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DISCUSSION PAPER SERIES

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# Peers, Gender, and Long-Term Depression

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# ABSTRACT

## Peers, Gender, and Long-Term Depression*

This study investigates whether exposure to peer depression in adolescence affects own depression in adulthood. We find a significant long-term depression peer effect for females but not for males in a sample of U.S. adolescents who are followed into adulthood. An increase of one standard deviation of the share of own-gender peers (schoolmates) who are depressed increases the probability of depression in adulthood by 2.6 percentage points for females (or 11.5% of mean depression). We also find that the peer effect is already present in the short term when girls are still in school and provide suggestive evidence for why it persists over time. In particular, we show that peer depression negatively affects the probability of college attendance and the likelihood of working, and leads to a reduction in income of adult females. Further analysis reveals that individuals from families with a lower socioeconomic background are more susceptible to peer influence, thereby suggesting that family can function as a buffer.

**JEL Classification:** I12, Z13

**Keywords:** peer effects, depression, contagion, gender, family background, adolescence, policy

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# 1 Introduction

Depression is a common mental disorder leaving a large economic footprint: it is estimated to cost society $210 billion per year in the United States (Greenberg et al., 2015). Adolescents are particularly vulnerable to depression. According to the World Health Organization (WHO), 10% to 20% of adolescents globally experience mental health conditions, with depression being a leading cause of illness and disability among this group.[1] In the United States, 13.3% of the population aged 12 to 17 years had at least one major depressive episode in 2017, with females being significantly more prone (20.0%) than males (6.8%).[2] Teenage depression in the United States is on the rise, having increased by approximately 50% in the period 2005-2017 (Twenge et al., 2019).

The development of adolescent depression has been linked to genetic, biological, emotional, and other vulnerabilities (Hankin, 2006, Thapar et al., 2012). There is also ample evidence that depression has different effects on adolescent boys and girls (Nolen-Hoeksema, 2001, Crick and Zahn-Waxler, 2003, Weller et al., 2006). Indeed, girls begin to exhibit more internalized emotional problems—especially symptoms of depression—than boys starting in early adolescence and lasting throughout most of adulthood (Hankin and Abramson, 1999, Kuehner, 2003).[3] Further, adolescence is a period in which the influence of peers begins to have a more pronounced impact, as adolescents seek to gain social approval (Brown and Larson, 2009). Child psychologists have argued that apart from the positive effects of peer relationships in adolescence on emotional and behavioral development, peer networks can facilitate the transmission of depressive symptoms as well (Dishion and Tipsord, 2011).

The aim of this paper is to investigate the long-term effect of having same-gender depressed peers in adolescence on own-depression in adulthood (14 years later) and to provide suggestive evidence about the mechanisms underlying this relationship. We use longitudinal data from the National Longitudinal Survey of Adolescent to Adult Health (Add Health), which enables us to investigate the impact of depression among adolescent peers when individuals are between 12 and 18 years of age (grades 7 through 12) on own-depression several years later (when they are between 24 and 32 years of age). Identifying peer effects poses some well-known empirical challenges (Manski, 1993)—the reflection problem, correlated effects, and the endogenous selection into groups. Testing for long-term peer effects using the longitudinal aspect of our data enables us to circumvent the reflection problem, which arises

[1] See `https://www.who.int/news-room/fact-sheets/detail/adolescent-mental-health`, accessed on March 18, 2020.

[2] These statistics are based on data from the 2017 National Survey on Drug Use and Health (NSDUH), as reported by the National Institute of Mental Health (`https://www.nimh.nih.gov/health/statistics/major-depression.shtml`), accessed on March 18, 2020.

[3] In our sample of 12,400 individuals, in adolescence, girls are more depressed than boys (24.8% versus 14.1%); in adulthood, women are more depressed than men (22.8% versus 16.5%).

due to the simultaneity inherent in estimating *contemporaneous* peer effects. Further, we exploit the quasi-random variation in the proportion of depressed peers (schoolmates) within school and across cohorts, following an established approach developed to estimate gender and race peer effects on student achievement (Hoxby, 2000),[4] thereby addressing the problem of endogenous selection of peer groups. The key idea underlying the identification strategy exploits the fact that parents may be selecting a school by taking into account the average depression level of pupils in schools; however, the within-school sorting into grade is unlikely to be driven by parents' knowledge of across-cohort differences in the share of depressed schoolmates. Therefore, it is reasonable to assume that the latter is not correlated with any unobserved determinants of depression, once school fixed effects as well as cohort/grade fixed effects have been accounted for. We also include a school-specific linear time trend, which captures any remaining time-variant influences that are specific to the school. These fixed effects and the time trend also account for the correlated-effect issue because they wash out anything that is specific to the grade or school. In our analysis, we perform a series of balancing and placebo tests that provide support for the identification strategy.

We find evidence of significant long-term peer effects on depression for females but *not* for males. In particular, a one standard deviation increase in the share of female peers who are depressed in adolescence increases the probability of own-depression in adulthood by 2.6 percentage points for females (or 11.5% of mean depression). This effect is more pronounced for females with low-initial mental health status in adolescence and is stronger for individuals who were exposed to a high proportion of depressed peers. Our estimates suggest that a girl who has a large share of depressed peers in high school (top quartile) will have a probability of being depressed in adulthood that is eight percentage points higher than one whose peer group has a low share of depressed peers (bottom quartile). This differential effect corresponds to an increase of over one-third of the average likelihood of female depression.

We explore the possible mechanisms underlying our main result by differentiating between the short-term effect (does exposure to depressed peers in adolescence have a contemporaneous impact on own depression?) and its long-term effect (why does this short-term effect persist over time?). For the short-term effect, we find that an increase of one standard deviation in female peer depression in Wave I (1994-1995) is associated with an increase of 2.9 percentage points in own-depression in Wave II (1996)—that is 11.8% of mean depression. There is no significant effect of peer depression on own-depression for males in adolescence. In other words, peer depression has a strong and immediate impact on own-depression only for females.

