# Peer Effects in Adolescent Mental Health

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**Abstract**

This paper examines how peer mental health influences adolescents' mental well-being, academic performance, physical health, and behavior. Mental illness is prevalent among children and adolescents, and can have significant consequences on various outcomes. To estimate peer effects, I use friends-of-friends as an instrument for peers' mental health to avoid endogenous and exogenous effects in estimating peer effects. I find that a one standard deviation increase in the mental health index of friends is associated with 0.73 standard deviation increase in one's own mental health. Additionally, the paper reveals significant negative effects of peer mental health not only on own mental health but also on academic achievement, physical health, and risky behavior, and the existence of the social contagion of mental health among adolescents.

**Keywords**: Social network; Peer effects; Instrumental variable; Add Health data set
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# 1 Introduction

Research on child mental health recognizes the prevalence of mental illness among children and adolescents. A large number of children suffer from some form of mental illness. Approximately one-third of school children reported some sort of mental health challenges (United States Department of Health and Human Services 2021), and about one in five adults lived with mental illness in 2020 (Center for Behavioral Health Statistics and Quality 2022). [1] Also, social networks and the role of peers are important to many policies, such as busing and affirmative action. Peer effects have been studied to explain the variation in crime rates (Glaeser, Scheinkman, and Sacerdote 2003), school achievements (Sacerdote 2001), academic cheating (Carrell, Malmstrom, and West 2008). Consequently, understanding peer effects on adolescent mental health has significant consequences on academic achievement, behavior, and policies targeting youth's mental health.

Estimating peer effects is marred with endogeneity (Manski 1993). One approach to estimate peer effects is random assignment (Sacerdote 2001; Zimmerman 2003). I use an instrumental variable approach that takes advantage of the unique network data that Add Health provides by using the mental health score of friends' friends of a student who are not their friends (henceforth friends-of-friends) as an instrument for peers' mental health. Mental health can have numerous consequences on academic, health, behavioral, and labor market outcomes.[2] Moreover, the economics literature documents the existence of peer effects on many outcomes. Economists have shown the existence of peer effects in risky behavior (Card and Giuliano 2013), academic achievement (Sacerdote 2001; Zimmerman 2003), and academic cheating (Carrell, Malmstrom, and West 2008). Thus, it is surprising that little attention has been paid to peer effects on mental health. This is especially true when considering the incidence of mental health problems among adolescents and their devastating consequences (Charpignon et al. 2022). Consequently, there is a gap in the literature that could be potentially filled.

I aim to fill this gap in the literature by investigating the influence of social relationships on adolescent mental health and how it consequently affects academic achievement, physical health, and behavioral issues. I address endogeneity issues and causal inference through an instrumental variable approach. I estimate the peer effects on

1. Mental illness is also a major cause of disability. It is the number one cause of years lived with disability, affecting one in eleven people worldwide (Vos et al. 2012; World Health Organization 2010). Moreover, mental illness carries a large economic cost. The economic cost of depression alone was estimated to be \$83.1 billion in 2005, \$210.5 billion in 2010, and \$326.2 billion in 2018. These costs are incurred through missed days of work, lost productivity, suicide, and direct medical costs of depression (Greenberg et al. 2015; Greenberg et al. 2021).

2. The instrumental variable approach follows the works of Jackson and Rogers (2007) and Bramoullé, Djebbari, and Fortin (2009) by using partially overlapping social network—non-mutual friends-of-friends (henceforth friends-of-friends).

mental health among a representative sample of adolescents using a mental health measure based on 15 questions from the Center for Epidemiologic Studies Depression Scale (CES-D). Furthermore, I focus on how the mental health of peers could affect an adolescent's own mental health and consequently affect their academic achievement, physical health, and behavioral issues. Up to my knowledge, this is one of the first attempts in economics to use the friends-of-friends instrumental variable approach to causally estimate peer effects. This paper also provides evidence to social contagion as a mechanism in peer effects in mental health.

Suicides among teens began increasing after years of decline (Charpignon et al. 2022). Moreover, mental health problems are more prevalent among children and adolescents than physical issues, and they have significant long-run effects on human capital accumulation, labor market outcomes, and health. Therefore, understanding the mental health of adolescents is important for a few reasons. First, understanding the effect of peers' mental health on each other could help determine how mental health affects the outcomes of adolescents in a school setting. Second, it could have important policy implications, one of which is that targeted treatment of adolescents in schools could decrease mental health prevalence. Third, to the extent that people with mental health problems could face worse labor market outcomes as adults, understanding how we could help them early in their lives could have significant positive long-term effects on their outcomes.

The results of this paper suggest that the presence of friends with worse mental health has a negative effect on the mental health of adolescents, academic achievements, behavioral issues, and physical health. I find that a one standard deviation increase in the mental health issues of peers causes an increase in adolescents' mental health by 0.76 standard deviations.[3] A one standard deviation increase in the mental health of peers decreases the GPA of a student by 0.33 points, increases the probability of missing school for health reasons by 15 percentage points, smoking cigarettes by 40 percentage points, intoxication by 30 percentage points, and missing school by 15 percentage points.

This paper fits in two strands of the literature. First is the economic literature on peer effects. Economics investigated the existence of peer effects in drug use and sexual behavior (Duncan et al. 2005), risky behavior (Card and Giuliano 2013; Urberg et al. 2003; Sotoudeh, Conley, and Mullan Harris 2017), academic outcomes (Zimmerman 2003; Sacerdote 2001; Burke and Sass 2013; Bursztyn and Jensen 2014), and cheating (Carrell, Malmstrom, and West 2008). Absent from the literature is the role of peer effects in the mental health of adolescents.

Second, the literature on mental health. Mental health and its effect on several

3. A mental health index is scored based on the answers to 15 questions. A higher score indicates worse mental health.

aspects of life and the consequences of treating mental illnesses are gaining popularity in economics. Economists studied the effect of treatment or access to mental health services on several outcomes. Klick and Markowitz (2006) show that mental health mandates are not effective in reducing suicides among adults, and Cuellar and Markowitz (2006) find that Medicaid eligibility expansions lower youth suicides. Baranov et al. (2020)—using a cluster-randomized controlled trial—study the effect of treating rural Pakistani mothers' maternal depression and its effect on depression and financial empowerment. They find that psychotherapy reduced depression by 17% and improved women's financial empowerment. Biasi, Dahl, and Moser (2021b) investigates the link between mental health and creativity, and Biasi, Dahl, and Moser (2021a) shows that access to bipolar disorder treatment increases labor market participation and earnings by 30 percent and 26 percent respectively.

Kessler et al. (1995) find that people with early onset psychiatric problems were less likely to finish high school or go to college, while Goodman, Joyce, and Smith (2011) find that childhood psychological problems reduced their earnings by 28% as adults—the results were not causal. Others find that mental illness among adolescents causally by comparing siblings, in the United States and Canada, has significant negative effects on labor market, educational, academic outcomes, and maternal education (Fletcher 2013; Currie and Stabile 2007). Cuellar, Markowitz, and Libby (2004) study the association between mental health and juvenile crime. The authors find that access to treatment for adolescents reduces crime. Peng, Meyerhoefer, and Zuvekas (2013) find that depression reduces the likelihood of employment but has no causal effect on hourly wages and weekly hours worked. They also find that depression increases the annual work loss by 1.4 days—a loss to productivity that is equal to \$700 million to \$1.4 billion. I contribute to this literature by introducing a new channel in which mental illness could affect the academic, health, and social behavior of adolescents and the labor market, educational, and social outcomes of adults.

To the best of my knowledge, three papers in economics tried to disentangle a causal peer effects in mental health. Eisenberg, Daniel et al. (2013) and Zhang (2019) use the randomization in college roommate and class assignments and find no peer effects in mental health. Giulietti, Vlassopoulos, and Zenou (2022) explore a causal estimate of peer effects in mental health on long-term outcomes using the longitudinal aspects of the Add Health data. Consequently, by focusing on peer effects in mental health and long-term outcomes, Giulietti, Vlassopoulos, and Zenou (2022) avoid the reflection problem that arises when estimating contemporaneous peer effects, and find that exposure to more depressed peers increases the probability of having depression in adulthood. Given the lack of papers that aim to causally quantify peer effects in mental health, the results of this paper showing evidence that peer effects in mental health significantly affect an adolescent's own mental health, academic and health outcomes, and insignificant effects on long-term outcomes could be a contribution to the literature. Moreover, the use of the friends-of-friends method as an instrument is another contribution, specially since this paper is quantifying peer effects in mental health and its effect on short-term outcomes—like own mental health, academic achievement, physical health, and behavioral outcomes— and on long-term outcomes.

The rest of this paper is structured as follows. First, I describe the data I use in section 2. Second, I introduce an empirical model section 3. Third, I summarize and discuss the results in sections 4 and 5. Finally, I conclude in section 6.

# 2 Data

## 2.1 The Add Health Data Set

I use data from waves 1 through 5 in home survey and wave 1 of the in-school survey of the restricted National Longitudinal Study of Adolescent Health (Add Health). Add Health collected information for a sample of adolescents in the U.S. who were in seventh through twelfth grades. The in-home survey began in 1994-1995 and collected data on a sample of over 20,000 pupils for five waves.[4] The in-school survey was carried out in the 1994-1995 school year and collected data on more than 90,000 students (Harris et al. 2019). The study is a random sample of 80 high schools paired with the biggest middle schools that fed into them. Add Health—both the in-home and in-school—collected a plethora of unique data, including friendship networks. Summary statistics of the sample are shown in Table 2 and summary statistics of the mental health variables in Table 3. I also provide summary statistics of broken down by different samples—full sample, sample of friends, and sample of friends-of-friends—in Table 4.

## 2.2 Friendship Data and Construction of Friends-of-Friends

Both the in-home and in-school surveys collected data on friends in wave 1. In both surveys, students were asked to list up to five friends of each gender. I use this information to match friends with each other, allowing me to construct a data set with information on the respondent and their friends. To construct a data set with information on the non-mutual friendships (henceforth friends-of-friends), I match a person's friendships with the friendships of all the listed connections, and I drop those that were also listed by the target. These steps resulted in a sample of $n = 64,168$ students

4. Participants were followed through adolescence and into adulthood with five in-home interviews in 1995 (Wave I), 1996 (Wave II), 2001–02 (Wave III), 2008–09 (Wave IV) and 2016–18 (Wave V).

from the in-school survey and a sample of $n = 12,088$ students from the in-home survey.[5]

### 2.3 Constructing the Mental Health Variable

A measure of mental health is essential for this paper. I construct a measure of mental health from a battery of psychological questions that are collected by Add Health. The questions are based on the Center for Epidemiologic Studies Depression Scale (CES-D), a self-reported scale that measures depressive symptoms in the general population (Radloff 1977). The CES-D scale is a 20-question test on symptoms in which a person answers how frequently they have felt depression symptoms during the past week.[6] 15 out of the 20 questions were asked in the in-school survey, 19 out of the 20 questions were asked in waves 1 and 2, and about half of the questions were asked in waves 3, 4, and 5. The 19-, 15-, or 10-item CES-D would allow me to construct a measure that would assess a person's mental health based on categories concerning depression, life, sadness, happiness, and blues (Perreira et al. 2005). A table of the in-school questions is in Table 1.

Using the CES-D questions, I calculate an average mental health variable. I use the 15-item CES-D questions in the in-school survey to construct a measure of mental health. I follow the psychology literature by giving a higher/lower value as the frequency of negative/positive symptoms being felt increases. I sum the answers to all the questions and then normalize the mental health variable to have a mean 0 and a standard deviation of 1. I show the summary statistics for the mental health of students, their friends, and friends-of-friends in Table 3.

## 3 Empirical Model

### 3.1 Explanation and Justification of the Friends-of-Friends Methodology

In this section, I introduce the empirical model for estimating the peer effects of mental health on a person's own mental health. Subsequently, I discuss its effects on academic achievement, physical health, and risky behavior. Estimating peer effects is difficult as it is hard to differentiate between endogenous and exogenous effects— i.e.,

5. The sample in the analysis might vary as a result of missing values of certain questions. This is a consequence of the Add Health process of interviewing pupils and assigning missing values to questions.

6. The frequency choices are: rarely or none of the time (less than 1 day ), some or a little of the time (1-2 days), occasionally or a moderate amount of time (3-4 days), and most or all of the time (5-7 days).

the reflection problem (Manski 1993). The reflection problem occurs in research investigating how average group behavior would influence the behavior of an individual in the same group, in other words, peer effects. The reflection problem leads to issues in identification where it becomes challenging to create an empirical model that separates the influence of group behavior from other individual-specific factors that influence the behavior.[7] Thus, to identify peer effects outside of a lab or an experiment, an instrument of some sort is needed. Bramoullé, Djebbari, and Fortin (2009) provide the necessary and sufficient conditions for the identification of estimating peer effects in a social network. The authors show that the endogenous and exogenous effects are identified when using partially overlapping networks.[8] Thus, peer effects will be identified when using the characteristics of friends-of-friends as an instrumental variable to identify the impact of friends.

The characteristics of friends-of-friends (friends' friends of a student who are not their friends), in this case, their average mental health score, are exogenous to the characteristics of a student. This stems from the fact that friendships form endogenously, i.e., two people meet, and they become friends if they match on some vector of characteristics. Similarly, people choose not to become friends endogenously, i.e., two people meet and decide to *not* become friends. Thus, the traits of friends-of-friends serve as a valid measure to estimate peer effects, which influence a student indirectly through their immediate friends.[9]

### 3.2 Statistical Estimation

Let $Y_{ia}$ be the outcome of interest for student $i$ at school $a$. $\mathtt{Depression}_{ia}^{\textit{friends}}$ is the average normalized mental health among $i$'s friends and $\phi_a$ is school specific fixed effects. The equation of interest could be written as:

$$Y_{ia} = \alpha_{0a} + \lambda_1 \mathtt{Depression}_{ia}^{\textit{friends}} + \mathbf{X}'_{ia}\pi + \phi_a + \mu_{ia} \tag{1}$$

Regression 1 estimates the peer effects of mental health on a student's own out-

7. For instance, consider a study aiming to understand how the study habits of peers influence an individual student's academic performance. Here, if all students are influencing each other's study habits simultaneously, it becomes difficult to pinpoint the causal effect of the peer group's study habits on the individual student, as their individual behavior is also affecting the average behavior of the group.

8. Bramoullé, Djebbari, and Fortin (2009) show that peer effects are identified when a few conditions are met. Two of these conditions are related to a simple property of the friendship network matrix if at least two groups have different sizes

9. This is similar to using lags of a variable $x_i$ as instruments for $y_{i-1}$ even with the existence of serial correlation in panel data (Chamberlain 1984). Also, peer effects literature frequently uses lagged peer outcomes as an instrument for current outcomes (Carrell, Malmstrom, and West 2008; Burke and Sass 2013; Acton, Cook, and Luedtke 2022).

comes. This estimation, however, will suffer from the endogenous and exogenous effects outlined in Manski (1993). Depression of friends could be endogenous with a concern that OLS estimate of $\lambda_1$ will be inconsistent. Consequently, I use the following first stage of IV estimation using the average depression score of friends-of-friends as an instrument:

$$
\begin{aligned}
1^{st}\text{ stage: }\mathrm{Depression}_{ia}^{\mathrm{friends}} = {} & \delta_{0a} + \theta_1 \mathrm{Depression}_{ia}^{\mathrm{friends-of-friends}} \\
& + \mathbf{X}'_{ia}\pi + \omega_a + r_{ia}
\end{aligned}
\tag{2}
$$

Where the dependent variable $\mathrm{Depression}_{ia}^{\mathrm{friends}}$ is the average mental health score among friends. The independent variable $\mathrm{Depression}_{ia}^{\textit{friends-of-friends}}$ is the average mental health score among friends-of-friends. $\mathbf{X}_{ia}$ is a vector of student-specific covariates. The average mental health variables among friends and friends are friends are calculated from the in-school survey and does not vary over time. The school specific fixed effects, $\omega_a$, captures any characteristics of a school that do not vary over time, such as size, the shared environment, etc. Throughout my analysis, I cluster the standard errors at the school level to account for correlation in the error term, $r_{ia}$, within a school.[10]

The parameter of interest is $\lambda_1$; it summarizes how peers with-in a school affect a student's own mental well-being, educational, health, behavioral, and labor market outcomes. In order for the $\lambda_1$ coefficient to represent the causal effect of peers' mental health on student's own outcomes, it must be the case that $\mathrm{Depression}_{ia}^{\textit{friends-of-friends}}$ must be both sufficiently partially correlated with $\mathrm{Depression}_{ia}^{\mathrm{friends}}$ and uncorrelated with the error term in the second stage. As I will show, the mental health of friends-of-friends has a large negative effect on the mental health of friends. There is no test to show that $\mathrm{Depression}_{ia}^{\textit{friends-of-friends}}$ is uncorrelated with the error term.

