8866	

4 Empirical Framework

A naive regression of own healthcare use or academic achievement on the share of peers with a mental health disorder would likely yield biased estimates due to both the time trends in mental health diagnosis of adolescents and the clustering of adolescents with mental health issues within certain areas and schools. To address this potential bias, our methodology exploits only the within-classroom variation in the share of peers with prior diagnosis of a mental health disorder. This means that we analyze idiosyncratic differences in peer composition between yearly cohorts of students enrolled in all possible combinations of schools, study tracks, and foreign languages. In addition, we account for any general time trend in the likelihood of receiving mental health diagnoses by adding year-fixed effects. (Manski, 1993). Specifically, to identify the peer effects of exposure to high school peers with prior diagnosis of a mental health disorder, we use OLS to estimate the following equation:

$$Y_{ict} = \beta_0 + \beta_1 S_{ict} + \beta_2 X_i + \beta_3 \widetilde{X}_j + \alpha_c + \gamma_t + \nu_{ict} \ , \tag{14}$$

where Y_{itc} is the outcome for student i who enrolled in classroom c in year t. Our coefficient of interest, β_1, identifies the causal effect of S_{itc}, the share of peers with a prior diagnosis of a mental health disorder. S_{itc} is defined as $\frac{\sum_{j \neq i} \mathbb{1}(D_j)}{\sum_{j \neq i} \mathbb{1}(j \in ct)}$, where D_j denotes whether a classmate j has a prior mental health disorder. Importantly for the causal identification of β_1, the equation includes both classroom (school-track-language combinations) and year fixed effects, α_c and γ_t respectively. These fixed effects account both for the (non-time varying) selection of students to high schools and for potential trends in the outcome and explanatory variables. To further control for potential within-classroom confounding differences between students who are exposed to differing shares of peers with prior mental health disorders the equation includes X_i, a set of pre-determined individual characteristics. Most importantly, X_i includes a dummy for whether student i herself has a prior

diagnosis of a mental health disorder. This is important as S_{itc} is by construction negatively correlated with own prior diagnosis. Given the negative correlation between own prior mental health diagnosis and current healthcare use and educational outcomes, failure to control for own prior diagnosis would bias the estimate of β_1. To further control for potential within-classroom confounding differences between students who are exposed to differing shares of peers with prior mental health disorders the equation includes $\widetilde{X}_j$, a set of pre-determined average characteristics of student of i's peers. Most importantly, $\widetilde{X}_j$ includes average lower secondary GPA for student i's peers, as some students are allocated to schools on the basis of lower secondary GPA which could vary within classroom over time. As is standard in the literature, we cluster standard errors at the classroom-year level to account for potential non-independence of individual errors for students within the same classroom cohort.

4.1 Identifying assumptions

The main assumption needed for a causal interpretation of the results is that peer composition in terms of prior mental health history is random conditional on fixed effects and, therefore, an exogenous factor for individuals. In Figures A3 and A4 in the Appendix, Section A, we show that the residuals of leave-out-shares and number of classmates with prior mental health diagnoses regressed on teacher- and year-fixed effects follow an approximately normal distribution centered around zero. This is the expected result if leave-out-shares and number of classmates with a prior mental health diagnosis are random conditional on fixed effects. Unobserved and systematic variation in the peer share seems to be well-explained by the fixed effects. Furthermore, Table 3 presents evidence that observable socioeconomic predictors of healthcare use and academic achievement are uncorrelated with the share of peers with mental health disorders once classroom- and year-fixed effects and peers' average lower secondary GPA are accounted for.[21]

5 Results

Table 4 presents our estimates of the effect of increasing the share of high school peers with prior mental diagnosis on both own mental health-related healthcare use (columns 1-3) and own educational outcomes (columns 4 and 5). As mentioned above, our results should be interpreted as lower bound estimates of the true peer effects of classmates' (diagnosed) mental health disorders

[21] Even without the fixed effects, the correlation between predictors of healthcare use and academic achievement are only weakly correlated with the share of peers with mental health disorder. For instance, having college-educated parents only decreases the predicted share of peers with mental health disorders by 0.001, or 0.017 of a standard deviation.