Next, we turn to examine family and social relationships as a potential channel medi-

[4]Ever since, the approach has been applied extensively to study peer effects in educational and other outcomes (Angrist and Lang, 2004, Lavy and Schlosser, 2011, Bifulco et al., 2011, 2014, Patacchini and Zenou, 2016, Elsner and Isphording, 2017, Merlino et al., 2019, Fruehwirth et al., 2019, Brenoe and Zölitz, 2020, Olivetti et al., 2020).

ating the short-term effect. We begin by examining the child-mother relationship, finding that having a strong bond with one's mother reduces female depression but it does not decrease the effect of peer depression on own-depression. Second, considering that adolescents spend considerable amount of time with their peers, we investigate the role of friendship and socialization. Child psychologists have argued that peer and friendship relationships differ substantially between genders (Rose and Rudolph, 2006), with females being more likely to share their negative feelings and stressful experiences. One channel through which this may occur is *co-rumination*, which refers to the tendency to extensively discuss and revisit problems without coming up with solutions, thereby leading to symptoms of anxiety and depression (Rose, 2002, Stevens and Prinstein, 2005, Prinstein, 2007). We investigate this channel in our data by examining how females and males interact with same-gender peers. We find a marked gender difference in our two measures of co-rumination: girls report to have discussed a problem with 69% of their nominated female friends, while boys report discussing their problems with 39% of their nominated male friends. Girls also report to have talked on the phone with a larger proportion of their female friends than boys have with male friends (81% versus 69%).

We subsequently investigate the channels underlying the long-term effects—that is, why peer depression in adolescence has still an impact when individuals are adults. Given that we consider peers in the same grade, it is very likely that girls do not interact any more with their female peers after high school. Then, why do high school peers still have an impact after students have left high school? We conjecture that peer depression in adolescence amplifies own-depression, affecting the likelihood of attending college, which is a decision made just after high school when peers have still an influence on own-depression. Reduced opportunities to accumulate human capital might imply, in turn, that girls who are exposed to depressed peers in adolescence have a lower likelihood of working and/or earning a high income. We provide suggestive evidence for this channel by examining the effect of peer depression in adolescence on college attendance, employment, and income. We find a significant and negative effect on all these outcomes only for women. In particular, an increase of one standard deviation in peer depression is associated with a lower probability of college attendance by 3.5 percentage points, a lower likelihood of working by 2.8 percentage points, and a reduction in income by \$1,870, which translates into a reduction in income by 6.22% at baseline. For males, there is no evidence of a long-term effect of peer depression on these outcomes.

Unlike peers, parents do not disappear after high school. Thus, in order to better understand the role of family, we study how family income and occupational status of the parents might mitigate the long-term impact of peer effects.[5] We find that the lower the income of the

[5]It is very unlikely that the ranking of families in terms of income and occupational status changes in 14 years—that is between the time when the girl is an adolescent and when she is an adult.

family and the lower the occupational status of the mother, the more females are influenced by the depression of their peers in adolescence. This suggests that parental background plays an important role in absorbing the negative peer effect on mental health as females from families with a lower socioeconomic background are more susceptible to influence from peer depression.

Our paper is linked to several literature strands. First, our work relates to research on the determinants of mental health. Recent studies have indicated the importance of the quality of the neighborhood (Kling et al., 2007), the degree of religiosity (Fruehwirth et al., 2019), and early-life circumstances, malnutrition, and stress in utero (Adhvaryu et al., 2019, Persson and Rossin-Slater, 2018) for mental health. There is also an important non-economic (mostly psychology and medical) literature stream (see e.g. Bearman and Moody, 2004 or Rosenquist et al., 2011) that examines the influence of peers on mental health (such as depression, suicide, etc.) and reveals a positive correlation between the two; however, the question remains whether this relationship is causal.[6]

Our paper is also linked to the literature that examines the impact of depression on different outcomes. It has been shown that depression affects school attainment and other short-term outcomes and can also have long-term effects (Fletcher, 2010, 2013, Goodman et al., 2011, Lundborg et al., 2014, Anderson et al., 2015), thereby having important consequences for the quality of life of those who suffer from it and for their environment.

Finally, our study is related to the literature that examines the long-term effects of peers at school. Researchers have examined the effect of adolescent peers on post-secondary education, college major, and occupation choices (Bifulco et al., 2011, Gould et al., 2009, Brenoe and Zölitz, 2020, Anelli and Peri, 2019), on after-school graduation outcomes—such as IQ scores, teenage childbearing, education, and labor market outcomes (Bifulco et al., 2014, Black et al., 2013, Carrell et al., 2018, Olivetti et al., 2020)— and on adult interracial relationships (Merlino et al., 2019).

To the best of our knowledge, our study is the first to document a causal link between the depression of one's peers in adolescence and depression later in life. We also provide suggestive evidence of mechanisms that explain why peer depression has a short-term effect only for girls and why it persists over time. One implication of our findings is that changing from a peer group with high incidence of depression to one with a low incidence of depression would have a big impact on long-term depression and capacity to go to college and work among females. For example, this could be achieved through a mobility program that incentivizes low-income families (for whom the estimated peer effect among females is more pronounced) to move to

[6]To the best of our knowledge, in economics, only two papers—Eisenberg et al. (2013) and Zhang (2018)—have examined the causal effect of peers on own mental health by exploiting natural experiments of college roommate and classroom assignments. Both find no peer effects in mental health but they only examine short-run effects.

lower-poverty areas. We further discuss the policy implications of our findings in the last section.

# 2 Data

We use data from the National Longitudinal Survey of Adolescent Health (AddHealth). AddHealth is a school-based, nationally representative survey of U.S. adolescents conducted over multiple waves, tracking respondents as they progressed in school and transitioned to adulthood. Wave I took place in the 1994-95 school year and involved an In-School survey administered to over 90,000 students in grades 7 to 12 and an In-Home follow-up that was administered to a sample of 20,745 adolescents and also included an interview of a parent. Our paper is based on the In-Home follow-up survey, as it collected information on our main variable of interest—depression. The Wave I In-Home sample is the basis for four subsequent longitudinal follow-up interviews on the social, economic, psychological, and health circumstances of respondents. In particular, the AddHealth cohort was reinterviewed in 1996 (Wave II), 2001-02 (Wave III), and 2008-09 (Wave IV) when respondents had transitioned into young adulthood (ages 24 to 32). Thus, by linking data from the various AddHealth waves, one can construct a longitudinal sample that spans 14 years from adolescence into early adulthood. In our analysis, we combine data from Waves I and IV of the In-Home sample, thereby enabling us to link information on depression and family characteristics measured at the time when respondents were in school to depression measured at the time when respondents were young adults. We also use data from Wave II of the In-Home sample when we investigate short-term peer effects.