# 4 Results

Tables Table 5 and figures 1-21 present the results of my analysis. Table 5 shows the results for the OLS estimation of Equation (1), reduced form regression that estimates the reduced form, first stage, and the 2SLS. The rest of the results show the 2SLS estimates of regression 1 on academic, behavioral, health, social, criminal, risky behavior,

10. For the analysis that uses the in-school survey, I control for sex, race, age, parental education, parental employment, parental occupation, and number of friends. For the analysis that uses the in-home survey waves 1 to 3, I control for sex, race, age, parental education, parental employment, parental health, and number of friends. For the analysis that uses the in-home survey waves 4 and 5, I control for sex, race, age, educational attainment, parental education, parental employment, parental health, and number of friends.

and labor market outcomes.

The results from the regression described above are consistent with two findings. First, I find that the mental health of peers significantly affect a person's own mental health. i.e., if peers' mental health gets worse, a student's own mental health deteriorates. Second, the mental health of peers also affects other outcomes, like educational and behavioral outcomes.

### 4.1 Reduced Form

Table 5 shows the results of estimating the reduced form (column 1). The results show that There is a strong relationship between the friends-of-friends instrument and the mental health of a student. A one standard deviation increase in the average mental health score among friends-of-friends is associated with a 0.187 standard deviation increase in the mental health score of the students themselves.

### 4.2 First Stage and IV Estimation

Table 5 presents the outcomes of the first stage estimation (column 2) and the instrumental variable (IV) estimation (column 3), showcasing a robust connection between the mental health of an individual's friends-of-friends and their friends. Specifically, a 1 standard deviation increase in the friends-of-friends' average mental health correlates with a 0.254 standard deviation increase in the friends' average mental health score. This lends credence to the validity of the inclusion restriction, which is crucial for the consistency of the 2SLS estimator for the parameter of interest. The robustness of the instruments used is further supported by the Olea and Pflueger (2013) Robust Weak Instrument Test, which reveals an Effective F statistic of 368.734 in my 2SLS model, thereby confirming that my instrument is indeed strong. The Montiel-Pflueger Robust Weak Instrument Test is presented in table 6. [11] The IV regression also uncovers a significant and substantial peer effects on mental health: a one standard deviation increase in the mental health of friends is associated with a 0.734 standard deviation rise in an individual's own mental health score.[12]

11. In line with the findings of Staiger and Stock, the Effective F statistic for the first stage in our alternative specification, where the dependent variables are not own mental health, is substantially above the threshold of 10, indicating the strength of our instruments (Staiger and Stock 1997).

12. Table 7 displays the results for a subset of students who did not utilize all five nominations for female friends or male friends. The outcomes in Table 7 closely resemble those in Table 5, suggesting that truncated data is not a significant concern. Table 8 displays an alternate specification in which I include school specific grade fixed effects. The results are similar to those in the main specification. Table 9 displays an alternate specification in which I only include reciprocated friendships. The results are unaffected throughout the different specification, suggesting that the findings are robust regardless of the specification employed.

### 4.3 The Social Multiplier

Moreover, numerous studies explore the existence and estimation of a social multiplier in the presence of spillovers (Becker and Murphy 2003; Glaeser, Scheinkman, and Sacerdote 2003; Graham 2008; Carrell, Malmstrom, and West 2008). For example, in a college network, new fraternity or sorority members will influence their peers, which will create more members. In this paper, the social multiplier implies that new students with mental health problems will exert influence on their peers, which will create more students with worse mental health. If we allow multiple rounds in which new students with poorer mental health enter and beget students with worse mental health. If this process continued infinitely and partial students with deteriorating mental health could be created, the social multiplier would approach $SM = TE/DE$ as the sample increases in size, where $TE$ is the total effect measured by the coefficient from the IV regression, capturing both direct and indirect effects of peers on individual mental health, and $DE$ is the direct effect estimated from the Ordinary Least Squares (OLS) regression. Estimating the social multiplier from the IV regression estimating peer effects in mental health on own mental health—Table 5—yields a value of 3.37. Consequently, my model estimates that adding one student with worse mental health will create approximately four students with worse mental health in full equilibrium. [13]

### 4.4 Effect of Peers' Mental Health on Academic and Behavioral Outcomes

I report in Figure 1 the main 2SLS estimates of Equation 2. The results reflect the effect of peers' mental health on own mental health, academic and behavioral outcomes. I present the effect of peers' mental health on own health (Panel 1a), GPA (Panel 1b), and probability of skipping school (Panel 1c) in Figure 1. Within each figure, I show the results of heterogeneous analysis by gender and the number of friends.

I find that a one standard deviation increase in the mental health of peers decreases the grade point average (GPA) by 0.32 points. That is equivalent to a reduction of 11% in the average GPA. Also, a one standard deviation increase in the mental health score of peers is increases the chances of skipping school for no reason by 23 percentage points (pp). Thus, peer effects on mental health have significant negative effects on academic and behavioral outcomes.

13. My estimate of the social multiplier is consistent with the estimates in Glaeser, Scheinkman, and Sacerdote (2003) and Carrell, Malmstrom, and West (2008). Glaeser, Scheinkman, and Sacerdote (2003) estimate a social multiplier of 2.8 in the Dartmouth room-mate experiment, and social multipliers that range from 1.72 to 8.16 using crime data at the county, state, and national levels. Carrell, Malmstrom, and West (2008) estimate a social multiplier of 3.93 in cheating using data from the United States Military Academy, United States Naval Academy, and United States Air Force Academy.

## 4.5 Effect of Peers' Mental Health on Physical Health

I report in Figures 2 and 3 the main 2SLS estimates of Equation 2. The results summarizes the effect of peers' mental health on physical health outcomes. I present the effect of peers' mental health on the probability of reporting poor health (Panel 2a), feeling sick (Panel 2b), and feeling tired (Panel 2c) in Figure 2, and on the probability of seeing a therapist (Panel 3a), and on missing school for health reasons (Panel 3b) in Figure 3. Within each figure, I show the results of heterogeneous analysis by gender and the number of friends.

I find that a one standard deviation increase in the mental health of peers increases the probability that a pupil would report poor health by 9 percentage points (pp), equivalent to a 120% increase, and decreases the probability of seeing a therapist by 13 percentage points, which is a 22% decrease. Additionally, a one standard deviation increase in the mental health score of peers increases the chances of reporting feeling sick by 11 percentage points, feeling tired by 19 percentage points, and missing school for health or mental reasons during the last month by 15 percentage points. This is equivalent to increases of 40%, 35%, and 33%, respectively.

## 4.6 Effect of Peers' Mental Health on Socialization, Alcohol and Drug Consumption

I report in Figures 4 to 8 the results of peer effects on mental health on smoking, socialization, alcohol, drug consumption, and sexual behavior. I find that a one standard deviation increase in the mental health of peers increases in the chances of smoking cigarettes by a 38 pp and the chances of getting intoxicated by 28 pp. That is equivalent to an increase of 130% and 96% increase in the probabilities of smoking and getting intoxicated.

I find that peers' mental health does not have an effect on socialization outcomes like the number of close friends. However, the estimated effect of peers' mental health on the frequency of meeting with friends is substantial, with a one standard deviation increase in peers' mental health decreasing the frequency of meeting friends by 0.24 standard deviations in the full sample and among women (see Figure 6). Moreover, I find that peers' mental health has no significant effect on alcohol consumption in wave 4—when the sample is 24- to 32-year-old—but it has a significant effect on drug and marijuana consumption. A one standard deviation increase in peers' mental health causes a 0.59 standard deviation increase in the frequency of drug consumption. A one standard deviation increase in peers' mental health causes 0.35 and 0.4 standard deviations increase in the frequency of marijuana consumption in waves 1 and 3, respectively. I find that peer effects in mental health has no significant long-term effect on marijuana use when the sample is 24- to 32-year-old. I find that peer effects in mental health does not affect a student's sexual behavior.

### 4.7 Effect of Peers' Mental Health on Long-term Outcomes and Welfare Programs Take Up

I report in Figures 9-23 the results of peer effects on mental health on long-term outcomes and the take up of welfare programs. I find no overall effects of peer effects in mental health on long-run outcomes. I find no persistent long-run effect of peer effects on own Body Mass Index and own mental health (Figures 9 to 12). I find no statistically significant effect of peers' mental health on long-run labor market outcomes (Figures 13 to 17), schooling (Figure 18), marital status (Figure 19), criminal activity and deliquincy (Figure 20), and having multiple partners or paying for sex (Figure 21).

Even though peers' mental health had no long-run labor market outcomes, it did affect some important health outcomes in the long-run. Having peers with worse mental health during adolescents carried a persistence effect on smoking cigarettes long into adulthood. A one standard deviation worsening in the mental health of peers increases the probability of smoking cigarettes by 28 pp in wave 1, 30 pp in wave 2, 14 pp in wave 3, 27 pp in wave 4, and 13 pp in wave 5 (see Figures 22 and 23.) This is likely due to the fact that nicotine is a highly addictive substance, and peer effects in mental health has a significant effect on take up of smoking during adolescents.

## 5 Discussion

In this paper, I find significant evidence on the existence of peer effects in mental health among adolescents using instrumental variable approach. I also find that peer effects in mental health affects educational, health, and behavioral outcomes. I find that a 1 standard deviation causes a 0.74 pp increase in a student's own mental health. I also find that a 1 standard deviation increase in the mental health of peers causes a 11% decrease in GPA and a 23 pp increase in the probability of skipping school without an excuse. Moreover, a 1 standard deviation increase in the mental health index of peers causes a 9, 11, and 19 pp increase in the probabilities of reporting poor health, feeling sick and feeling tired, respectively.

This paper adds to the growing literature on peer effects. Zimmerman (2003), Sacerdote (2001), and Lavy and Sand (2012) find positive peer effects in academic achievements, while Burke and Sass (2013) find small to negligible effects. Card and Giuliano (2013) find peer effects in risky behavior. They find effects of around 5 pp increase in sexual initiation, smoking, marijuana use, and truancy, and larger effects for females.

Finally, Carrell, Malmstrom, and West (2008) find that an addition of one student that cheated in high school leads 0.33 to 0.47 students to cheat in college. The magnitudes of peer effects found in the literature aligns with the findings of this paper.

## 5.1 Heterogeneous Effects

In all the figures discussed above, I show the results of the 2SLS regression using different samples of the data to study heterogeneous effects. Primarily, I repeat my analysis on samples of men, women, students with above median number of friends (popular students), and students with below median number of friends (less popular students). I also report the p-value of the equality tests of the men-women, and popular-less popular heterogeneous analysis.

In Panel 1a, I find that women students are more affected by the mental health of their peers. A 1 standard deviation increase in peers' mental health increases women's mental health index by 0.84 standard deviations, *versus* 0.71 for men. The equality test between the two is statistically significant with a p-value of 0.06. I also find that more popular students' mental health is more affected by the mental health of their peers. A 1 standard deviation increase in peers' mental health increases popular students' mental health index by 0.89 standard deviations, *versus* 0.6 for the less popular students.

In Panel 1b, I find that women students' GPA is more affected by the mental health of their peers. A 1 standard deviation increase in peers' mental health decreases women's GPA by 0.39 points, *versus* 0.22 for men. That is equivalent to a 14% decrease in the GPA of women and 7% decrease in the GPA of men. The equality test between the two is statistically significant at 10%. I also find that more popular students' GPA is more affected by the mental health of their peers. A 1 standard deviation increase in peers' mental health decreases popular students' GPA by 0.55 points, *versus* a statistically insignificant 0.04 for the less popular students. That is equivalent to a 19% decrease in the GPA of popular students.

In Panel 1c, I find that women students' behavioral issues is similarly affected by the mental health of their peers compared to men. A 1 standard deviation increase in peers' mental health increases the probability that a woman/man would skip school without an excuse by 24 pp That is equivalent to an 80% decrease in the probability of skipping school. I also find that more popular students' behavior is more affected by the mental health of their peers. A 1 standard deviation increase in peers' mental health increases the probability that popular students would skip school without an excuse by 30 pp, *versus* 15 pp for the less popular students. That is equivalent to a 100% decrease in the probability of skipping school for popular students, and a 50% decrease for the less popular students.

## 5.2 Robustness Checks

My empirical approach relies on the assumption that, after accounting for unobservable school characteristics and the observable characteristics of a student, the mental health of friends-of-friends are uncorrelated with the unobserved determinants of a student's own outcomes. In this section I will discuss the result of a few robustness checks.

I conduct a placebo regression by randomizing peers to a pupil. I give every person 10 placebo peers. After the randomization, I take the average mental health index and estimate a regression where the dependent variable is a student's own mental health and the independent variable is the average mental health of their peers. I save the estimated coefficient for the regression. I repeat these steps for 2,500 simulations. I present the results to this simulation in Figure 24 I find that there effect of random peers' mental health is concentrated around zero. Thus, the probability that the estimates I am finding are random is low.

Moreover, as another robustness check, I estimated the model using the average mental health score of non-friends as an instrument. [14] A null result would be further evidence that the exclusion restriction holds. I present the results in Table 10. I find that non-friends have no significant direct effect on the mental health of a student—Table 10 column 1. The instrumental variable estimation yields similar insignificant results (Table 10 column 2.) A one standard deviation increase in the mental health of non-friends has no significant results on a student's own mental health.

I also estimated the empirical model on predetermined biological outcomes—as a falsification test. Since race and height are predetermined, they should not be affected by the mental health of peers. I find that peers' mental health does not affect the height nor the race of an adolescent. These results are presented in Figure 25. I find that peer effects in mental health has no significant effect on the pre-determined outcomes, which is a further indication that that the results presented in this paper are not spurious.

## 5.3 Mechanisms

This paper establishes the existence of peer effects in mental health and it effect on other outcomes. In this section, I will introduce a mechanism in which the results could be better understood. This mechanism is driven by the social contagion of mental health.

Glaeser and Scheinkman (2001) posit that contagion in behavioral outcomes—such as crime—occur through a process of information inquiry and learning, and modifica-

14. Non-friends are defined as individuals within a specific school who are not directly connected to a given student and are not friends-of-friends.

tion to preferences and prices. However, mental health could be thought to have some behavioral aspects but is not behaviors. Eisenberg, Daniel et al. (2013) offer a conceptual framework of mental health guided by Grossman (1972) where mental health is an input in the production function.