Table 3: Peer composition is conditionally uncorrelated with predictors of healthcare use and academic achievement

	Share of peers with mental health disorder		
Student characteristics	(1)	(2)	(3)
Male	-0.002***	-0.000	-0.000
	(0.0003)	(0.0002)	(0.0002)
College-educated parents	-0.001***	-0.000	-0.000
	(0.0003)	(0.0002)	(0.0002)
Non-immigrant	-0.003***	-0.000	-0.000
	(0.0004)	(0.0002)	(0.0002)
Birth month (1-12)	0.000***	-0.000	-0.000
	(0.0000)	(0.0000)	(0.0000)
Prior GPA (1-6)	-0.004***	-0.001***	0.000
	(0.0003)	(0.0002)	(0.0001)
Classroom and year fixed effects	No	Yes	Yes
Control for peers' avg. GPA	No	No	Yes
N	231095	231095	231095

Standard errors clustered at the classroom-year level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

as our constructed measure of classrooms is imprecise and because the composition of classrooms can change over the three years of high school while we assign peers based on the initial (proxied) classroom assignment.

We find that being exposed to a larger share of high school peers with prior mental diagnosis increases the likelihood of having a mental health-related GP consultation in the period of up to three years after enrolling in high school.[22] In terms of effect size, we estimate that a one standard deviation increase in the share of high school peers with prior mental diagnosis increases the likelihood of having a mental health-related GP consultation by 0.010 standard deviations.[23] This effect on mental health-related healthcare use is present not only for consultations related to only symptoms of mental health issues (column 2), but also for consultations that are classified as concerning a clinical diagnosis of a mental health disorder (column 3). In terms of the latter, we find that a one standard deviation increase in the share of high school peers with prior mental diagnosis increases the likelihood of having a consultation related to a clinical diagnosis of a mental health disorder by 0.007 standard deviations.[24]

In terms of educational outcomes, we find a negative effect of exposure to peers with a prior mental health diagnosis on both the likelihood of on-time graduation and high school GPA. A one standard deviation increase in the share of high school peers with prior mental diagnosis decreases the likelihood of on-time graduation (finishing high school in the expected three years) by 0.011 standard deviations. Since we only observe GPA among those who complete high school, the selection into our sample for the GPA outcome influenced by the treatment we investigate. Still, within this selected sample we find that a one standard deviation increase in the share of high school peers with prior mental diagnosis decreases GPA by 0.011 standard deviations.

We argue, based on our conceptual framework, that these observed joint effects of both a positive impact on healthcare use and a negative impact on educational outcomes are mostly in line with the main mechanism being a emotional contagion–i.e. a direct effect of peers' mental health on own mental health, rather than the mechanisms of classroom disturbance / teacher resources or students' updating their beliefs about stigma / effectiveness of treatment via contact with diagnosed peers. First, while the share of classmates with mental health issues can affect educational outcomes via classroom disturbance or limiting teacher resources, this mechanism does not affect own mental health or mental health-related healthcare use in our conceptual framework. Second, while the share of classmates with a diagnosed mental health issues can cause students to update their beliefs

[22] This period is equal to expected high school duration if the student graduates on time.

[23] Likewise, moving from P25 to P75 in the distribution of the treatment variable increases the likelihood of having a mental health-related GP consultation by 2.0%.

[24] Moving from P25 to P75 in the distribution of the treatment variable increases the likelihood of having a consultation related to a clinical diagnosis of a mental health disorder by 2.8%.

Table 4: Peer effects of classmates' mental health on own outcomes.

	MH-related GP consultation			Education outcomes	
	All	Symptoms	Disorder	On-time completion	GPA
Share of classmates with prior MH disorder	0.071***	0.038*	0.032**	-0.075***	-0.127***
	(0.024)	(0.020)	(0.015)	(0.023)	(0.041)
Outcome sample mean	0.237	0.161	0.076	0.796	4.21
Classroom fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Controlling for own prior MH diagnosis	Yes	Yes	Yes	Yes	Yes
Controlling for classroom avg. GPA	Yes	Yes	Yes	Yes	Yes
N	231095	231095	231095	231095	176460

Standard errors in parentheses are clustered at the classroom-year level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

about treatment effectiveness or the stigma of mental health and hence increase own mental health-related healthcare use, this mechanism does not imply a negative effect on educational outcomes in our conceptual framework. If anything, this mechanism implies a positive effect on educational outcomes under the assumption that mental health issues have a negative effect on educational outcomes and that mental health-related healthcare use can alleviate this negative effect.