## 2.1 Sample selection

Our sample is constructed in several steps. The Wave I In-Home sample is our starting point, from which we derive the measures of individual and peer depression (explained in the next subsection) as well as all the pre-determined individual and family characteristics that we use as covariates in our regression analysis. The initial sample of the Wave I In-Home survey is 20,745. From this, we first exclude observations for which the anonymous school/student identifiers are missing, the few students who are in grade 6, and those with missing information on grade or depression, leaving us with 19,865 observations. We then also exclude observations where the peer group is too small to permit meaningful analysis, that is, grades for which there are less than 10 students. We use the remaining sample of 18,970 to construct the key explanatory variable of our analysis—that is, the within-gender share of depressed peers in a given school/grade, among the students that we observe in this subsample. The resulting average number of own-gender students in one's peer group is 15.8

for females and 13.7 for males. We also extract additional information regarding the students (e.g., self-reported depression, race, number of siblings, and average picture vocabulary score), their parents, and the household (presence of father in the household, mother's education and occupation, and household income).[7] Thereafter, we match data between Waves I and IV, when it is possible.[8] The final sample used in our core analysis comprises 12,400 individuals (6,663 females and 5,737 males) drawn from 128 schools.

In Table A1 in the Online Appendix, we assess whether attrition from Wave I to Wave IV biases our analysis. This could be an issue if, for example, individuals who are more likely to be depressed or have a larger proportion of depressed peers drop out of the sample. We regress an indicator variable on whether an observation attrites from Wave I to Wave IV using the full set of covariates that we include in our baseline regression. The results indicate that own-depression and peer depression are not significant predictors of attrition, thereby allaying concerns regarding attrition bias.

## 2.2 Construction of main variables

We obtain our outcome variable, self-reported depression, from Waves I and IV. The depression variable is constructed using answers to the Center for Epidemiologic Studies Depression Scale (CES-D) questionnaire. In Wave I, students completed the 20-questions version of the questionnaire (CES-D-20), while in Wave IV, students completed the 10-item version (CES-D-10). For constructing our variable of depression, we use the CES-D-10 both for Waves I and IV. This enables us to obtain a measure of depression that is based on identical questions over time. The CES-D includes questions regarding whether students feel depressed, blue, happy, etc. As a first step, we constructed a score by adding up the answers to the 10 items. All answers vary from 0 (never or rarely) to 3 (most of the time or all of the time). Questions that have a positive affect (e.g. happiness) are reverse coded (i.e., a 3 would indicate a low level of depression). After adding up all 10 items, the score of CES-D-10 ranges from 0 to 30. Table A2 in the Online Appendix reports the questions of the CES-D-10 questionnaire.[9] As a second step and following the literature (see e.g. Suglia et al., 2016), we define a person as depressed when the CES-D-10 score is 11 or higher and 0 otherwise. We construct our main independent variable of interest, the within-gender and grade share of depressed peers (ex-

[7] A number of observations are missing information on household income and mother's education. Thus, in order not to exclude these observations from our sample, we opted to impute household income (also adding an indicator variable to account for the imputation) and introduce a separate category for cases where mother's education is missing.

[8] Note that in Wave IV, 15,701 out of the 20,745 original Wave I respondents were reinterviewed. However, according to Brownstein et al. (2011), "Wave IV non-response bias is negligible and the Wave IV sample adequately represents the same population surveyed at Wave I" (p. 7).

[9] Note that the CES-D-10 and CES-D-20 scores are highly correlated. Indeed, using our sample in Wave I, we observe that the correlation of the two scores is above 0.9.

cluding oneself), using the above definition of depression. Further, Figure A1 in the Online Appendix displays the distribution of the percentage of depressed peers for males (dashed curve) and females (solid curve). The figure reveals that peer depression is more spread out for females, while for males the distribution is slightly skewed to the right.

### 2.3 Summary statistics

Table 1 presents the summary statistics for the variables that we use in the analysis. On average, individuals are 15 years old in Wave I and 28 years old in Wave IV. Approximately 60% of the sample is White, 23% Black and 16% are of Hispanic ethnicity. In terms of family characteristics, approximately 27% of the sample's mothers have college education and approximately 26% are professionals, while approximately 30% are single-parent families (father is absent) and average household income is above $46,000.

The prevalence of depression in Wave IV (main outcome) is 22.8% for females and 16.5% for males, that is, depression is more prevalent among females than males in the sample, which is consistent with the broad evidence. The gender difference in depression is also reflected by the main explanatory variable of interest, the share of own-gender peers who are depressed in Wave I. For females, this share is 25.6%, while for males it is 15%. Table A3 in the Online Appendix presents the depression transition matrix across the two waves. It is noteworthy that approximately 41% of the females who are depressed in Wave IV were also depressed in Wave I. For males, the corresponding figure is only 27%.

## 3 Empirical Framework

### 3.1 Empirical strategy

We are interested in estimating whether peer depression in adolescence has an effect on own-depression in adulthood. We formulate the baseline regression specification in the following manner:

$$y_{isgt+1} = \alpha_s + \theta_g + \beta \bar{y}_{-isgt} + \gamma y_{isgt} + \delta X_{isgt} + \rho_s g + \epsilon_{isgt+1}, \tag{1}$$

where $y_{isgt+1}$ is an indicator variable for whether individual $i$ who was in school $s$ and grade/cohort $g$ at time $t$ (Wave I) is depressed as an adult at time $t+1$ (Wave IV), $\bar{y}_{-isgt}$ is the within In-Home survey sample share of own-gender students (excluding individual $i$) in individual $i$'s school and grade who were depressed in adolescence at time $t$. $\beta$ is our main parameter of interest. We control for whether an individual was depressed at time $t$ to proxy for genetic or environmental time-invariant determinants of depression at the individual level. We also use a set of covariates $X_{isgt}$ measured at time $t$ to capture observable individual