Social interactions with peers experiencing worsening mental health could be an input in a person's own mental health. The mechanism in which this could be the case are explained by the literature on mental health in psychology. Empathy can potentially worsen an individual's mental health when they deeply imagine themselves in the situation of someone experiencing a decline in mental health (Hatfield, Cacioppo, and Rapson 1993). Offering support may either enhance one's mental well-being or exert a psychological cost, while receiving less support in return can be detrimental (Joiner Jr. and Katz 1999). The presence of a depressive individual might directly lower one's mental state due to negative social interactions (Hokanson et al. 1989). Depression may further spread through shared negative perceptions, critical self-feedback, and mutual negative evaluations of behavior. Additionally, unconscious mimicry of physical expressions can influence emotions, and social comparisons might lead to envy or lowered self-esteem, or alternatively, provide relief or induce guilt, depending on the nature of comparison (Joiner Jr. and Katz 1999).

Research indicates that individuals often subconsciously emulate the facial expressions, vocal tones, movements, and behaviors of those around them, which can influence their own emotions (Hatfield, Cacioppo, and Rapson 1993). Furthermore, emotional contagion can also result from social comparisons. For instance, when individuals compare themselves to those they perceive as more successful, they might do so to align with these individuals. However, such upward comparisons can lead to feelings of envy or a diminished sense of self-worth (Exline and Lobel 1997). On the other hand, downward comparisons might offer temporary solace by highlighting that one's circumstances could be more challenging, yet they can also trigger feelings of guilt and defensiveness. These phenomena collectively underscore that the specific outcomes and intensity of emotional contagion effects remain subjects for empirical investigation.

My analysis delves into how contagion effects vary among different individuals. Those who openly share their emotional struggles may influence the mental health of their surroundings differently compared to those who are introverted and keep their distress to themselves. The concept of 'co-rumination', as discussed in the field of psychology, highlights that regularly dwelling on and discussing negative thoughts and feelings can intensify distress within a group Kennedy-Moore and Watson (2001). Conversely, not expressing emotional distress can strain relationships and adversely affect both the individual and their peers Butler et al. (2003). Therefore, the way one communicates their emotional state can either mitigate or amplify the spread of distress, contingent upon the nature of the interaction Kennedy-Moore and Watson (2001).

It has been observed that women are more inclined to vocalize their emotions Kahn and Garrison (2009) and are less prone to concealing them Gross and John (2003). Consequently, the transmission of mental health challenges among women could vary, influenced by whether the amplification effect of co-rumination or the protective effect of less suppression prevails. Although some research indicates that women may experience more immediate emotional contagion Doherty (1997), these findings do not consider long-term contagion through ongoing interactions as investigated in our study.

The impact of contagion is also influenced by an individual's mental health status. Those struggling with their mental health may be more vulnerable to contagion if they lack effective coping mechanisms for the stress associated with interacting with others facing similar challenges. However, individuals in distress might provide more empathy and support to each other, forming the foundation of peer support groups Davidson et al. (2006).

There are evidence that supports the concept of social contagion and transmission and a heterogeneity that could explain why women and students with higher number of friends are affected more by the mental health of their peers. Using the Add Health data, I constructed indicator variables that are reflective of socialization. I show how these socialization variables differ by gender in Table (12) and by number of friends in Table (13). Notice how women and students with more friends are more likely to talk about problems and socialize with their friends than men and students with less friends. Consequently, this could facilitate the contagion and transmission of mental health among peers and could explain why women and more popular students are affected more by the mental health of their peers.

I also show the results of the 2SLS estimates of Equation 2 where the dependent variables are the socialization indicators. The estimates could show how poor mental health is transmitted among friends. Notice how having peers with worse mental health affects people by talking about their problems and socializing more with their friends. These results indicate that social contagion is the mechanism that is more likely to explain peer effects in mental health.

# 6 Conclusion

This paper contributes to the literature by investigating the peer effects on adolescent mental health and its subsequent impact on academic achievement, physical health, and behavioral issues. To circumvent the difficulties in estimating peer effects causally, I use instrumental variable approach. I leverage the distinct network data supplied by Add Health. This method uses the mental health scores of a student's friends-of-friends—who are not directly connected to the student—as an instrument for the mental health of peers.

The findings demonstrate that there are significant and negative peer effects on mental health among adolescents. Specifically, a one standard deviation increase in the mental health score of peers leads to a 0.76 standard deviation increase in the mental health of the individual. Moreover, peers' mental health significantly affects academic outcomes, with a one standard deviation increase in peers' mental health resulting in a 0.33 decrease in GPA and an increased likelihood of missing school for health reasons by 15 percentage points. Additionally, peers' mental health influences behavioral issues, such as smoking and intoxication, with a one standard deviation increase in peers' mental health associated with a 40 and 30 percentage point increase, respectively.

Furthermore, this study sheds light on the importance of addressing mental health issues among adolescents. Mental health problems have significant consequences for academic achievement, health, and long-term labor market outcomes. As peers play a crucial role in influencing mental health, targeting treatment and interventions to improve mental health in schools could have positive effects on reducing mental health prevalence and improving overall well-being in the long run. These findings have important policy implications, emphasizing the significance of early interventions to improve mental health among adolescents and thereby positively impacting their future outcomes in multiple areas of life. For example, the results indicate that there could be negative, and multiplying, school-wide effects on mental health in the aftermath of a school-shooting or a student suicide. Consequently, such events would require immediate interventions to containing the social-multiplier effect in a school following a tragic event.

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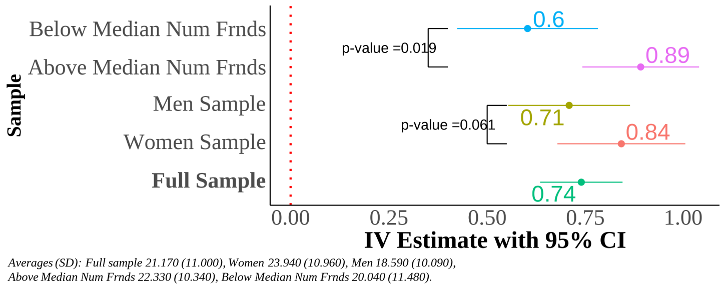
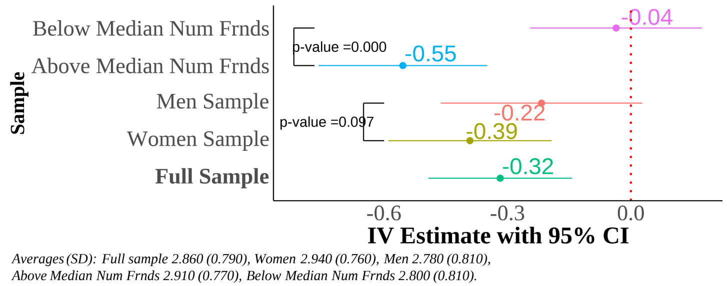
# A FIGURES

Figure 1: Spillover Effect of Peers' Mental Health on Own Mental Health, Academic and Behavioral Outcomes

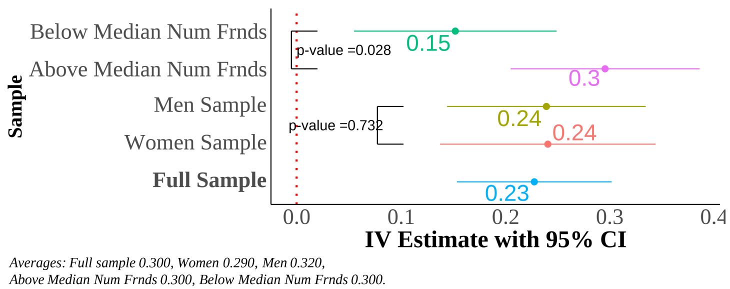
(a) Own Mental Health




(b) GPA

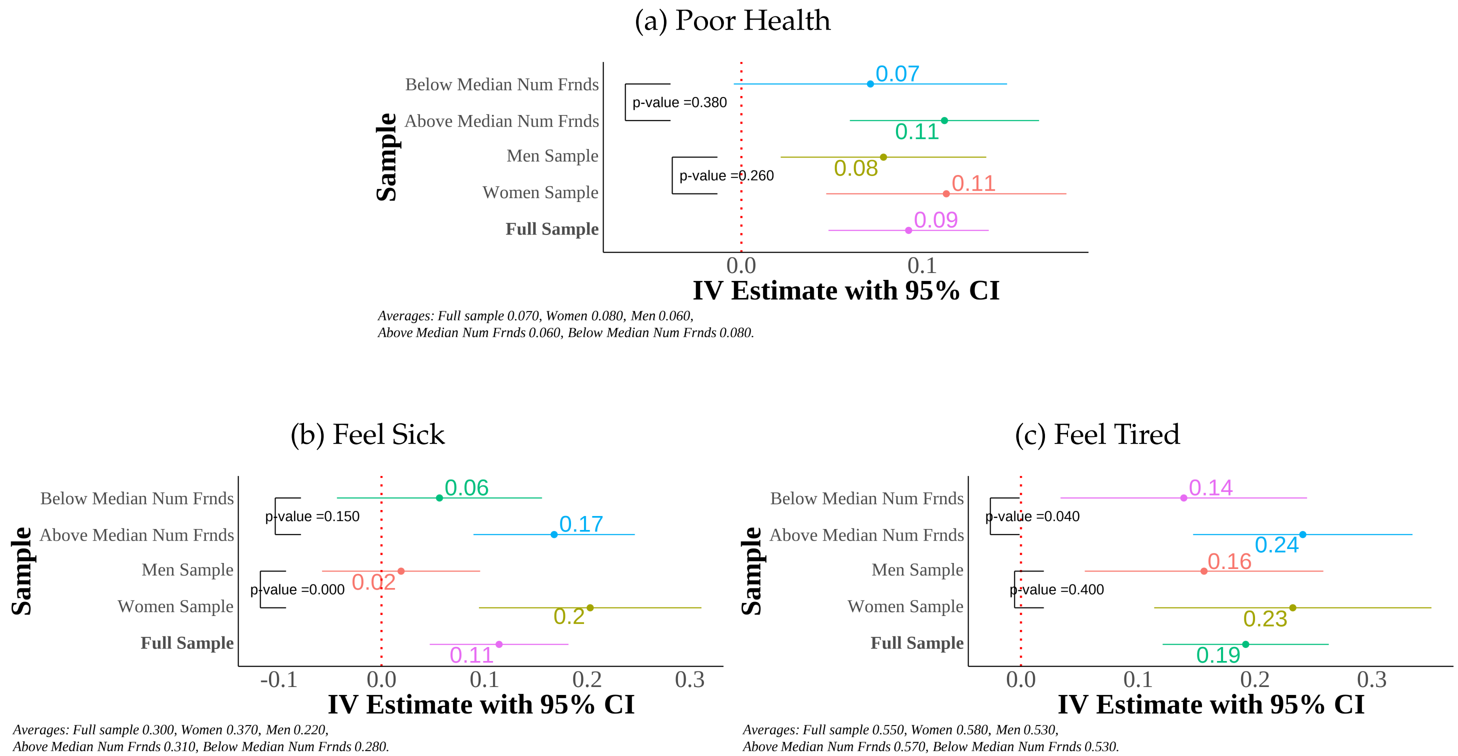



(c) Skipping School




This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects on mental health, academic, and behavioral outcomes. Additionally, separate IV estimations of equation (1) are provided for different samples. In panel (A), the IV estimation is presented for own mental health. Panel (B) shows the IV estimation for GPA. Panel (C) displays the IV estimation for skipping school without an excuse. The control variables in the analysis include sex, race, age, parental education, parental employment, parental occupation, and number of friends. Standard errors are clustered at the school level. The data source is the Add Health in-school survey.

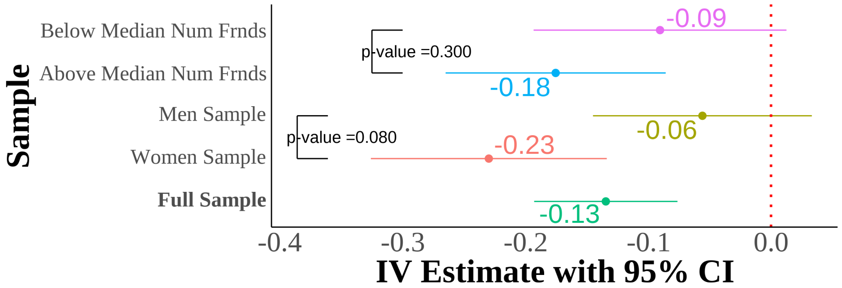
Figure 2: Spillover Effect of Peers' Mental Health on Health Outcomes




This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects focusing on health outcomes. Moreover, I have conducted separate IV estimations for different samples. In panel (A), the IV estimation is presented for the effect of equation (1) on self-reported poor health. Panel (B) provides the IV estimation for the impact of equation (1) on feeling sick. In panel (C), the IV estimation pertains to the effect of equation (1) on feeling tired. The control variables used in the analysis include sex, race, age, parental education, parental employment, parental occupation, and number of friends. Standard errors are clustered at the school level. The data source for this study is the Add Health in-school survey.

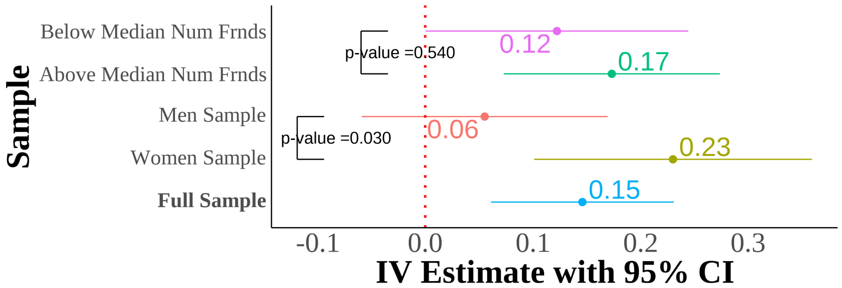
Figure 3: Spillover Effect of Peers' Mental Health on Health Outcomes

(a) Therapy




*Averages: Full sample 0.630, Women 0.640, Men 0.630,*
*Above Median Num Frnds 0.640, Below Median Num Frnds 0.620.*

(b) Miss School due to Health

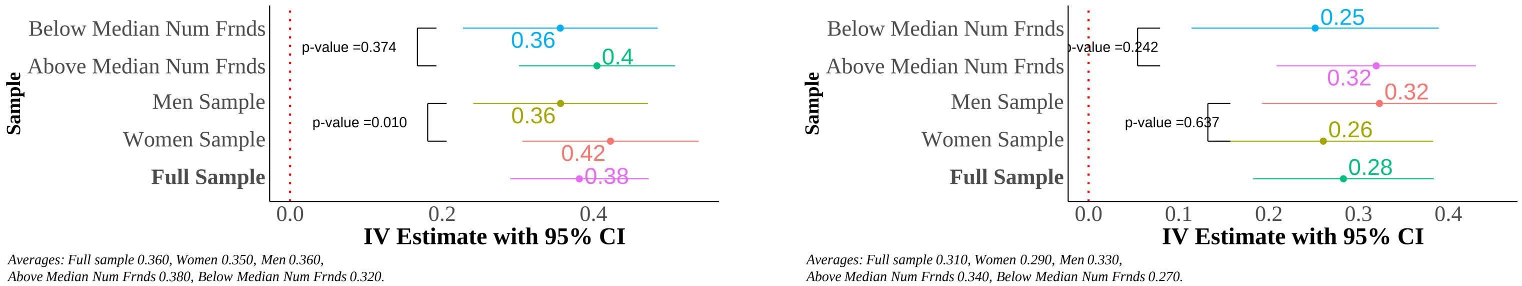



*Averages: Full sample 0.450, Women 0.480, Men 0.420,*
*Above Median Num Frnds 0.440, Below Median Num Frnds 0.460.*

This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects focusing on health outcomes. Moreover, I have conducted separate IV estimations for different samples. Panel (A) shows the IV estimation for the influence of equation (1) on attending therapy. Finally, in panel (B), the IV estimation is presented for the relationship of equation (1) with missing school due to health reasons. The control variables used in the analysis include sex, race, age, parental education, parental employment, parental occupation, and number of friends. Standard errors are clustered at the school level. The data source for this study is the Add Health in-school survey.