To further investigate the joint relationship between mental health-related healthcare use and educational outcomes, we have estimated Equation (14) separately for the four potential joint outcomes mental health-related healthcare use and on-time graduation. We present the results from this analysis in Table 5. We find that the share of peers with prior mental health disorder has no impact on the joint likelihood of on-time graduation and healthcare use, decreases the likelihood of on-time graduation and no healthcare use, and increases the likelihood of delayed graduation joint with either healthcare use and no healthcare use. Overall, the results provide suggestive evidence in favor of the hypothesis that healthcare use might alleviate the negative effects of exposure to mentally ill peers on own academic achievement.

Table 5: Joint effects on MH-related health care use and on-time completion

	On-time completion		Delayed completion/dropout	
	w/ MH-care use	w/o MH-care use	w/ MH-care use	w/o MH-care use
Share of classmates with prior MH disorder	0.033	-0.109***	0.037**	0.039**
	(0.021)	(0.027)	(0.015)	(0.019)
N	231 095			

Controlling for classroom and year fixed effects, own prior MH disorder and classroom avg. GPA.

Standard errors clustered on the classroom-year level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Having established the peer effects of mental health on mental health-related healthcare use and educational outcomes, a key question is which mental health diagnoses are driving the observed effects. Unfortunately, we do not have the power to separately identify the effects of the 17 different clinical diagnoses of mental health disorders in the ICPC-2 framework. However, we have estimated Equation (14) separately for the two largest groups of mental health disorders among adolescents, anxiety/depression and ADHD-related issues.[25] We present the results from these analyses in Table 6. While the share of classmates with a prior diagnosis of anxiety/depression has a statistically significant effect on the likelihood of having a consultation related to a clinical diagnosis of a mental health disorder and the likelihood of on-time graduation from high school, we find no similar statistically significant effect for the share of classmates with a prior diagnosis of ADHD. However, for GPA (measured among those who graduated from high school) we find a statistically significant effect of the share of classmates with ADHD but not the share of classmates with anxiety/depression. Finally, we acknowledge that these results are only suggestive as we lack statistical power and the estimated coefficients on the two different sets of diagnoses are not statistically significantly different from each other.

Table 6: Peer effects of the share of classmates with anxiety/depression vs. the share with ADHD

	MH-related GP consultation			Education outcomes	
	All	Symptoms	Diagnosis	On-time completion	GPA
Share of classmates with prior depression/anxiety	0.090	0.024	0.066*	-0.108*	-0.004
	(0.063)	(0.052)	(0.040)	(0.060)	(0.103)
Share of classmates with prior ADHD	0.041	0.052	-0.011	-0.003	-0.278**
	(0.072)	(0.062)	(0.047)	(0.071)	(0.124)
Classroom fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Controlling for own prior MH diagnosis	Yes	Yes	Yes	Yes	Yes
Controlling for classroom avg. GPA	Yes	Yes	Yes	Yes	Yes
N	231095	231095	231095	231095	176460

Standard errors in parentheses are clustered at the classroom-year level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

As we argue in our conceptual framework, mental health outcomes are likely to be affected by one's own prior history of mental health diagnoses in a way that makes peer characteristics have a heterogeneous effect. In the model described in Equations (1)–(3), a student of type k will have

[25] According to the ICPC-2 framework, we define anxiety/depression as having a diagnose of P74 "Anxiety disorder/anxiety state" or P76 "Depressive disorder", while we define ADHD-related issues as having a diagnose of P81 "Hyperkinetic disorder".

an average perceived utility of treatment ψ_k and a utility cost of seeking treatment c_k. β_k is the overall change in the probability that a student of type k visits the GP for mental health concerns due to a change in the share of peers s_j with a prior mental health diagnosis. This occurs through a negative mental health shock ϵ that is a function of s_j, meaning that the empirical model is in reduced form. Calculating the β separately for different groups of students k means that we allow for different average utility costs of seeking treatment, different baseline perceptions of treatment effectiveness, and different average baseline mental health.