Table 1: Summary statistics

| | Females | | Males | |
|---|---|---|---|---|
| | Mean | SD | Mean | SD |
| Depressed in Wave IV | 0.228 | 0.419 | 0.165 | 0.372 |
| Depressed in Wave I | 0.248 | 0.432 | 0.141 | 0.348 |
| % own gender peers depressed | 0.256 | 0.117 | 0.150 | 0.088 |
| % other gender peers depressed | 0.152 | 0.088 | 0.259 | 0.114 |
| % own gender peers depressed CES-D-19 scale | 0.299 | 0.127 | 0.194 | 0.099 |
| Age in Wave I | 15.52 | 1.69 | 15.68 | 1.69 |
| Age in Wave IV | 28.39 | 1.73 | 28.60 | 1.73 |
| Race: White | 0.586 | 0.493 | 0.604 | 0.489 |
| Race: African American | 0.234 | 0.423 | 0.200 | 0.400 |
| Race: Asian | 0.062 | 0.241 | 0.073 | 0.261 |
| Ethnicity: Hispanic | 0.160 | 0.366 | 0.165 | 0.371 |
| Number of siblings | 2.576 | 1.413 | 2.621 | 1.420 |
| Picture Vocabulary Test score | 100.26 | 14.36 | 101.81 | 14.29 |
| Mother's educ: Missing | 0.041 | 0.198 | 0.051 | 0.219 |
| Mother's educ: High school / some college | 0.526 | 0.499 | 0.519 | 0.500 |
| Mother's educ: College degree or above | 0.261 | 0.439 | 0.285 | 0.452 |
| Mother's occup: Managerial / professional | 0.250 | 0.433 | 0.269 | 0.443 |
| Mother's occup: Technical / office / sales | 0.256 | 0.437 | 0.259 | 0.438 |
| Mother's occup: Blue collar | 0.342 | 0.474 | 0.326 | 0.469 |
| Father not present | 0.306 | 0.461 | 0.261 | 0.439 |
| Household income (thousand dollars) | 46.888 | 51.472 | 46.958 | 45.002 |
| Observations | 6663 | | 5737 | |

Source: Longitudinal Survey of Adolescent Health (Add Health), Harris et al. (2009), Waves I and IV.

Depressed in Wave I and Depressed in Wave IV are defined as a dummy variable for whether the 10-item Center for Epidemiologic Studies Depression Scale is above 11.

% own gender peers depressed is the proportion of students who are depressed among all students of the same gender and in the same school and grade of the respondent. The respondent is excluded from the calculations of the % own gender peers depressed.

Excluded category for race is: Other races (American Indian and Other Race).

Excluded category for mother's education is: Less than high school. Excluded category for mother's occupation is: Homemaker. Occupation categories are defined as follows: Homemaker identifies individuals working at home. Managerial / professional includes professions such as doctor, lawyer, scientist, teacher, librarian, nurse; and managerial includes positions such as executive, director. Technical / office / sales includes technical, such as computer specialist, radiologist; office worker, such as bookkeeper, office clerk, secretary; sales worker, such as insurance agent, store clerk. Blue collar includes: craftsperson, such as toolmaker, woodworker; construction worker, such as carpenter, crane operator; mechanic, such as electrician, plumber, machinist; factory worker or laborer, such as assembler, janitor; transportation, such as bus driver, taxi driver; military or security, such as police officer, soldier, fire fighter; farm or fishery worker; other.

and family pre-determined characteristics. These include race, number of siblings, the Picture Vocabulary Test (PVT) score that measures basic cognitive skills, whether the father was present, mother's education, and household income. In a robustness analysis, we also control for additional peer characteristics—drawing from the full set of individual, parental and household characteristics. $\alpha_s$ and $\theta_g$ are school and grade fixed effects, while $\rho_s g$ is a school-specific linear time trend. School fixed effects absorb the influence of any factors that are common to all students within the same school, including the effect of the school itself.

Grade fixed effects absorb any influences that are specific to the cohort that are common across all students in the sample. Note that our sample spans 128 schools and 6 grades. The school-specific linear time trend captures any remaining time-variant influences that relate to the school. Finally, $\epsilon_{isgt}$ is the error term. We cluster standard errors at the school level and apply survey weights throughout the regression analysis.

In our specification, identification of the main parameter of interest, $\beta$, relies on comparing individuals within the same school, with the same own and family characteristics who are exposed to a different proportion of own-gendered depressed peers on account of being in a different grade in school. Formally, our identification relies on assuming strict exogeneity conditioning on school fixed effects, cohort fixed effects, and school-specific time trends—that is, $E(\epsilon_{isgt+1}|X_{isgt}, \alpha_s, \theta_g, \rho_s g) = 0$. Put simply, our identifying assumption is that while parents may be choosing school for their children on the basis of the mental health and other characteristics of the student body, they are unlikely to be aware of and to act upon year-by-year differences in the share of pupils of each gender who are depressed.

### 3.2 Evidence of the validity of the identification strategy

We follow the previous literature that has utilized this identification strategy and provide evidence for its validity (Bifulco et al., 2011, Lavy and Schlosser, 2011, Olivetti et al., 2020). We perform several checks.

First, we corroborate that there is sufficient variation in the main variable (peer depression) after controlling for grade/school fixed effects and school-specific trends. Table A4 in the Online Appendix indicates that the standard deviation of the residual peer depression for females, after eliminating grade/school fixed effects and school trends, is more than half of the raw standard deviation. For males, the residual standard deviation is approximately 60% of the raw standard deviation, thereby indicating that, for both genders, the fixed effects do not absorb all the variation in the main explanatory variable of interest.

Second, we perform balancing tests that provide evidence for the identifying assumption that peer depression is quasi-randomly assigned conditioning on school fixed effects. These tests amount to estimating a series of regressions in which we regress the main variable of interest—share of depressed peers—on the various student and family characteristics. In practice, we estimate one regression model for each characteristic, controling for own-depression and the usual grade and school fixed effects and school-specific time trends. These results are presented in Table 2, where each row reports the estimated coefficient on the characteristic indicated on the left column. As is evident, only one characteristic is statistically significant at 5% in the female sample and none in the male sample, which provides support for our identifying assumption.

Table 2: Balancing test

| | Females | Males |
|---|---|---|
| Race: White | .003 | .001 |
| | (.002) | (.003) |
| Race: African American | −.001 | −.000 |
| | (.003) | (.004) |
| Race: Asian | −.005 | −.008 |
| | (.006) | (.006) |
| Ethnicity: Hispanic | −.002 | −.001 |
| | (.003) | (.003) |
| Number of siblings | .001 | −.000 |
| | (.001) | (.001) |
| Picture Vocabulary Test score | .000 | .000 |
| | (.000) | (.000) |
| Mother's educ: Missing | .003 | .005 |
| | (.004) | (.006) |
| Mother's educ: High school / some college | .004** | .002 |
| | (.002) | (.002) |
| Mother's educ: College degree or above | −.003 | −.002 |
| | (.002) | (.002) |
| Mother's occup: Managerial / professional | .000 | −.001 |
| | (.002) | (.002) |
| Mother's occup: Technical / office / sales | −.001 | −.000 |
| | (.002) | (.002) |
| Mother's occup: Blue collar | .001 | −.001 |
| | (.002) | (.001) |
| Father not present | −.003 | .001 |
| | (.002) | (.002) |
| Household income (thousand dollars) | .000 | −.000 |
| | (.000) | (.000) |
| Grade fixed effects | Yes | Yes |
| School fixed effects | Yes | Yes |
| School time trends | Yes | Yes |

Source: Longitudinal Survey of Adolescent Health (Add Health), Harris et al. (2009), Waves I and IV.
Each coefficient corresponds to a regression of own-gender peer depression on the indicated variable controlling for own depression.
Robust standard errors clustered at the school level are given in parentheses.
* $p < 0.10$.; ** $p < 0.05$.; *** $p < 0.01$.