Figure 4: Spillover Effect of Peers' Mental Health on Behavioral Outcomes

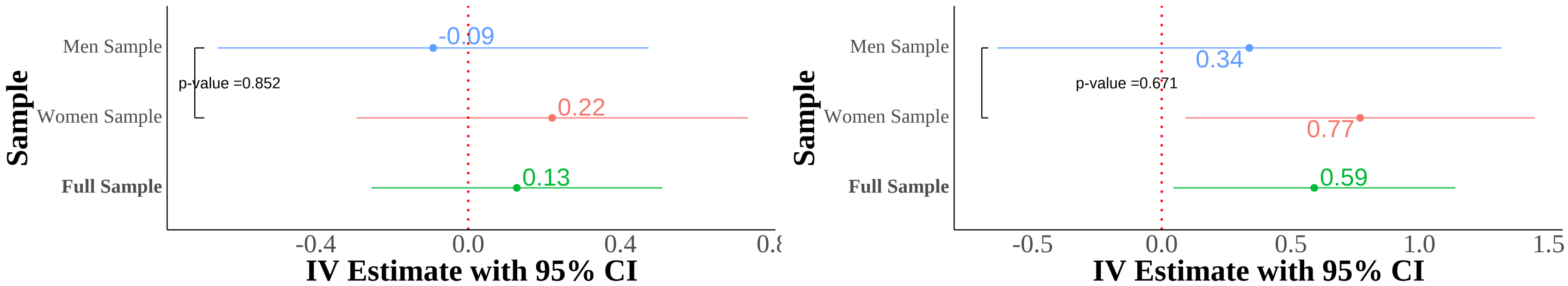
(a) Smoking Cigarettes (b) Intoxication




This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects on getting intoxicated and smoking cigarettes. Additionally, separate IV estimations of equation (1) are provided for different samples. In panel (A) demonstrates the IV estimation for smoking, while Panel (B) covers intoxication. The control variables in the analysis include sex, race, age, parental education, parental employment, parental occupation, and number of friends. Standard errors are clustered at the school level. The data source is the Add Health in-school survey.

Figure 5: Spillover Effect of Peers' Mental Health on Alcohol Consumption

(a) Frequency of Drinking (Wave 4) (b) Frequency of Drug Use (Wave 3)

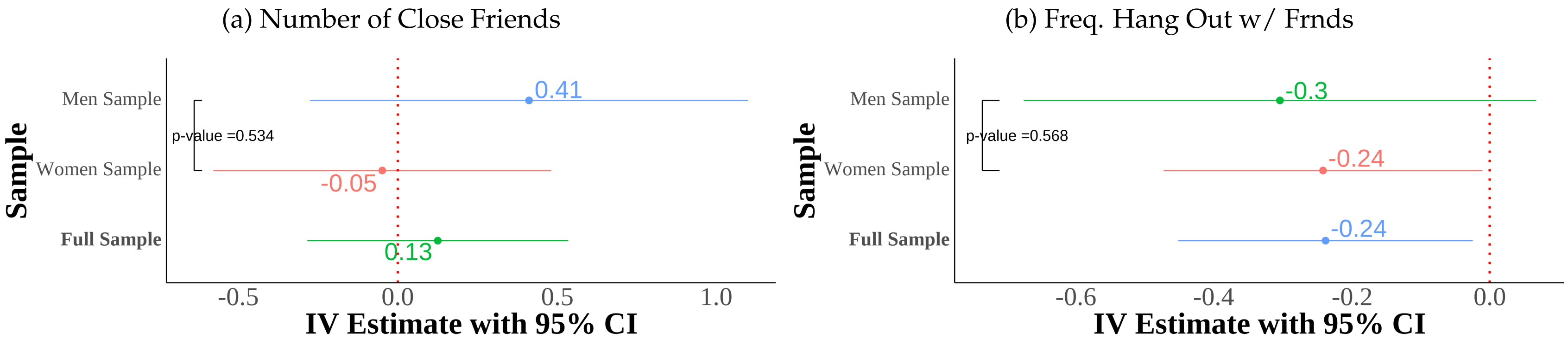



*Averages: Full sample 1.690 (1.840), Women 1.510 (1.680), Men 1.870 (1.980).*

*Averages: Full sample 0.120 (0.620), Women 0.070 (0.470), Men 0.180 (0.740).*

This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects, examining alcohol, and drug consumption. Separate IV estimations are performed for different samples. All dependent variables are normalized to have a mean of zero and a standard deviation of one. Panel (A) the IV estimation is presented for the frequency of alcohol use in wave 4. In panel (B), the IV estimation is presented for the frequency of drug use in wave 3. For the analysis using in-home survey wave 3, control variables include sex, race, age, parental education, parental employment, parental health, and number of friends. For the analysis using in-home survey waves 4 , control variables include sex, race, age, educational attainment, parental education, parental employment, parental health, and number of friends. Standard errors are clustered at the school level. The data source for this study is the Add Health in-home survey.

Figure 6: Spillover Effect of Peers' Mental Health on Socialization



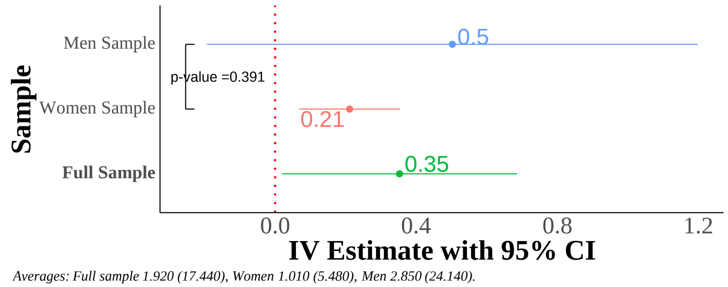

*Averages: Full sample 3.120 (1.000), Women 3.050 (0.950), Men 3.190 (1.050).*

*Averages: Full sample 2.960 (2.690), Women 3.300 (2.620), Men 2.610 (2.720).*

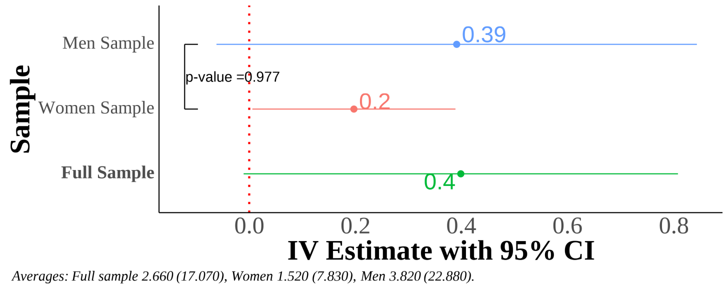
This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects, examining socialization. Separate IV estimations are performed for different samples. All dependent variables are normalized to have a mean of zero and a standard deviation of one. In panel (A), the IV estimation is presented for the number of close friends in wave 4. Panel (B) shows the IV estimation is presented for the frequency a person hangs out with their friends in wave 5. For the analysis using in-home survey waves 4 and 5, control variables include sex, race, age, educational attainment, parental education, parental employment, parental health, and number of friends. Standard errors are clustered at the school level. The data source for this study is the Add Health in-home survey.

Figure 7: Spillover Effect of Peers' Mental Health on Drug Consumption

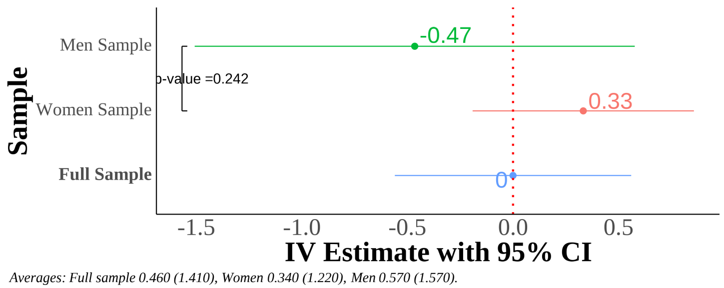
(a) Frequency of Marijuana Use (Wave 1)




(b) Frequency of Marijuana Use (Wave 3)




(c) Frequency of Marijuana Use (Wave 4)

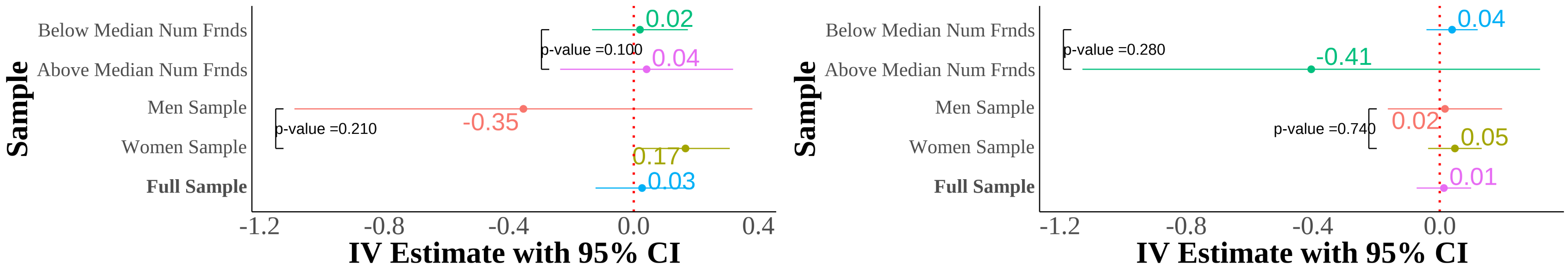



This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects, examining marijuana consumption. Separate IV estimations are performed for different samples. All dependent variables are normalized to have a mean of zero and a standard deviation of one. Panels (A), (B), and (C) present the IV estimation is presented for the frequency of marijuana use during the last 30 days in waves 1, 3, and 4, respectively. For the analysis using in-home survey waves 1 to 3, control variables include sex, race, age, parental education, parental employment, parental health, and number of friends. For the analysis using in-home survey waves 4 and 5, control variables include sex, race, age, educational attainment, parental education, parental employment, parental health, and number of friends. Standard errors are clustered at the school level. The data source for this study is the Add Health in-home survey.

Figure 8: Spillover Effect of Peers' Mental Health on Sexual Behavior

(a) Sexual Intercourse

(b) Intimate Touching



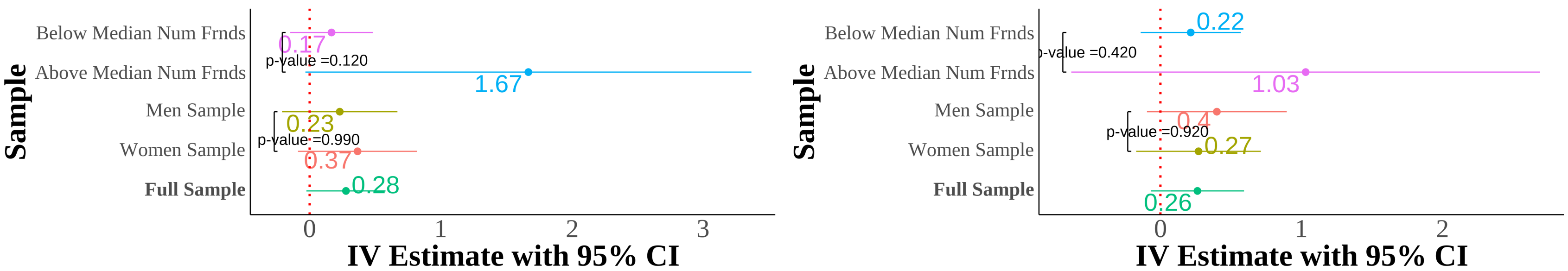

*Averages: Full sample 0.920, Women 0.910, Men 0.920, Above Median Num Frnds 0.920, Below Median Num Frnds 0.920.*

*Averages: Full sample 0.970, Women 0.960, Men 0.980, Above Median Num Frnds 0.970, Below Median Num Frnds 0.970.*

This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects on sexual behavior. Separate IV estimations are conducted for different samples. Panel (A) provides the IV estimation is presented for having sex (wave 1). Panel (B) shows the IV estimation is presented for intimate touching (wave 1). For the analysis using in-home survey wave 1, control variables include sex, race, age, parental education, parental employment, parental health, and number of friends. Standard errors are clustered at the school level. The data source for this study is the Add Health in-home survey.

Figure 9: Spillover Effect of Peers' Mental Health on BMI During Adolescents

(a) BMI (w1) (b) BMI (w2)



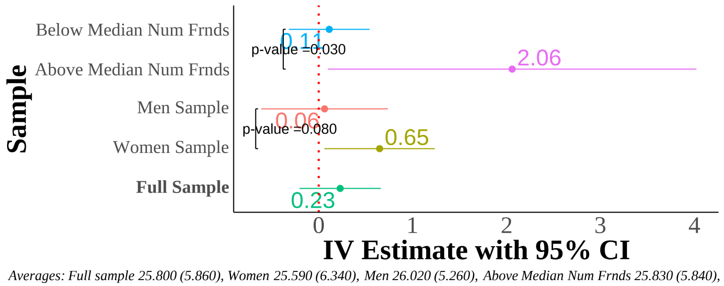

*Averages: Full sample 22.550 (4.450), Women 22.340 (4.450), Men 22.760 (4.450), Above Median Num Frnds 22.580 (4.410), Below Median Num Frnds 22.510 (4.490).*

*Averages: Full sample 22.940 (4.700), Women 22.700 (4.800), Men 23.190 (4.590), Above Median Num Frnds 22.970 (4.630), Below Median Num Frnds 22.890 (4.730).*

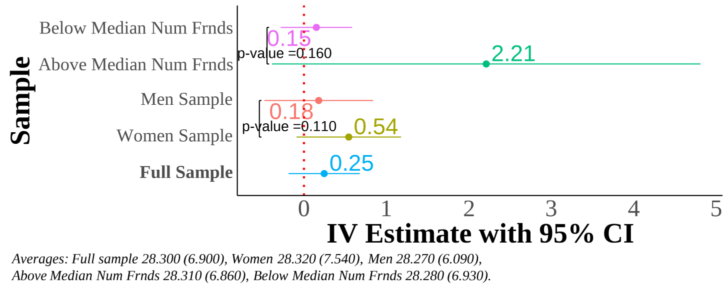
This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects on BMI. I also estimate the regression separately for different samples. All the dependent variables are standardized with a mean of zero and a standard deviation of one. In panel (A), the IV estimation is presented for BMI in wave 1. In panel (B), the IV estimation is presented for BMI in wave 2. For the analysis that uses the in-home survey waves 1 to 3, I control for sex, race, age, parental education, parental employment, parental health, and number of friends. Standard errors are clustered on the school level. Data source is the Add Health in-home survey.