To investigate whether the peer effect indeed differs between students with different baseline mental health, we estimate a modified version of Equation (14) in which we also include interaction terms between the share of peers with a prior mental health diagnosis and the student's prior mental health history. The results are presented in Table 7. The results in the first row denotes the peer effect for students with no prior GP consultations related to mental health. The second row represents the differential peer effect for students with a prior GP consultation related to a mental health symptom. For students with a prior GP consultation related to a mental health disorder, the overall effect is equal to the sum of the coefficient in the first and third rows. The table clearly illustrates that the peer effects on healthcare use and on-graduation are larger for students who themselves have a mental health history. In terms of magnitudes, a one standard deviation increase in the share of peers with a mental health diagnosis increases the likelihood of having at least one consultation related to a mental health disorder during high school by 0.042 of a standard deviation and decreases the likelihood of on-time graduation by 0.024 of a standard deviation for students who themselves had a prior consultation related to a mental health disorder.

Table 7: Main results-interacted with own prior MH

	MH-related GP consultation			Education outcomes	
	All	Symptoms	Diagnosis	On-time completion	GPA
Share of classmates with prior MH diagnosis (S)	0.033	0.030	0.004	-0.044*	-0.109**
	(0.024)	(0.021)	(0.015)	(0.024)	(0.044)
S X own prior MH symptoms	0.146**	0.055	0.091*	-0.156**	-0.201
	(0.073)	(0.068)	(0.052)	(0.066)	(0.127)
S X own prior MH diagnosis	0.203*	-0.141*	0.344***	-0.248**	0.092
	(0.105)	(0.084)	(0.109)	(0.105)	(0.198)
Classroom fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Controlling for own prior MH diagnosis	Yes	Yes	Yes	Yes	Yes
Controlling for classroom avg. GPA	Yes	Yes	Yes	Yes	Yes
N	231095	231095	231095	231095	231095

Standard errors in parentheses and clustered on the classroom-year level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Finally, we investigate the heterogeneity of the peer effect across boys and girls and whether the observed peer effects are gender-specific. The results from this analysis are presented in Table 8. We find that girls' mental health-related healthcare use is affected by the share of female peers with a mental health disorder but not by the share of male peers with a mental health disorder. Similarly, we find that girls' likelihood of on-time graduation is affected by female peers but not male peers. There is no effect of girls' GPA. For boys, there is no peer effect on healthcare use regardless of the gender of the peers. However, boys likelihood of on-time graduation is affected by the share of female peers with a mental health disorder, and their GPA is affected by both the share of female and male peers with a mental health disorder.

Table 8: Gender-specific peer effects

	MH-related GP consultation			Education outcomes	
	All	Symptoms	Disorder	On-time completion	GPA
Panel A. Girls					
Share of girls with prior MH disorder	0.077***	0.043**	0.034**	-0.058***	-0.039
	(0.024)	(0.021)	(0.016)	(0.022)	(0.040)
Share of boys with prior MH disorder	0.009	-0.001	0.010	0.002	-0.038
	(0.016)	(0.013)	(0.011)	(0.013)	(0.026)
N	123 629	123 629	123 629	123 629	96 891
Panel B. Boys					
Share of girls with prior MH disorder	-0.008	-0.014	0.006	-0.053**	-0.078**
	(0.017)	(0.015)	(0.011)	(0.021)	(0.034)
Share of boys with prior MH disorder	-0.015	-0.005	-0.010	-0.002	-0.078*
	(0.022)	(0.019)	(0.014)	(0.024)	(0.045)
N	102 509	102 509	102 509	102 509	75 973
Classroom fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Controlling for own prior MH diagnosis	Yes	Yes	Yes	Yes	Yes
Controlling for classroom avg. GPA	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses and clustered on the classroom-year level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6 Summary and Concluding Remarks

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