As a further check, we visually inspect whether the variation in the share of depressed peers that we leverage for identification is random. This is illustrated in Figure A2 in the Online Appendix, which indicates that the residual distribution of peer depression, after accounting for fixed effects and school trends, is indeed symmetric and centered around zero.

In addition to these identification checks, we estimate versions of equation (1) where we generate placebo peer groups, which we discuss further on in Section 4.2 after presenting the

baseline results.

# 4 Results

## 4.1 Baseline findings

Table 3 presents the regression results of the baseline specification (1) by gender—columns 1-4 for females and columns 5-8 for males. Columns 1 and 5 present the raw correlation between own depression in Wave IV and share of depressed peers in Wave I. Columns 2 and 6 include the main explanatory variables, own and peer depression in adolescence, as well as school and grade fixed effects and a school trend. Columns 3 and 7 further include student controls (race, ethnicity, number of siblings and PVT test score), while columns 4 and 8 also include parental and household characteristics (i.e., mother's education and occupation, presence of father, and household income).

Beginning with the results in columns 1 and 5, we find that peer depression in adolescence (Wave I) is positively correlated with depression in adulthood (Wave IV). In columns 2 and 6 we find that, consistent with previous evidence, *own-depression* in adolescence is a strong and statistically significant predictor of the risk of depression in adulthood, for both females and males. More importantly, we find that *own-gender peer depression* in adolescence positively affects the incidence of depression in adulthood, for both females and males. However, the coefficient is larger and statistically significant *only* for females. Addition of individual and family characteristics in the remaining columns does not substantially change the picture. Taking the estimates in our preferred specification (column 4 for females and 8 for males), the size of the effect indicates that an increase by one standard deviation in the proportion of depressed female peers (11.7 percentage points) increases the incidence of depression in adulthood by 2.6 percentage points for females (or 11.5% of baseline depression incidence) and does not have a significant effect for males. A test of equality of the coefficient on peer depression across the female and male samples indicates that they are not statistically distinguishable.

In Table A5 in the Online Appendix, we investigate the robustness of our findings to the inclusion of additional peer contextual effects by including a full set of individual, parental and household characteristics across peers. As can be gleaned from this table, inclusion of these peer controls does not affect the estimate of our main coefficient of interest, for both genders.

We believe that the size of the peer effect we find is sizeable and plausible. In order to promptly gauge the magnitude of the estimates, it is instructive to compare the peer effect to the estimated impact that other covariates have on adult depression. Our results indicate

Table 3: Effects of peer depression on depression in adulthood

| | Females | | | | Males | | | |
|---|---|---|---|---|---|---|---|---|
| % own-gender peers depressed | .211** | .215** | .224** | .231** | .111 | .111 | .098 | .132 |
| | (.099) | (.100) | (.101) | (.098) | (.133) | (.132) | (.131) | (.111) |
| Depressed in Wave I | .222*** | .209*** | .203*** | .202*** | .207*** | .193*** | .191*** | .194*** |
| | (.019) | (.020) | (.019) | (.019) | (.025) | (.025) | (.025) | (.025) |
| Race: White | | −.045 | −.041 | −.049 | | −.056** | −.057** | −.065** |
| | | (.036) | (.036) | (.036) | | (.028) | (.028) | (.027) |
| Race: African American | | −.019 | −.027 | −.040 | | −.011 | −.021 | −.022 |
| | | (.039) | (.039) | (.040) | | (.035) | (.035) | (.034) |
| Race: Asian | | −.014 | −.018 | −.036 | | −.029 | −.028 | −.036 |
| | | (.053) | (.052) | (.050) | | (.050) | (.050) | (.050) |
| Ethnicity: Hispanic | | .003 | −.008 | −.005 | | −.058* | −.065** | −.065** |
| | | (.036) | (.037) | (.037) | | (.030) | (.031) | (.030) |
| Number of siblings | | .006 | .006 | .005 | | −.005 | −.005 | −.005 |
| | | (.005) | (.005) | (.005) | | (.006) | (.006) | (.006) |
| Picture Vocabulary Test score | | −.003*** | −.002*** | −.002*** | | −.002*** | −.002*** | −.002*** |
| | | (.001) | (.001) | (.001) | | (.001) | (.001) | (.001) |
| Mother's educ: Missing | | | .007 | .012 | | | .042 | .046 |
| | | | (.048) | (.047) | | | (.047) | (.048) |
| Mother's educ: High school / some college | | | −.039* | −.038* | | | −.005 | −.005 |
| | | | (.021) | (.020) | | | (.024) | (.023) |
| Mother's educ: College degree or above | | | −.055** | −.050* | | | −.018 | −.009 |
| | | | (.026) | (.026) | | | (.025) | (.025) |
| Mother's occup: Managerial / professional | | | −.012 | −.016 | | | −.029 | −.024 |
| | | | (.025) | (.024) | | | (.023) | (.024) |
| Mother's occup: Technical / office / sales | | | −.010 | −.011 | | | −.025 | −.021 |
| | | | (.024) | (.023) | | | (.021) | (.021) |
| Mother's occup: Blue collar | | | .004 | .002 | | | −.032 | −.024 |
| | | | (.019) | (.020) | | | (.020) | (.019) |
| Father not present | | | .036** | .042** | | | .026 | .020 |
| | | | (.017) | (.017) | | | (.018) | (.017) |
| Household income (thousand dollars) | | | −.000 | −.000 | | | −.000 | −.000 |
| | | | (.000) | (.000) | | | (.000) | (.000) |
| Grade fixed effects | No | Yes | Yes | Yes | No | Yes | Yes | Yes |
| School fixed effects | No | Yes | Yes | Yes | No | Yes | Yes | Yes |
| School time trends | No | Yes | Yes | Yes | No | Yes | Yes | Yes |
| N | 6663 | 6663 | 6663 | 6663 | 5737 | 5737 | 5737 | 5737 |
| $R^2$ | .12 | .13 | .13 | .13 | .13 | .14 | .14 | .14 |