Figure 10: Spillover Effect of Peers' Mental Health on BMI During Adulthood

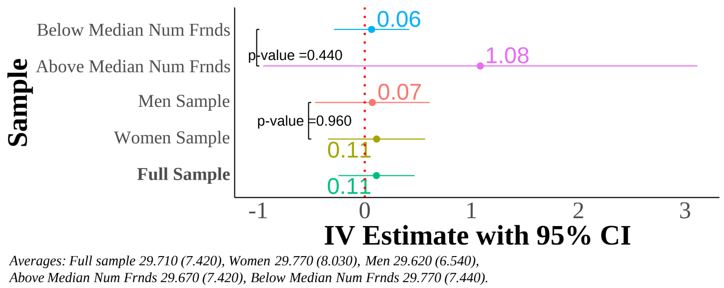
(a) BMI (w3)




(b) BMI (w4)



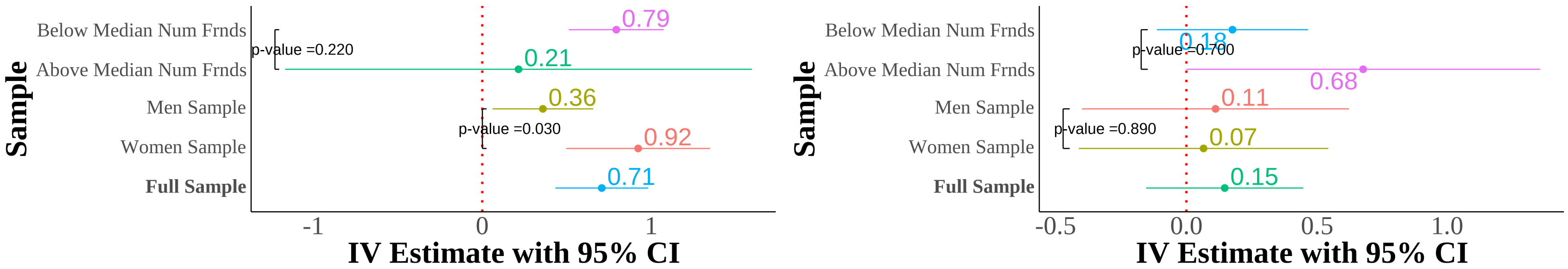

(c) BMI (w5)




This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects on BMI. I also estimate the regression separately for different samples. All the dependent variables are standardized with a mean of zero and a standard deviation of one. In panel (A), the IV estimation is presented for BMI in wave 3. In panel (B), the IV estimation is presented for BMI in wave 4. In panel (C), the IV estimation is presented for BMI in wave 5. For the analysis that uses the in-home survey wave 3, I control for sex, race, age, parental education, parental employment, parental health, and number of friends. For the analysis that uses the in-home survey waves 4 and 5, I control for sex, race, age, educational attainment, parental education, parental employment, parental health, and number of friends. Standard errors are clustered on the school level. Data source is the Add Health in-home survey.

Figure 11: Spillover Effect of Mental Health on Own Mental Health During Adolescents

(a) Own Mental Health (w1) (b) Own Mental Health (w2)



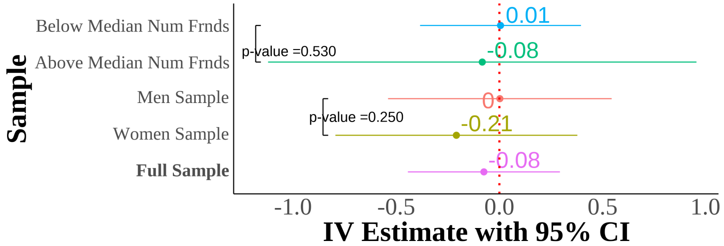

*Averages: Full sample 21.650 (10.930), Women 24.100 (10.890), Men 19.100 (10.390), Above Median Num Frnds 22.130 (10.840), Below Median Num Frnds 21.500 (11.020).*

*Averages: Full sample 8.050 (8.270), Women 8.790 (8.860), Men 7.300 (7.550), Above Median Num Frnds 8.190 (8.290), Below Median Num Frnds 7.750 (8.170).*

This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects on own mental health. I also estimate the regression separately for different samples. All the dependent variables are standardized with a mean of zero and a standard deviation of one. In panel (A), I provide the IV estimation is presented for mental health score in wave 1. In panel (B), I provide the IV estimation is presented for mental health score in wave 2. For the analysis that uses the in-home survey waves 1 to 3, I control for sex, race, age, parental education, parental employment, parental health, and number of friends. Standard errors are clustered on the school level. Data source is the Add Health in-home survey.

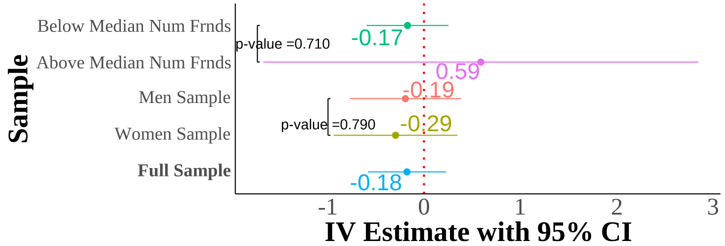
Figure 12: Spillover Effect of Mental Health on Own Mental Health During Adulthood

(a) Own Mental Health (w3)



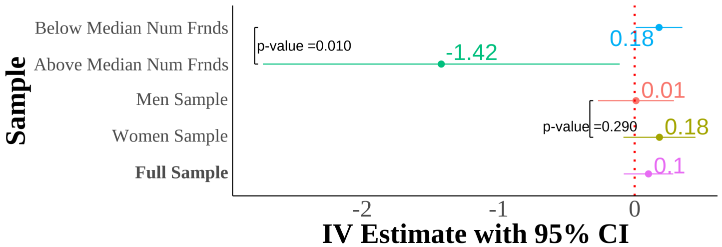

*Averages: Full sample 3.440 (4.120), Women 3.900 (4.420), Men 2.970 (3.730), Above Median Num Frnds 3.470 (4.120), Below Median Num Frnds 3.340 (4.050).*

(b) Own Mental Health (w4)




*Averages: Full sample 4.700 (4.930), Women 5.280 (5.220), Men 4.110 (4.550), Above Median Num Frnds 4.770 (4.930), Below Median Num Frnds 4.630 (4.900).*

(c) Own Mental Health (w5)

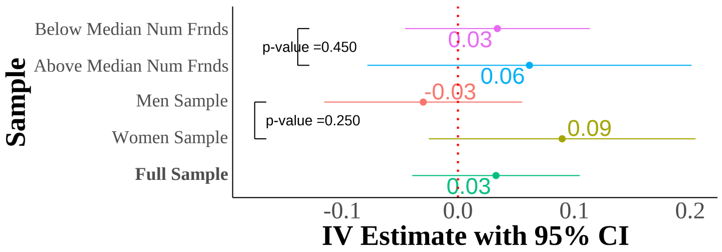



*Averages: Full sample 10.870 (9.710), Women 12.330 (9.580), Men 9.380 (9.610), Above Median Num Frnds 11.010 (9.680), Below Median Num Frnds 10.900 (9.720).*

This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects on own mental health. I also estimate the regression separately for different samples. All the dependent variables are standardized with a mean of zero and a standard deviation of one. In panel (A), I provide the IV estimation is presented for mental health score in wave 3. In panel (B), I provide the IV estimation is presented for mental health score in wave 4. In panel (C), I provide the IV estimation is presented for mental health score in wave 5. For the analysis that uses the in-home survey wave 3, I control for sex, race, age, parental education, parental employment, parental health, and number of friends. For the analysis that uses the in-home survey waves 4 and 5, I control for sex, race, age, educational attainment, parental education, parental employment, parental health, and number of friends. Standard errors are clustered on the school level. Data source is the Add Health in-home survey.

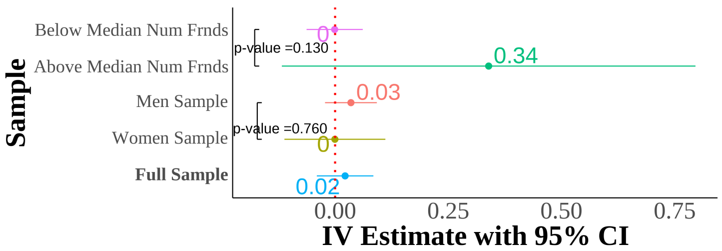
Figure 13: Spillover Effect of Mental Health on Welfare Programs Take Up

(a) Received Food Stamps (w3)




*Averages: Full sample 0.040, Women 0.060, Men 0.010,*
*Above Median Num Frnds 0.040, Below Median Num Frnds 0.040.*

(b) Received Welfare Payments (w3)

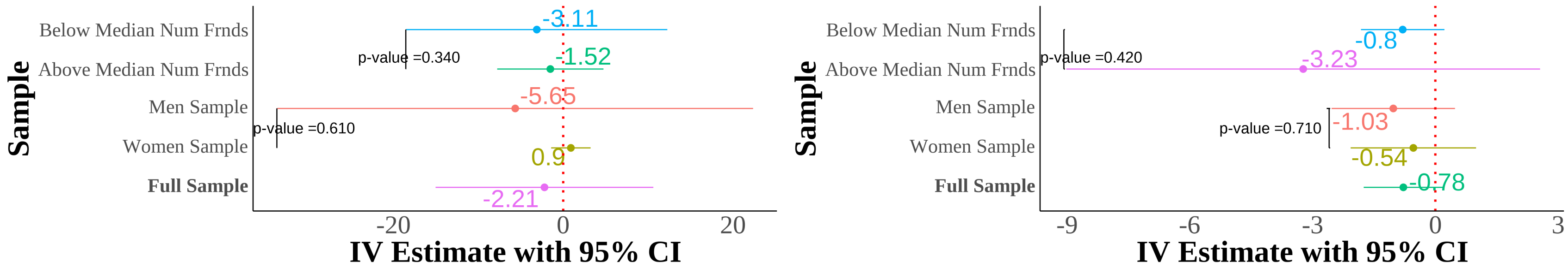



*Averages: Full sample 0.030, Women 0.050, Men 0.010,*
*Above Median Num Frnds 0.030, Below Median Num Frnds 0.030.*

This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects on own mental health. I also estimate the regression separately for different samples. In panel (A), I provide the IV estimation is presented for receiving income from disability, unemployment, and social security benefits in wave 3. In panel (B), I provide the IV estimation is presented for receiving food stamps in wave 3. In panel (C), I provide the IV estimation is presented for receiving welfare payments in wave 3. For the analysis that uses the in-home survey wave 3, I control for sex, race, age, parental education, parental employment, parental health, and number of friends. For the analysis that uses the in-home survey waves 4 and 5, I control for sex, race, age, educational attainment, parental education, parental employment, parental health, and number of friends. Standard errors are clustered on the school level. Data source is the Add Health in-home survey.

Figure 14: Spillover Effect of Mental Health on Earnings

(a) Hourly Earnings (w3) (b) Log Total Personal Earnings (w4)



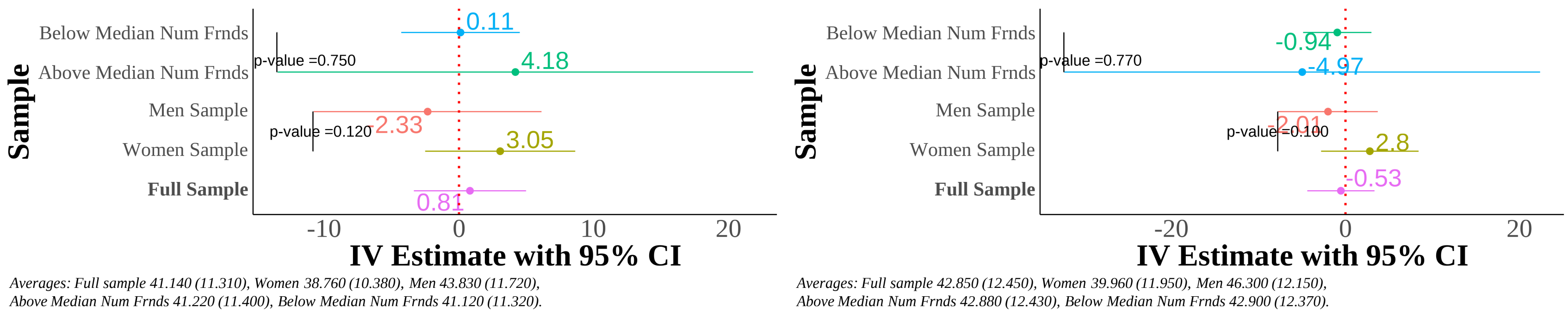

*Averages: Full sample 11.640 (41.060), Women 10.860 (38.820), Men 12.460 (43.260), Above Median Num Frnds 11.420 (38.920), Below Median Num Frnds 11.110 (37.410).*

*Averages: Full sample 35292.710 (44976.270), Women 29370.380 (38364.930), Men 41984.550 (50615.050), Above Median Num Frnds 36060.850 (46329.160), Below Median Num Frnds 34842.610 (44311.460).*

This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects on own mental health. I also estimate the regression separately for different samples. In panel (A), I provide the IV estimation is presented for hourly earnings in wave 3. In panel (B), I provide the IV estimation is presented for log total personal earnings in wave 4. For the analysis, I control for sex, race, age, parental education, parental employment, parental health, and number of friends. Standard errors are clustered on the school level. Data source is the Add Health in-home survey.

Figure 15: Spillover Effect of Mental Health on Weekly Hours Worked

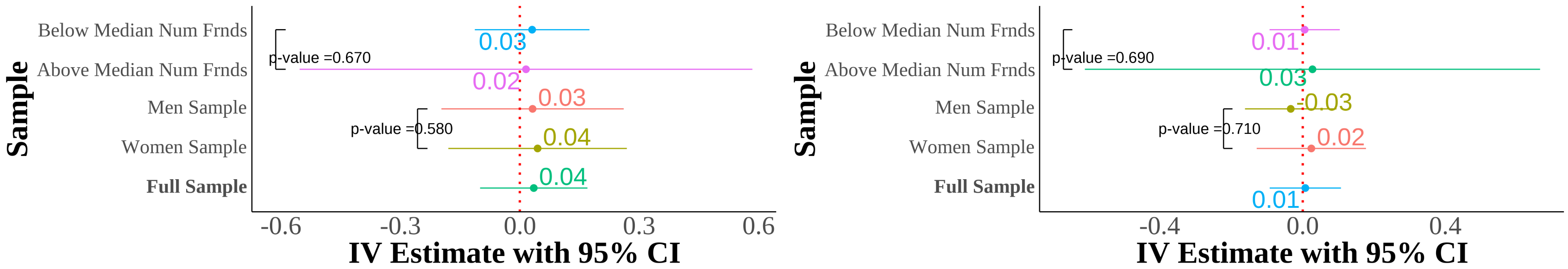
(a) Weekly Hours Worked (w4) (b) Weekly Hours Worked (w5)




This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects on own mental health. I also estimate the regression separately for different samples. In panel (A), I provide the IV estimation is presented for weekly hours worked in wave 4. In panel (B), I provide the IV estimation is presented for weekly hours worked in wave 5. For the analysis, I control for sex, race, age, parental education, parental employment, parental health, and number of friends. Standard errors are clustered on the school level. Data source is the Add Health in-home survey.

Figure 16: Spillover Effect of Mental Health on Full Time Work

(a) Worked Full Time (w4) (b) Worked Full Time (w5)

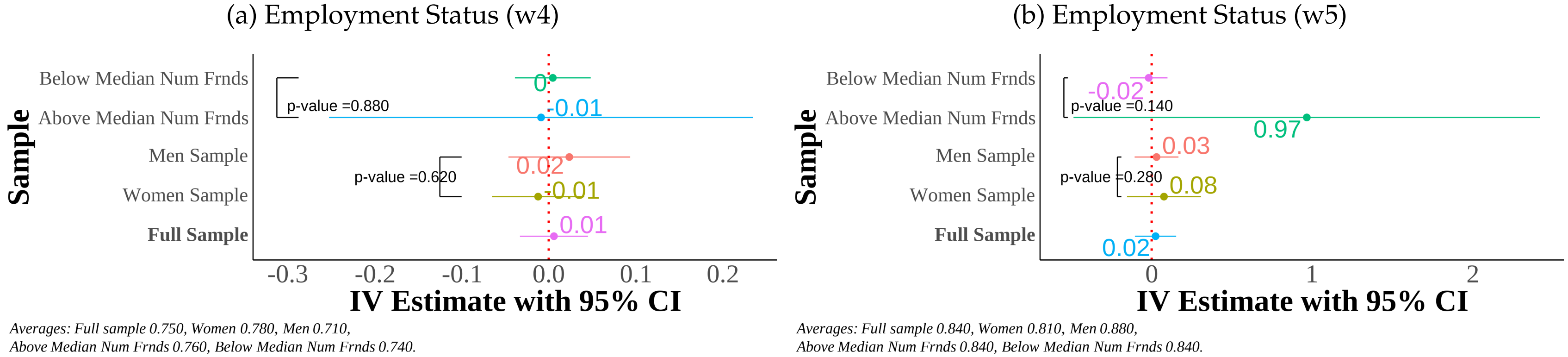



*Averages: Full sample 0.630, Women 0.630, Men 0.630,*
*Above Median Num Frnds 0.640, Below Median Num Frnds 0.630.*

*Averages: Full sample 0.680, Women 0.700, Men 0.660,*
*Above Median Num Frnds 0.690, Below Median Num Frnds 0.680.*

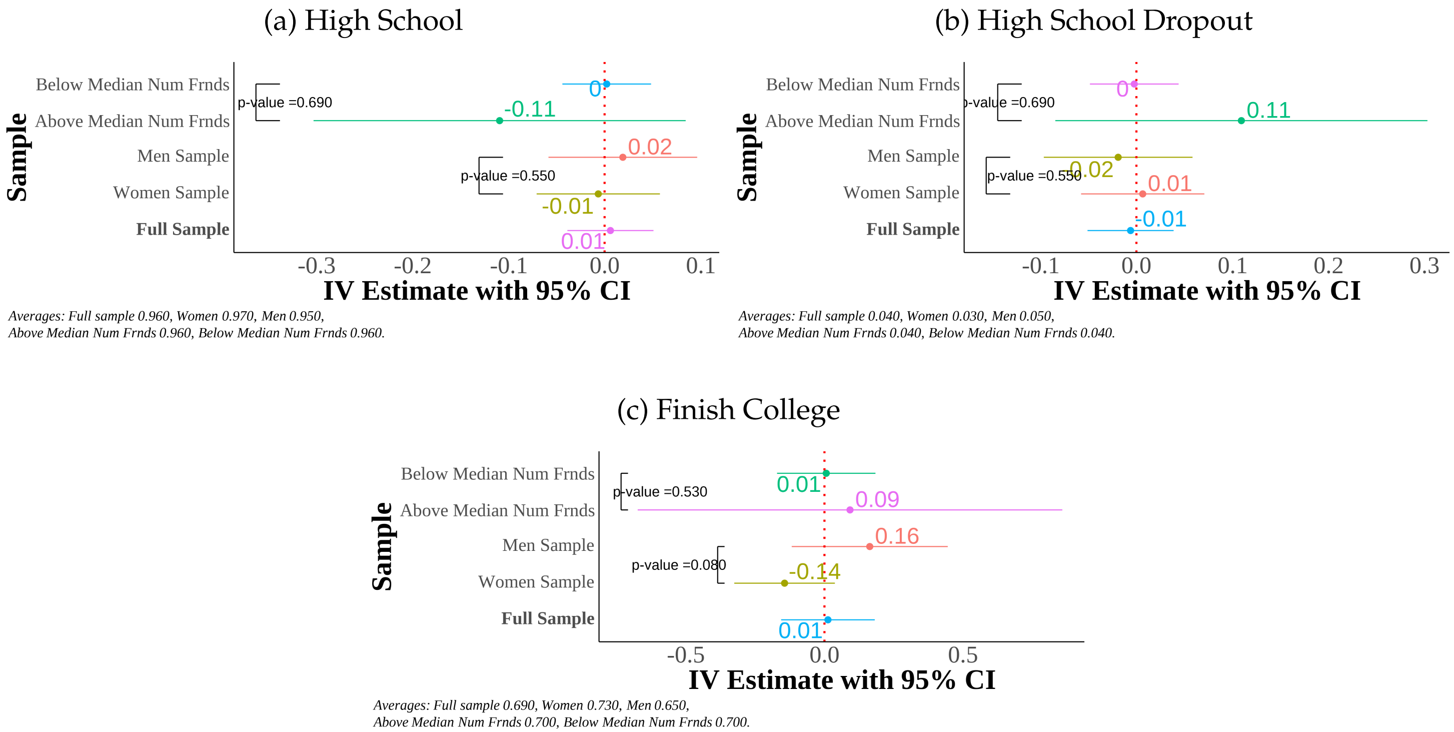
This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects on own mental health. I also estimate the regression separately for different samples. In panel (A), I provide the IV estimation is presented for working full time in wave 4. In panel (B), I provide the IV estimation is presented for working full time in wave 5. For the analysis, I control for sex, race, age, parental education, parental employment, parental health, and number of friends. Standard errors are clustered on the school level. Data source is the Add Health in-home survey.

Figure 17: Spillover Effect of Mental Health on Employment Status




This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects on own mental health. I also estimate the regression separately for different samples. In panel (A), I provide the IV estimation is presented for employment status in wave 4. In panel (B), I provide the IV estimation is presented for employment status in wave 5. For the analysis, I control for sex, race, age, parental education, parental employment, parental health, and number of friends. Standard errors are clustered on the school level. Data source is the Add Health in-home survey.

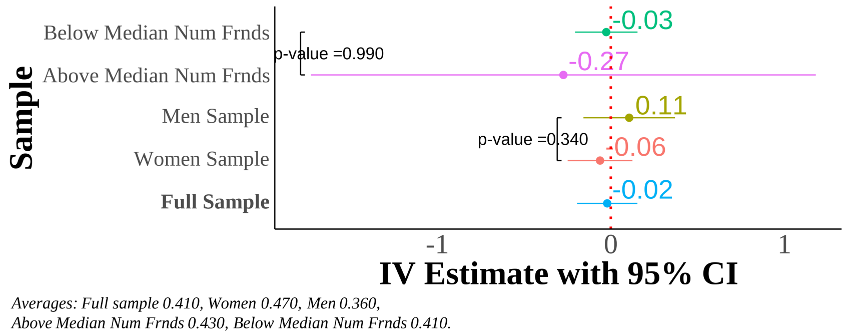
Figure 18: Spillover Effect of Peers' Mental Health on Schooling



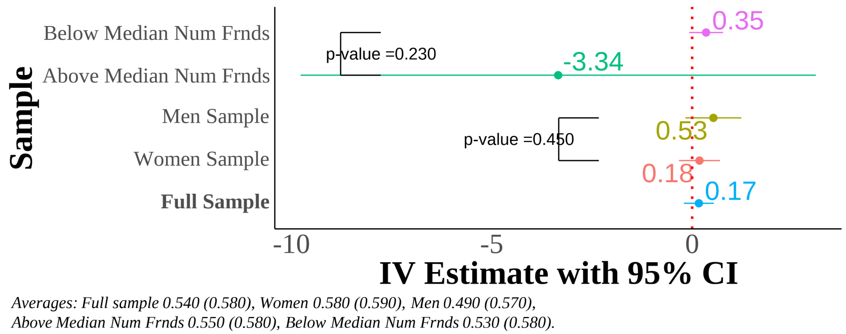

This graph presents the 2SLS estimation of the regression (equation 1) with school fixed effects on schooling. I also estimate the regression separately for different samples. In panel (A), the IV estimation is presented for finishing high school. In panel (B), the IV estimation is presented for dropping out of high school. In panel (C), the IV estimation is presented for finishing college. The control variables include sex, race, age, educational attainment, parental education, parental employment, parental health, and number of friends. Standard errors are clustered on the school level. Data source is the Add Health in-home survey. The dependent variables in panels A to C are constructed from wave 5.

Figure 19: Spillover Effect of Peers' Mental Health on Marriage

(a) Marital Status

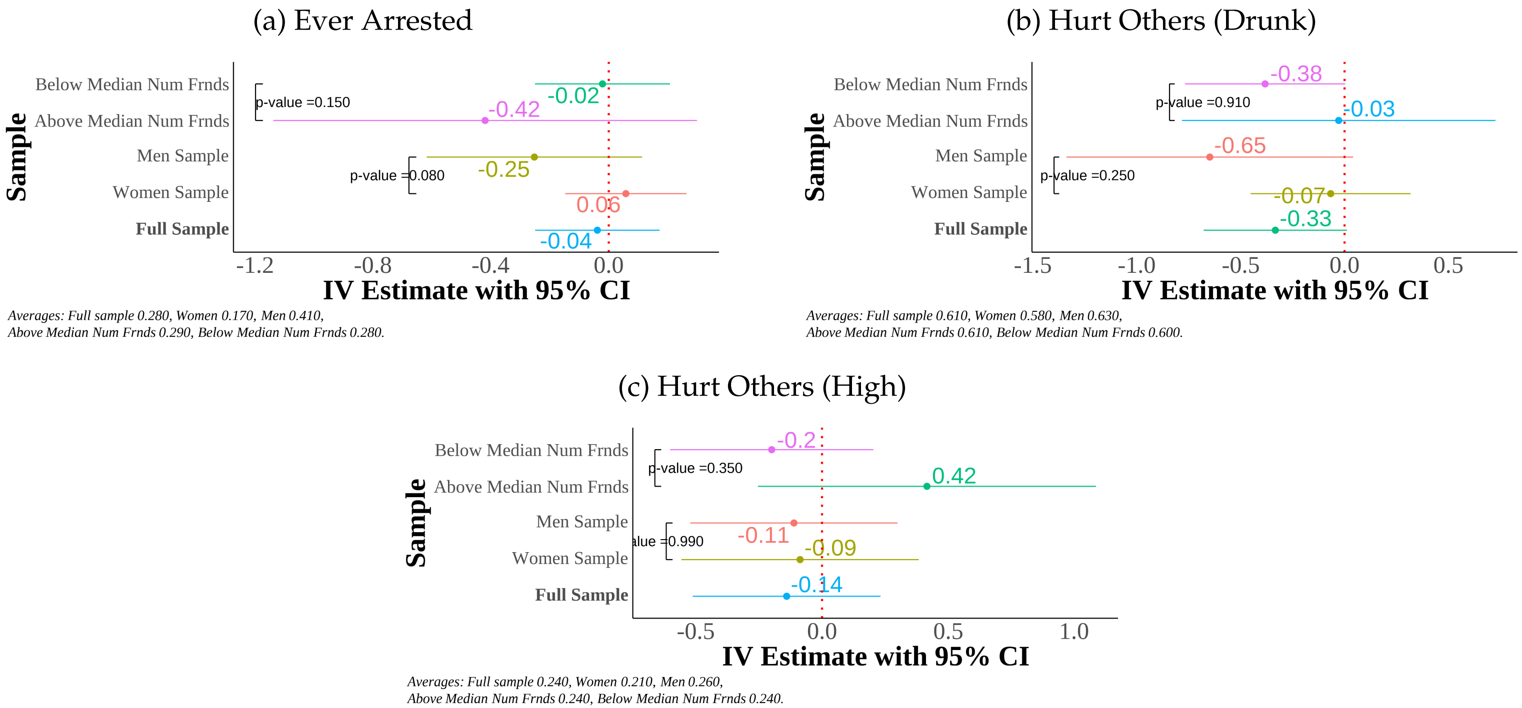



(b) Times Married




This graph presents the 2SLS estimation of the regression (equation 1) with school fixed effects on marriage. I also estimate the regression separately for different samples. The dependent variable times married is normalized with a mean of zero and standard deviation of one. In panel (A), the IV estimation is presented for being married in wave 5. In panel (B), the IV estimation is presented for times married. The control variables include sex, race, age, educational attainment, parental education, parental employment, parental health, and number of friends. Standard errors are clustered on the school level. Data source is the Add Health in-home survey. The dependent times married dependent variable is constructed using wave 4 data, while marital status is constructed using data from wave 5.

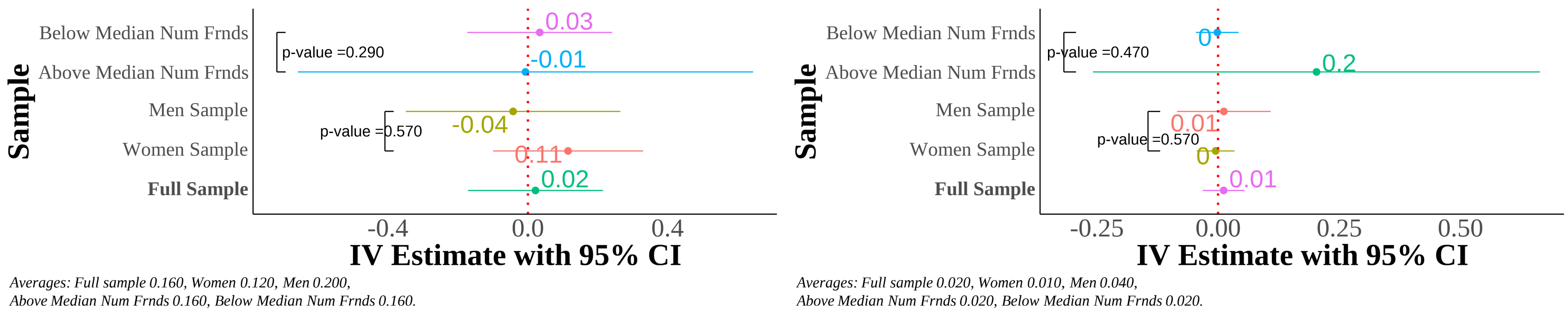
Figure 20: Spillover Effect of Peers' Mental Health on Criminal Behavior




This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects on criminal behavior. Separate IV estimations are conducted for different samples. Panel (A) presents the IV estimation is presented for if they have ever been arrested (wave 4). Panels (B) and (C) provide the IV estimation is presented for if they ever hurt others while drunk or high—including unprotected sex (wave 4). For the analysis using in-home survey waves 1 to 3, control variables include sex, race, age, parental education, parental employment, parental health, and number of friends. For the analysis using in-home survey waves 4 and 5, control variables include sex, race, age, educational attainment, parental education, parental employment, parental health, and number of friends. Standard errors are clustered at the school level. The data source for this study is the Add Health in-home survey.

Figure 21: Spillover Effect of Peers' Mental Health on Sexually Risky Behavior

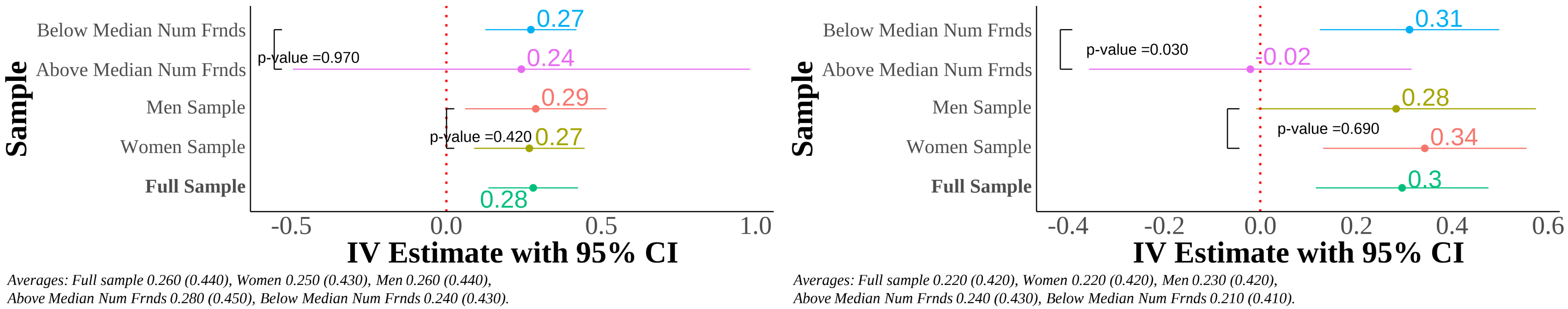
(a) Multiple Partners (b) Paid for Sex




This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects on sexually risky behavior. Separate IV estimations are conducted for different samples. Panel (A) shows the IV estimation is presented for having multiple sexual partners (wave 4). Panel (B) presents the IV estimation is presented for if they ever paid for sex (wave 4). For the analysis using in-home survey waves 4, control variables include sex, race, age, educational attainment, parental education, parental employment, parental health, and number of friends. Standard errors are clustered at the school level. The data source for this study is the Add Health in-home survey.