Source: Longitudinal Survey of Adolescent Health (Add Health), Harris et al. (2009), Waves I and IV.
The dependent variable is depression, defined as a dummy variable for whether the 10-item Center for Epidemiologic Studies Depression Scale is above 11.
% own gender peers depressed is the share of students who are depressed among all students of the same gender and in the same school and grade as that of the respondent. The respondent is excluded from the calculations of the % own gender peers depressed.
The dependent variable is measured at the time of Wave IV; all control variables are measured at the time of Wave I. The excluded category for race is: Other races (American Indian and Other Race). The excluded category for mother's education is: Less than high school. Excluded category for mother's occupation is: Homemaker.
Robust standard errors clustered at the school level are given in parentheses.
* $p < 0.10$.; ** $p < 0.05$.; *** $p < 0.01$.

that the peer effect has quantitatively a similar effect to that of the PVT score: an increase of one standard deviation in the PVT score is associated with a reduction of 3.3 percentage points in the likelihood of depression for females, or the effect of growing up in a family with a missing father, which is associated with an increase of 3.6 percentage points in the likelihood of being depressed for females.

In Table 4, we explore several possible sources of heterogeneity in the peer-depression effect. In panel I, we estimate two specifications that enable us to examine whether the

impact of peer depression varies with the intensity of exposure. In the first specification, we include an indicator variable for whether an individual is exposed to an above median share of peers who are depressed. In the second specification, we include three indicator variables for the three top quartiles of the share of depressed peers distribution. All the regressions in the table contain the same control variables as in our preferred specification in Table 3 (Columns 4 and 8), including grade fixed effects, school fixed effects, and school time trends. The results suggest that, for females, having an above-the-median share of peers who are depressed is associated with a significant increase (5.9 percentage points) in the likelihood of being depressed in adulthood relative to having below-the-median share of peers who are depressed. For males, the effect is positive but smaller and statistically insignificant. With regard to the results of the specification involving quartile dummies, we again find a marked gender difference. For females, all coefficients are positive and increasing along the quartiles, with the third and fourth quartiles being statistically distinguishable from the first.[10] Having a proportion of peers who are depressed and in the fourth (third) quartile is associated with an increase of 8.3 (5.2) percentage points in the likelihood of being depressed in adulthood for females, relative to being in the first quartile. This implies that moving a girl from a school peer group in which 40% of peers are depressed (average share in 4th quartile) to one in which 11% of peers are depressed (average share in 1st quartile) will reduce the likelihood of the girl being depressed in adulthood by more than one-third of the average likelihood of depression of females.

In panel II of Table 4, we investigate whether exposure to peer depression has a different impact on individuals depending on their own mental health status. Indeed, the effect may depend on one's own mental health. People with poor mental health may be more susceptible to being affected by peer depression because they may have less ability to cope with the stress of being around someone else with poor mental health. In order to test this cross effect of own and peer depression, we divide our sample into a low/high mental health group on the basis of their CES-D-10 score in Wave I (above/below the median). The results indicate that, indeed, individuals who had worse mental health are more susceptible to the depression of their peers. For females, the estimated coefficient of the peer effect for the high-score group is large and statistically significant at 5%, whereas for the low-score group this coefficient is smaller in size and statistically insignificant. For males, the estimated effect is also larger for the high-score group than the low-score group, but none of the coefficients are statistically significant.

In summary, our results indicate a positive effect of peer depression for females. The effect is more pronounced for females who have low mental health status and who are located in

[10] We fail to reject equality of coefficients of contiguous quartiles for both genders, with the exception of comparing second to third quartiles of females (p-value = 0.07).

Table 4: Effects of peer depression on depression in adulthood: Heterogeneity

| | Females | | Males | |
|---|---|---|---|---|
| | Panel I: Heterogenous peer-effects | | | |
| Above median | .059*** | | .023 | |
| | (.019) | | (.022) | |
| $2nd$ quartile | | .006 | | .001 |
| | | (.029) | | (.026) |
| $3rd$ quartile | | .052* | | .027 |
| | | (.029) | | (.030) |
| $4th$ quartile | | .083** | | .019 |
| | | (.033) | | (.038) |
| N | 6663 | 6663 | 5737 | 5737 |
| $R^2$ | .13 | .13 | .14 | .14 |
| | Panel II: CES-D-10 score Wave I | | | |
| | Low | High | Low | High |
| % own-gender peers depressed | .085 | .326** | .084 | .158 |
| | (.141) | (.154) | (.170) | (.173) |
| N | 2830 | 3833 | 2365 | 3372 |
| $R^2$ | .17 | .18 | .22 | .20 |

Source: Longitudinal Survey of Adolescent Health (Add Health), Harris et al. (2009), Waves I and IV.

The dependent variable is depression, defined as a dummy variable for whether the 10-item Center for Epidemiologic Studies Depression Scale is above 11.

Panel I: The key independent variable in Columns 1 and 3 is an indicator that is equal to 1 if the % own-gender peers depressed is above median and 0 otherwise; the key independent variables in Columns 2 and 4 are dummy variables representing the quartiles of the % own-gender peers depressed (first quartile is the reference group).

Panel II: The CES-D-10 score Wave I is the score obtained using answers from the CES-D-10 questionnaire. See Table A2 for details.

All regressions contain the same control variables as Table 3, Columns 4 and 8, including grade fixed effects, school fixed effects, and school time trends.

Robust standard errors clustered at the school level are given in parentheses.

* $p < 0.10$.; ** $p < 0.05$.; *** $p < 0.01$.

schools with a comparatively large share of depressed classmates.

## 4.2 Robustness checks

Table 5 presents robustness checks on our baseline findings, focusing on alternative methods of measuring depression and alternative definitions of the peer reference group.

We first explore whether there is an across-gender peer effect by including the share of other-gender peers who are depressed in the baseline specification. The results in column 1 for females indicate that the other gender's effect is small and statistically insignificant, while the own-gender effect remains positive and statistically significant. For males (column 6), both peer effects are not statistically significant. These results indicate that when the peer effect does matter—for females—it operates through own-gendered peers.