Figure 22: Spillover Effect of Mental Health on Smoking Cigarettes During Adolescents

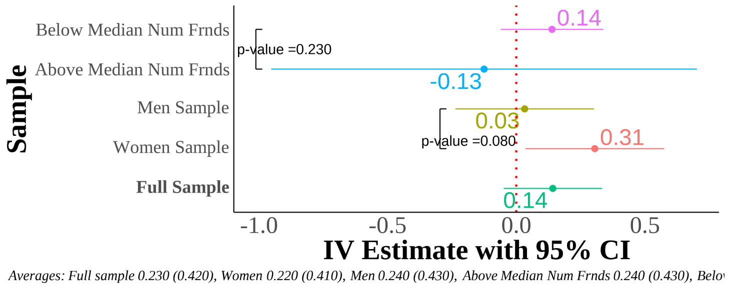
(a) Smoking Cigarettes (w1) (b) Smoking Cigarettes (w2)



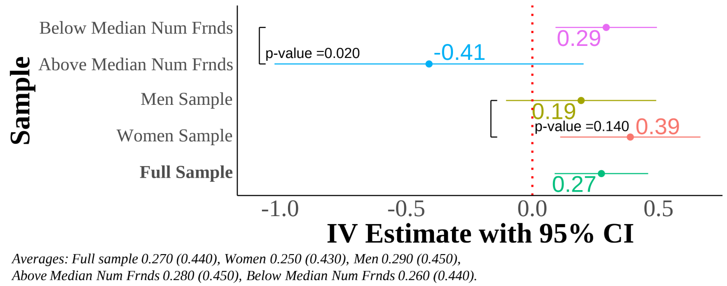

This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects on probability of smoking cigarettes. I also estimate the regression separately for different samples. In panel (A), I provide the IV estimation is presented for smoking cigarettes in wave 1. In panel (B), I provide the IV estimation is presented for smoking cigarettes in wave 2. For the analysis that uses the in-home survey waves 1 to 3, I control for sex, race, age, parental education, parental employment, parental health, and number of friends. Standard errors are clustered on the school level. Data source is the Add Health in-home survey.

Figure 23: Spillover Effect of Mental Health on Smoking Cigarettes During Adulthood

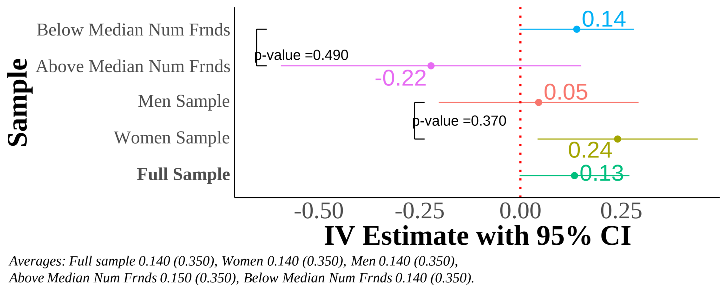
(a) Smoking Cigarettes (w3)




(b) Smoking Cigarettes (w4)

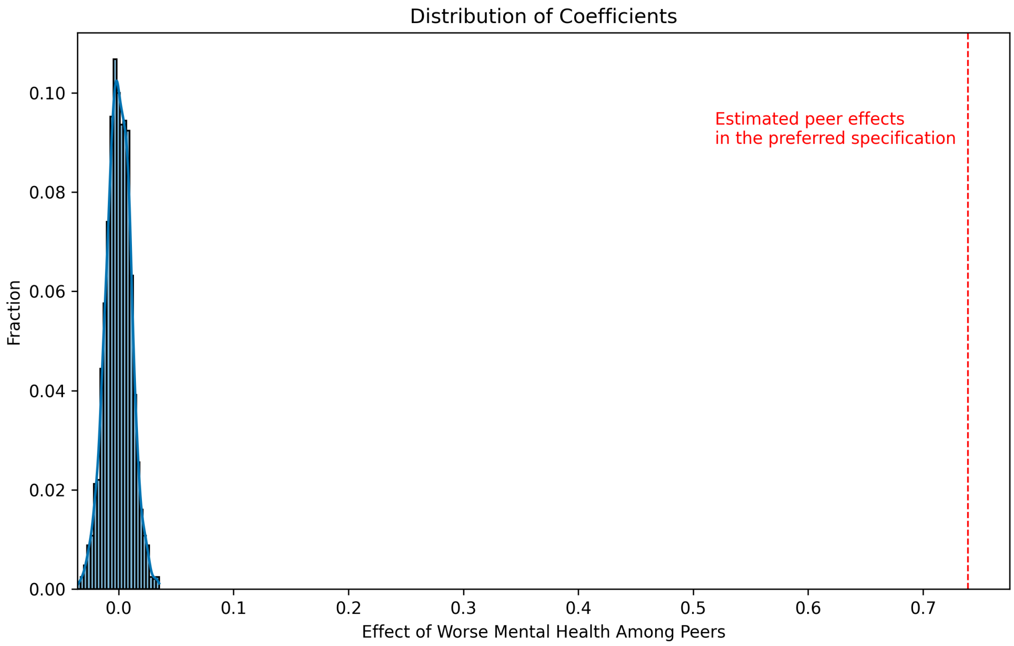



(c) Smoking Cigarettes (w5)




This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects on probability of smoking cigarettes. I also estimate the regression separately for different samples. In panel (A), I provide the IV estimation is presented for smoking cigarettes in wave 3. In panel (B), I provide the IV estimation is presented for smoking cigarettes in wave 4. In panel (C), I provide the IV estimation is presented for smoking cigarettes in wave 5. For the analysis that uses the in-home survey wave 3, I control for sex, race, age, parental education, parental employment, parental health, and number of friends. For the analysis that uses the in-home survey waves 4 and 5, I control for sex, race, age, educational attainment, parental education, parental employment, parental health, and number of friends. Standard errors are clustered on the school level. Data source is the Add Health in-home survey.

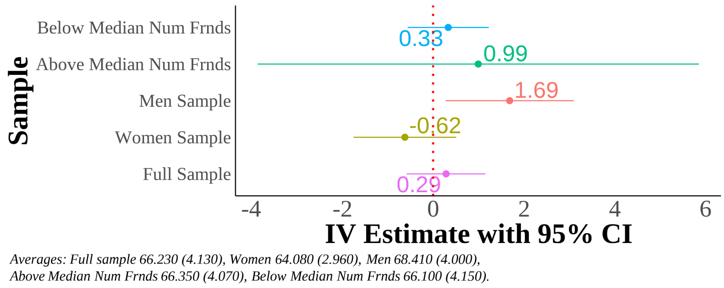
Figure 24: Placebo Tests with Randomly Selected Peers



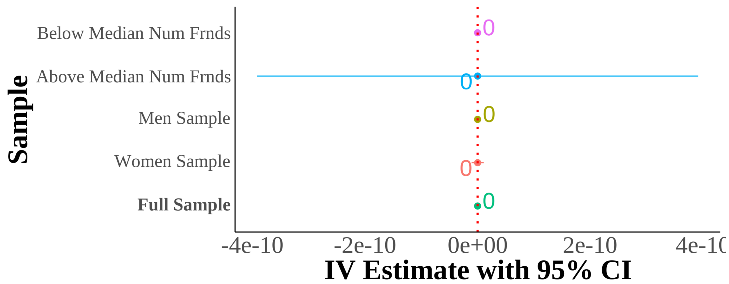

This figure depicts the the full distribution of results of a placebo test in which we assign random peers to students. The graph describes the distribution of the estimated effect of the random peers' mental health on the student's own mental health. The red dashed line is the estimated effect in my preferred specification using 2SLS IV to estimate the effect of peers' mental health on a student's own mental health is equal to 0.73.

Figure 25: Falsification: Spillover Effect of Mental Health on Height and Race

(a) Height




(b) Race: White




This plot presents the 2SLS estimation of the regression (equation 1) with school fixed effects on the predetermined biological height and race outcomes. I also estimate the regression separately for different samples. In panel (A), I provide the IV estimation is presented for height—height is in inches. In panel (B), I provide the IV estimation is presented for being White.

# B TABLES

Table 1: Mental Health Question

| Variable | Question |
|---|---|
| **S60I** | How often have you had a poor appetite? |
| **S46B** | Since school started this year, how often have you had trouble paying attention in school? |
| **S60J** | How often have you had trouble falling asleep or staying asleep? |
| **S60L** | How often have you had trouble relaxing? |
| **S60K** | How often was the following true during the past week [or month]? You felt depressed. |
| **S60O** | How often have you felt fearful? |
| **S60N** | How often have you cried frequently? |
| **S60M** | How often have you been moody? |
| **S62A** | Do you agree or disagree with the following statement? You have a lot of energy. |
| **S62N** | Do you agree or disagree with the following statement? You feel like you are doing everything just about right. |
| **S62P** | Do you agree or disagree with the following statement? You feel loved and wanted. |
| **S62O** | Do you agree or disagree with the following statement? You feel socially accepted. |
| **S62H** | Do you agree or disagree with the following statement? You have a lot of good qualities. |
| **S62K** | Do you agree or disagree with the following statement? You have a lot to be proud of. |
| **S62M** | Do you agree or disagree with the following statement? You like yourself just the way you are. |

[1] These are the questions used to construct the depression index. The 15 items questions roughly translates to the 20 Center for Epidemiologic Studies Depression (CES-D) scale (Radloff 1977). To construct my mental health measure, I summed the responses to the negative questions and subtracted the responses to the positive. The final mental health measure is a normalized score with a mean of 0 and a standard deviation of 1.

Table 2: Summary Statistics of In-School Survey

| | Mean | Std.Dev. | Range | Sample.Size |
|---|---|---|---|---|
| **Demographic** | | | | |
| Age | 15.00 | 1.71 | [10, 19] | 85,267 |
| Female | 0.50 | 0.50 | [0, 1] | 84,792 |
| White | 0.61 | 0.49 | [0, 1] | 85,267 |
| Black | 0.19 | 0.39 | [0, 1] | 85,267 |
| Asian | 0.07 | 0.25 | [0, 1] | 85,267 |
| Native American | 0.05 | 0.23 | [0, 1] | 85,267 |
| Other | 0.10 | 0.30 | [0, 1] | 85,267 |
| Married (w5) | 0.41 | 0.49 | [0, 1] | 20,854 |
| **Educational Outcomes** | | | | |
| GPA | 2.86 | 0.79 | [1, 4] | 54,023 |
| Number of Friends | 6.53 | 3.64 | [0, 10] | 85,267 |
| **Health Outcomes** | | | | |
| Poor Health | 0.07 | 0.26 | [0, 1] | 81,287 |
| Feel Sick | 0.30 | 0.46 | [0, 1] | 79,652 |
| Feel Tired | 0.55 | 0.50 | [0, 1] | 79,611 |
| Miss School for Health Reasons | 0.45 | 0.50 | [0, 1] | 78,110 |
| Ever Saw a Therapist | 0.63 | 0.48 | [0, 1] | 79,444 |
| Miss School | 0.45 | 0.50 | [0, 1] | 78,136 |
| **Behavioral Risk Outcomes** | | | | |
| Skip School | 0.30 | 0.46 | [0, 1] | 79,646 |
| *During the last 12 months* | | | | |
| Smoke | 0.36 | 0.48 | [0, 1] | 79,916 |
| Get Intoxicated | 0.31 | 0.46 | [0, 1] | 79,263 |
| Freq. Drink Alcohol | 1.69 | 1.84 | [0, 6] | 20,854 |
| Freq. High on Drugs | 0.04 | 0.35 | [0, 4] | 20,854 |
| *During the last month* | | | | |
| Freq. marijuana (w1) | 1.92 | 17.44 | [0, 900] | 20,854 |
| Freq. marijuana (w3) | 0.69 | 10.05 | [0, 999] | 20,854 |
| Freq. marijuana (w4) | 0.46 | 1.41 | [0, 6] | 20,854 |
| Freq. Hang Out w/ Frnds | 2.96 | 2.69 | [0, 7] | 20,854 |
| Hurt Others b/c Drunk | 0.61 | 0.49 | [0, 1] | 6,419 |
| Including Unprot. Sex (w4) | | | | |
| Hurt Others b/c High | 0.24 | 0.43 | [0, 1] | 4,241 |
| Including Unprot. Sex (w4) | | | | |

Table 2: Summary Statistics of In-School Survey *(continued)*

| | Mean | Std.Dev. | Range | Sample.Size |
|---|---|---|---|---|
| Hurt Others b/c Drugs | 0.43 | 0.50 | [0, 1] | 1,647 |
| Including Unprot. Sex (w4) | | | | |
| Paid for Sex (w4) | 0.02 | 0.14 | [0, 1] | 13,504 |

[1] Data source is the Add Health survey. Questions regarding skipping school without an excuse, frequency of smoking cigarettes, getting intoxicated, drinking alcohol, and getting high on drugs were asked over a 12 month period. For example, the question on frequency of smoking was 'During the past 12 months, how often did you smoke cigarettes?'. Questions regarding missing school for health reasons and frequency of consuming marijuana, and frequency of hanging out with friends were asked over a 30 day period. For example, the question on frequency of consuming marijuana 'During the past 30 days, on how many days did you use marijuana?'

Table 3: Summary Statistics of the Mental Health Variable

| | Mean | Std.Dev. | Range | Sample.Size |
|---|---|---|---|---|
| Raw Mental Health Score | 21.17 | 11.00 | [0, 67] | 89,940 |
| Raw Mental Health Score: Friends | 21.56 | 6.80 | [0, 67] | 67,993 |
| Raw Mental Health Score: Friends-of-friends | 21.60 | 4.81 | [0, 60] | 64,168 |

[1] Data source is the Add Health survey. The mental health score is the sum of the questions in table 1. The score for the friends and friends-of-friends is the average of the mental health score of the friends and friends-of-friends.

Table 4: Summary Statistics of the Full Sample, Friends, and Friends of Friends

| | Full Sample | Friends | Friends of Friends |
|---|---|---|---|
| **Demographic** | | | |
| Age | 15.02 | 14.98 | 14.98 |
| Female | 0.50 | 0.51 | 0.51 |
| White | 0.61 | 0.62 | 0.62 |
| Black | 0.19 | 0.19 | 0.19 |
| Asian | 0.07 | 0.07 | 0.07 |
| Native American | 0.05 | 0.05 | 0.05 |
| Other | 0.10 | 0.09 | 0.09 |
| Married (w5) | 0.41 | 0.43 | 0.43 |
| **Educational Outcomes** | | | |
| GPA | 2.86 | 2.88 | 2.88 |
| Number of Friends | 6.20 | 6.52 | 6.57 |
| **Health Outcomes** | | | |
| Poor Health | 0.07 | 0.07 | 0.07 |
| Feel Sick | 0.30 | 0.30 | 0.30 |
| Feel Tired | 0.55 | 0.56 | 0.56 |
| Miss School for Health Reasons | 0.45 | 0.44 | 0.44 |
| Ever Saw a Therapist | 0.63 | 0.64 | 0.64 |
| Miss School | 0.45 | 0.44 | 0.44 |
| **Behavioral Risk Outcomes** | | | |
| Skip School | 0.30 | 0.29 | 0.29 |
| *During the last 12 months* | | | |
| Smoke | 0.36 | 0.36 | 0.36 |
| Get Intoxicated | 0.31 | 0.31 | 0.31 |
| Freq. Drink Alcohol | 1.69 | 1.74 | 1.75 |
| Freq. High on Drugs | 0.12 | 0.12 | 0.12 |
| *During the last month* | | | |
| Freq. marijuana (w1) | 1.92 | 1.76 | 1.74 |
| Freq. marijuana (w3) | 2.66 | 2.69 | 2.71 |
| Freq. marijuana (w4) | 0.46 | 0.46 | 0.46 |
| Freq. Hang Out w/ Frnds | 2.96 | 3.04 | 3.05 |
| Hurt Others b/c Drunk | 0.61 | 0.61 | 0.61 |
| Including Unprot. Sex (w4) | | | |

Table 4: Summary Statistics of the Full Sample, Friends, and Friends of Friends *(continued)*

| | Full Sample | Friends | Friends of Friends |
|---|---|---|---|
| Hurt Others b/c High Including Unprot. Sex (w4) | 0.24 | 0.24 | 0.24 |
| Hurt Others b/c Drugs Including Unprot. Sex (w4) | 0.43 | 0.42 | 0.43 |
| Paid for Sex (w4) | 0.02 | 0.02 | 0.02 |

[1] Data source is the Add Health survey. Questions regarding skipping school without an excuse, frequency of smoking cigarettes, getting intoxicated, drinking alcohol, and getting high on drugs were asked over a 12 month period. For example, the question on frequency of smoking was 'During the past 12 months, how often did you smoke cigarettes?'. Questions regarding missing school for health reasons and frequency of consuming marijuana, and frequency of hanging out with friends were asked over a 30 day period. For example, the question on frequency of consuming marijuana 'During the past 30 days, on how many days did you use marijuana?'

Table 5: Spillover Effect of Peers' Mental Health on Own Mental Health

| | Mental Health (1) OLS (Reduced Form) | Friends Mental Health (2) First Stage | Mental Health (3) OLS | Mental Health (4) IV |
|---|---|---|---|---|
| Friends of Friends Mental Health | 0.191*** | 0.259*** | | |
| | (0.017) | (0.019) | | |
| Friends Mental Health | | | 0.220*** | 0.739*** |
| | | | (0.012) | (0.053) |
| Observations | 53,725 | 53,725 | 55,470 | 53,725 |
| First Stage F-statistic | | | | 1,675.97 |
| Social Multiplier | | | | 3.37 |

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

[1] This table presents the 2SLS estimation of the regression (equation 1) with school fixed effects. Column (1) displays the estimation of the reduced form equation using own mental health as the dependent variable. Moving on to column (2), I present the results of the first stage analysis using the average friends' depression as the dependent variable. Column (3) displays the estimation of the OLS regression with own mental health as a dependent variable and friends' mental health as an independent variable. Finally, column (4) includes the results of the instrumental variable (IV) estimation. The control variables include sex, race, age, parental education, parental employment, parental occupation, and number of friends.

[2] The social multiplier is calculated as $SM = TE/DE$, where $TE$ represents the total effect measured by the coefficient from the Instrumental Variable (IV) regression, capturing both direct and indirect effects of peers on individual mental health, and $DE$ is the direct effect estimated from the Ordinary Least Squares (OLS) regression. This ratio illustrates the amplification of peer effects through social networks beyond the direct influence, highlighting the broader impact of peer mental health on the individual within the social context.

[3] Standard errors are clustered on the school level.

[4] Data source is the Add Health in-school survey.

Table 6: Montiel-Pflueger Robust Weak Instrument Test

| | TSLS | LIML |
|---|---|---|
| Effective F statistic: 368.734 | | |
| Confidence level alpha: 1% | | |
| **% of Worst Case Bias** | | |
| $\tau = 5\%$ | 46.219 | 46.219 |
| $\tau = 10\%$ | 30.125 | 30.125 |
| $\tau = 20\%$ | 20.816 | 20.816 |
| $\tau = 30\%$ | 17.232 | 17.232 |

Table 7: Spillover Effect of Peers' Mental Health on Own Mental Health: Trimmed

| | Mental Health (1) OLS (Reduced Form) | Friends Mental Health (2) First Stage | Mental Health (3) OLS | Mental Health (4) IV |
|---|---|---|---|---|
| Friends of Friends Mental Health | 0.229*** | 0.272*** | | |
| | (0.022) | (0.018) | | |
| Friends Mental Health | | | 0.242*** | 0.839*** |
| | | | (0.015) | (0.061) |
| Observations | 41,868 | 41,868 | 42,609 | 41,868 |
| First Stage F-statistic | | | | 1,422.54 |
| Social Multiplier | | | | 3.37 |

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

[1] This table presents the 2SLS estimation of the regression (equation 1) with school fixed effects. Column (1) displays the estimation of the reduced form equation using own mental health as the dependent variable. Moving on to column (2), I present the results of the first stage analysis using the average friends' depression as the dependent variable. Column (3) displays the estimation of the OLS regression with own mental health as a dependent variable and friends' mental health as an independent variable. Finally, column (4) includes the results of the instrumental variable (IV) estimation. The control variables include sex, race, age, parental education, parental employment, parental occupation, and number of friends.

[2] The social multiplier is calculated as $SM = TE/DE$, where $TE$ represents the total effect measured by the coefficient from the Instrumental Variable (IV) regression, capturing both direct and indirect effects of peers on individual mental health, and $DE$ is the direct effect estimated from the Ordinary Least Squares (OLS) regression. This ratio illustrates the amplification of peer effects through social networks beyond the direct influence, highlighting the broader impact of peer mental health on the individual within the social context.

[3] Students that used all of there friendship nominations were trimmed from the analysis.

[4] Standard errors are clustered on the school level.

[5] Data source is the Add Health in-school survey.

Table 8: Spillover Effect of Peers' Mental Health on Own Mental Health

| | Mental Health (1) OLS (Reduced Form) | Friends Mental Health (2) First Stage | Mental Health (3) OLS | Mental Health (4) IV |
|---|---|---|---|---|
| Friends of Friends Mental Health | 0.159*** | 0.238*** | | |
| | (0.018) | (0.020) | | |
| Friends Mental Health | | | 0.197*** | 0.669*** |
| | | | (0.012) | (0.057) |
| Observations | 53,508 | 53,508 | 55,238 | 53,508 |
| School x Grade FE | X | X | X | X |
| First Stage F-statistic | | | | 1,386.2 |
| Social Multiplier | | | | 3.39 |

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

[1] This table presents the 2SLS estimation of the regression (equation 1) with school x grade fixed effects. Column (1) displays the estimation of the reduced form equation using own mental health as the dependent variable. Moving on to column (2), I present the results of the first stage analysis using the average friends' depression as the dependent variable. Column (3) displays the estimation of the OLS regression with own mental health as a dependent variable and friends' mental health as an independent variable. Finally, column (4) includes the results of the instrumental variable (IV) estimation. The control variables include sex, race, age, parental education, parental employment, parental occupation, and number of friends.

[2] The social multiplier is calculated as $SM = TE/DE$, where $TE$ represents the total effect measured by the coefficient from the Instrumental Variable (IV) regression, capturing both direct and indirect effects of peers on individual mental health, and $DE$ is the direct effect estimated from the Ordinary Least Squares (OLS) regression. This ratio illustrates the amplification of peer effects through social networks beyond the direct influence, highlighting the broader impact of peer mental health on the individual within the social context.

[3] Standard errors are clustered on the school level.

[4] Data source is the Add Health in-school survey.

Table 9: Spillover Effect of Reciprocated-Friends Mental Health on Own Mental Health

| | Mental Health (1) OLS (Reduced Form) | Friends Mental Health (2) First Stage | Mental Health (3) OLS | Mental Health (4) IV |
|---|---|---|---|---|
| Reciprocated Friends of Friends Mental Health | 0.105*** | 0.178*** | | |
| | (0.013) | (0.013) | | |
| Reciprocated Friends Mental Health | | | 0.187*** | 0.590*** |
| | | | (0.014) | (0.078) |
| Observations | $27,848$ | $27,848$ | $31,469$ | $27,848$ |
| First Stage F-statistic | | | | 685.49 |
| Social Multiplier | | | | 3.16 |

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

[1] This table presents the 2SLS estimation of the regression (equation 1) with school fixed effects. Column (1) displays the estimation of the reduced form equation using own mental health as the dependent variable. Moving on to column (2), I present the results of the first stage analysis using the average friends' depression as the dependent variable. Column (3) displays the estimation of the OLS regression with own mental health as a dependent variable and friends' mental health as an independent variable. Finally, column (4) includes the results of the instrumental variable (IV) estimation. The control variables include sex, race, age, parental education, parental employment, parental occupation, and number of friends.

[2] The social multiplier is calculated as $\mathtt{SM} = \mathtt{TE}/\mathtt{DE}$, where $\mathtt{TE}$ represents the total effect measured by the coefficient from the Instrumental Variable (IV) regression, capturing both direct and indirect effects of peers on individual mental health, and $\mathtt{DE}$ is the direct effect estimated from the Ordinary Least Squares (OLS) regression. This ratio illustrates the amplification of peer effects through social networks beyond the direct influence, highlighting the broader impact of peer mental health on the individual within the social context.

[3] Standard errors are clustered on the school level.

[4] Data source is the Add Health in-school survey.

Table 10: Spillover Effect of Non-Friends Mental Health on Own Mental Health

| | Mental Health<br>(1)<br>OLS<br>(Reduced Form) | Mental Health<br>(2)<br>IV |
|---|---|---|
| Friends Depression | | 0.272<br>(0.239) |
| Non-Friends Depression | −0.525<br>(0.402) | |
| Observations | 48,418 | 39,451 |

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

[1] This table presents the 2SLS estimation of the regression (equation 1) with school fixed effects. Column (1) displays the estimation of the reduced form equation using own mental health as the dependent variable. Column (2) includes the results of the instrumental variable (IV) estimation. The control variables include sex, race, age, parental education, parental employment, parental occupation, and number of friends.

[2] Standard errors are clustered on the school level.

[3] Data source is the Add Health in-school survey.

Table 11: Spillover Effect of Peers' Mental Health on own mental health: with mutual and non-mutual friends of friends

| | Mental Health<br>(1)<br>OLS<br>(Reduced Form) | Friends Depression<br>(2)<br>First Stage | Mental Health<br>(3)<br>IV |
|---|---|---|---|
| Friends Depression | | | 1.559*** |
| | | | (0.052) |
| Friends of Friends Depression | 0.868*** | 0.557*** | |
| | (0.021) | (0.024) | |
| Observations | 54,258 | 54,258 | 54,258 |
| First Stage F-statistic | | | 7,886.53 |

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

[1] This table presents the 2SLS estimation of the regression (equation 1) with school fixed effects, but this sample includes mutual and non-mutual friends of friends. Column (1) displays the estimation of the reduced form equation using own mental health as the dependent variable. Moving on to column (2), I present the results of the first stage analysis using the average friends' depression as the dependent variable. Finally, column (3) includes the results of the instrumental variable (IV) estimation. The control variables include sex, race, age, parental education, parental employment, parental occupation, and number of friends.

[2] Standard errors are clustered on the school level.

[3] Data source is the Add Health in-school survey.

Table 12: Descriptive statistics about social interactions by gender

| | Men (N=42493) | | Women (N=42494) | | | |
|---|---|---|---|---|---|---|
| | Mean | Std. Dev. | Mean | Std. Dev. | Diff. in Means | Std. Error |
| Talk about problems | 0.581 | 0.493 | 0.823 | 0.382 | 0.241 | 0.003 |
| Talk on the phone | 0.700 | 0.458 | 0.848 | 0.359 | 0.148 | 0.003 |
| Visit house | 0.663 | 0.473 | 0.723 | 0.448 | 0.059 | 0.003 |
| Hang out | 0.683 | 0.465 | 0.739 | 0.439 | 0.056 | 0.003 |
| Spend weekend | 0.665 | 0.472 | 0.745 | 0.436 | 0.079 | 0.003 |

Source: Add Health in-school survey.

Table 13: Descriptive statistics about social interactions by number of friends

| | Above Median Friends (N=43664) | | Below Median Friends (N=46276) | | | |
|---|---|---|---|---|---|---|
| | Mean | Std. Dev. | Mean | Std. Dev. | Diff. in Means | Std. Error |
| Talk about problems | 0.867 | 0.340 | 0.478 | 0.500 | -0.389 | 0.003 |
| Talk on the phone | 0.928 | 0.258 | 0.552 | 0.497 | -0.376 | 0.003 |
| Visit house | 0.842 | 0.365 | 0.485 | 0.500 | -0.356 | 0.003 |
| Hang out | 0.869 | 0.337 | 0.493 | 0.500 | -0.376 | 0.003 |
| Spend weekend | 0.863 | 0.344 | 0.488 | 0.500 | -0.375 | 0.003 |

Source: Add Health in-school survey.

Table 14: Peer Effects and Social Contagionin Mental Health: Mechanism

| | Talk to Frnds (1) | Call Frnds (2) | Visit Frnds (3) | Hang out Frnds (4) | Spend Weekend Frnds (5) |
|---|---|---|---|---|---|
| *Panel A: Full Sample* | | | | | |
| Friends Mental Health | 0.092*** | 0.058** | 0.082*** | 0.091*** | 0.078** |
| | (0.025) | (0.024) | (0.029) | (0.028) | (0.030) |
| Observations | 53,725 | 53,725 | 53,725 | 53,725 | 53,725 |
| *Panel B: Women* | | | | | |
| Friends Mental Health | 0.046 | 0.032 | 0.073* | 0.124*** | 0.092** |
| | (0.036) | (0.033) | (0.041) | (0.047) | (0.042) |
| Observations | 28,609 | 28,609 | 28,609 | 28,609 | 28,609 |
| *Panel C: Men* | | | | | |
| Friends Mental Health | 0.141*** | 0.084** | 0.099*** | 0.068* | 0.073* |
| | (0.042) | (0.035) | (0.037) | (0.037) | (0.039) |
| Observations | 25,102 | 25,102 | 25,102 | 25,102 | 25,102 |
| *Panel D: Above median friends* | | | | | |
| Friends Mental Health | 0.107*** | 0.079*** | 0.058 | 0.089** | 0.059 |
| | (0.030) | (0.026) | (0.037) | (0.036) | (0.038) |
| Observations | 34,554 | 34,554 | 34,554 | 34,554 | 34,554 |
| *Panel E: Below median friends* | | | | | |
| Friends Mental Health | 0.059 | 0.027 | 0.111*** | 0.088** | 0.095** |
| | (0.046) | (0.040) | (0.041) | (0.041) | (0.045) |
| Observations | 19,171 | 19,171 | 19,171 | 19,171 | 19,171 |

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

[1] This table presents the 2SLS estimation of the regression (equation 1) with school fixed effects. Column (1) includes the results of the instrumental variable (IV) estimation where the dependent variables are indicators for talking to female/male friends about problems. Column (2) includes the results of the instrumental variable (IV) estimation where the dependent variables are indicators for talking to female/male friends on the phone. Column (3) includes the results of the instrumental variable (IV) estimation where the dependent variables are indicators for visiting the houses of female/male friends. Column (4) includes the results of the instrumental variable (IV) estimation where the dependent variables are indicators for hanging out with female/male friends outside of school. Column (5) includes the results of the instrumental variable (IV) estimation where the dependent variables are indicators for spending the weekend at female/male house. The control variables include sex, race, age, parental education, parental employment, parental occupation, and number of friends.

[2] Standard errors are clustered on the school level.

[3] Data source is the Add Health in-school survey.