We also estimate our baseline specification relying on a different measure of depression in Wave I that uses the 20-item Center of Epidemiological Studies Depression Scale (which is not available in Wave IV). The results presented in columns 2 and 7 are consistent with the baseline results in Table 3—that is, for females, the effect is positive and statistically significant, while for males the effect is very small and statistically insignificant. A further robustness check that we perform is to check whether our results are sensitive to the choice of the CES-D-10 score cutoff, above which we designate an individual as being depressed. In columns 3-5 for females and 8-10 for males, we present results where we use higher cutoffs than those in the baseline—that is, designating depression as a rarer condition. For females, what is evident across the columns is that the peer effect is robustly positive and statistically significant, while for males, the effect is never statistically significant.

Table 5: Effects of peer depression on depression in adulthood: Robustness

| | Females | | | | | Males | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Both genders | CES-D-19 | CES-D-10 threshold: | | | Both genders | CES-D-19 | CES-D-10 threshold: | | |
| | | | $\geq 12$ | $\geq 13$ | $\geq 14$ | | | $\geq 12$ | $\geq 13$ | $\geq 14$ |
| % own gender peers depressed | .193* | .163* | .201*** | .160* | .204** | .136 | .022 | .030 | .102 | .109 |
| | (.108) | (.091) | (.074) | (.085) | (.085) | (.119) | (.122) | (.099) | (.118) | (.129) |
| % other gender peers depressed | −.018 | | | | | .023 | | | | |
| | (.121) | | | | | (.121) | | | | |
| N | 6462 | 6661 | 6663 | 6663 | 6663 | 5566 | 5735 | 5737 | 5737 | 5737 |
| $R^2$ | .13 | .14 | .11 | .10 | .10 | .15 | .15 | .13 | .12 | .13 |

Source: Longitudinal Survey of Adolescent Health (Add Health), Harris et al. (2009)
The dependent variable is depression, defined as a dummy variable for whether the 10-item Center for Epidemiologic Studies Depression Scale is above 11.
Both genders: both the % peers depressed for males and females are included in the regression.
CES-D-19: The dependent variable is depression, defined as a dummy variable for whether the 19-item Center for Epidemiologic Studies Depression Scale is above 16. The % own-gender peers depressed is calculated using the same defintion of depression.
CES-D-10 threshold: Depression is defined using different thresholds of the CES-D-10 score in Wave I. See Table A2 for details.
All regressions contain the same control variables as Table 3, Columns 4 and 8, including grade fixed effects, school fixed effects, and school time trends.
Robust standard errors clustered at the school level are given in parentheses.
* $p < 0.10$.; ** $p < 0.05$.; *** $p < 0.01$.

Finally, we perform placebo regressions in which we attach to each student a placebo peer depression by reassigning them to a randomly selected grade within the same school. These results are presented in Table A6 in the Online Appendix, which reports specifications similar

to the ones in the baseline results in Table 3. Reassuringly, the coefficient on the placebo peer depression is not statistically significant in any of these specifications. This provides further support for the validity of our identification strategy.

# 5 Mechanisms

We have established that females' peer depression in adolescence has an enduring effect on own-depression in adulthood. In order to understand the mechanisms underlying this result, we will, first, investigate why peer depression in adolescence has a positive impact on other adolescents' depression (short-term effects). Then, we will explore why this short-term effect lasts and continues to impact individual depression into adulthood (long-term effects).

## 5.1 Understanding the short-term effect of peer depression

It is well-documented that, during adolescence, which is a developmental period, peer relationships are of central importance in psychosocial development, and difficulties in this domain can be detrimental to mental health (Berndt, 1982). Indeed, as adolescence involves unique upheaval, young people spend more time with their peers than with their families (Meeus et al., 2005) and exert a great deal of energy forming peer networks (Steinberg and Morris, 2001).

It is also well-documented that adolescent girls have tighter and closer contacts with their female peers than boys have with their male peers, and these gender differences in socialization could play a role in depression. Indeed, adolescent girls' relationships and friendships are characterized by greater levels of intimacy, emotional support, and self-disclosure (Rose, 2002, Rose and Rudolph, 2006), whereas such relationships among boys tend to be grounded in companionship and shared activities (Maccoby, 1990). For girls compared with boys, close interpersonal relationships are more important for self-definition and identity (Maccoby, 1990) and are considered more as a source of emotional support (Cross and Madson, 1997). Such gender differences in the form and function of interpersonal relationships are amplified as youth progress through adolescence, and the importance of the peer group grows in significance for youths' social and emotional experiences (Furman and Buhrmester, 1985, Laursen, 1996). A few researchers have suggested that this type of socialization may cause depression to manifest differently in men than women (Wide et al., 2011).

### 5.1.1 The short-term effect of peer depression

In order to investigate these issues, we first examine whether adolescent peer depression has a short-term effect on depression when (the majority of) individuals are still in school. This

would provide direct evidence that depression of peers is, indeed, contagious and confirm, in a causal manner, the psychology studies cited above. Using the same empirical strategy adopted in our baseline model, we estimate equation (1), but now $y_{isgt+1}$ is measured in Wave II and not in Wave IV—that is, $t$ = Wave I and $t+1$ = Wave II.[11] Recall that Wave II was conducted one year after Wave I.

The results, presented in Table 6 in columns 1 and 4, indicate that for adolescent females, there is a positive and significant short-term effect of peer depression, while for males the coefficient is smaller and statistically insignificant. Quantitatively, the coefficient in column 1 of Table 6 suggests that a one standard deviation increase in female peer depression in Wave I is associated with an increase in own-depression by 2.9 percentage points in Wave II (11.8% of baseline). This result indicates that peer depression has a strong and immediate causal impact on own-depression for females only.[12]

Table 6: Effects of peer depression on depression in adulthood: Short run

| | Females | | | Males | | |
|---|---|---|---|---|---|---|
| % own-gender peers depressed | .251** | | .325** | .124 | | .198* |
| | (.098) | | (.126) | (.096) | | (.118) |
| Bond with mother above median | | −.027* | .005 | | −.017 | .007 |
| | | (.014) | (.029) | | (.013) | (.019) |
| Bond with mother above median × % own-gender peers depressed | | | −.125 | | | −.172 |
| | | | (.116) | | | (.118) |
| N | 5948 | 5948 | 5948 | 5541 | 5541 | 5541 |
| $R^2$ | .23 | .23 | .23 | .21 | .21 | .21 |

Source: Longitudinal Survey of Adolescent Health (Add Health), Harris et al. (2009), Waves I and II.
The dependent variable is depression, defined as a dummy variable for whether the 10-item Center for Epidemiologic Studies Depression Scale is above 11, measured in Wave II.
The dependent variable is measured at the time of Wave II; all control variables are measured at the time of Wave I.
All regressions contain the same control variables as Table 3, Columns 4 and 8, including grade fixed effects, school fixed effects, and school time trends.
Robust standard errors clustered at the school level are given in parentheses.
* $p < 0.10$.; ** $p < 0.05$.; *** $p < 0.01$.

We have seen above that adolescence is a special phase in which young people spend more time with their peers than with their families (Meeus et al., 2005). Consequently, we now investigate the interplay between peers' and parents' influence in the development of depression in the short-term. That is, we aim to understand whether the strength of the connection that an adolescent has with his/her parents could act as a buffer for the negative peer influence on mental health in the short run. To do so, we construct an index of the

[11] Observe that we do not regress peer depression (i.e., $\bar{y}_{-isgt}$) in Wave I on own-depression $y_{isgt+1}$ in Wave I—that is, $t = t+1$ = Wave I—because of the occurrence of the reflection problem.

[12] In Table 6, we consider students who are in both Waves I and II but the sample in Wave II may be different to the one in Wave IV that we used in Table 3. As a robustness check, in Table A7 in the Online Appendix, we use the same sample as in Table 3 but for Waves I and II. We see that the effects are similar, particularly for the short-run effect of peer depression on own-depression.

strength of the mother/child relationship by taking the average across eight items contained in the Wave I questionnaire, in which respondents are asked to report on their connections with each parent during the past month through communication (i.e., whether parent and youth had discussed a personal problem, a romantic partner, or school work) and activities that facilitate connection (whether parent and youth worked on a project, played a sport, or went to a religious service, recreational/cultural event, or shopping together). We focus on the adolescent/mother relationship because information for fathers is missing for a large part of the sample (approximately 30%).

In order to measure the direct effect of the bond between the adolescent and his/her mother on own-depression, we estimate a version of the regression presented in Table 6 in columns 2 and 5, replacing peer depression with the strength of the child's bond with their mother (indicator for the index being above the median). The results in columns 2 and 5 indicate that, indeed, having a strong connection to own mother is associated with a lower probability of being depressed for girls, while for boys the effect is not statistically significant. We then estimate a model that includes both peer depression and the quality of bond with the mother and their interaction. The results are displayed in columns 3 and 6 in Table 6. We find that the interaction term, while being negative (which indicates that a strong connection can attenuate the negative effect of peers on mental health), is not statistically significant. The lack of a significant interaction effect could be attributed to the fact that, in adolescence, children become increasingly more independent from their parents, whereas relationships with friends become more significant, as reported by the psychology literature cited above.

#### 5.1.2 Gender differences in adolescent friendship socialization

We have documented above that the manner in which girls interact with their female peers is very different from the manner in which boys interact with their male peers. In particular, during adolescence, girls appear to be more likely than boys to respond to stress and distress with *rumination*, focusing inward on feelings of distress and personal concerns rather than taking action to relieve their distress. Indeed, it has been hypothesized that a leading mechanism through which peer influence could operate is *co-rumination*, which refers to the tendency particularly observed among adolescent girls to extensively discuss and revisit problems without coming up with solutions, thereby leading to symptoms of anxiety and depression (Rose, 2002, Stevens and Prinstein, 2005, Prinstein, 2007).

In order to investigate this, in the Add Health data, we examine the peer-nomination questionnaire in Wave I, in which participants were asked to nominate up to five female friends and five male friends. They were also asked to report whether they had engaged in a number of activities with each friend during the past week. These activities include interactions with the friend (visiting their house, hanging out, or spending time on the weekend) and time spent

talking with their nominated friends regarding a problem or talking on the phone, in the last seven days. Answers to these last two questions could be perceived as measures of whether respondents engage in behavior that would be considered as suggestive of co-rumination.

We present the summary statistics for these questions in Table 7 by gender—that is, girls with their nominated female friends and boys with their nominated male friends. Each entry of this table refers to the average incidence of the activity in question performed with friends of the same gender. We find a marked gender difference in the two measures of co-rumination reported in the two first rows of Table 7. Indeed, on average, girls report to have discussed a problem to 69% of their nominated female friends, while for boys this happens on average only with 39% of their nominated male friends. The difference is statistically significant ($p < 0.001$). Girls also report to have talked on the phone with a larger proportion of their female friends than boys have with male friends (81% versus 69%); this difference is also statistically significant ($p < 0.001$). Interestingly, for the other three measures—which are not capturing co-rumination but rather the time spent with friends—we see much smaller gender differences. This is clearly not causal evidence but merely indicates that co-rumination may explain why peer depression is more contagious for girls than for boys.[13]

In summary, the short-run evidence indicates that there are differences in friendship relationships between girls and boys because girls are more likely to engage in communication with their female friends and discuss problems. The tendency to discuss extensively and co-ruminate about problems has been linked in the psychology literature to the development of depression symptoms and could explain the gender difference in peer influence that we find in this paper.

### 5.2 Understanding the long-term effect of peer depression

We have seen that the short-term effect of peer depression on own-depression is rather strong for female students. The key question is how this effect persists over time, particularly after 14 years. Indeed, in Wave I (1994-1995), students are between 13 (year 7) and 18 years of age (year 12) while, in Wave IV (2008-2009), they are between 27 and 32 years of age. Recall that we define peers as students who are in the same grade, which implies that the respondents might know only a few of them personally. Thus, there is a high likelihood that these students do not interact with each other after high school, which implies that they have not seen each other for 9 years (for those who were in grade 7) and up to 14 years (for those who were in grade 12). We argue that the short-term effect of peer depression on own-depression persists

[13]In Table A8 in the Online Appendix, we provide a more general picture of friendship relationships than that of Table 7 by examining both directly nominated friends (as in Table 7) but also the peers in the same school/grade. We also display the relationships between male and female friends, and female and male friends. The general picture is similar to that in Table 7, in the sense that girls tend to co-ruminate more than boys.

Table 7: Gender Differences in Own-Gender Friend Socialization among Adolescents

| | Females | Males | Difference |
|---|---|---|---|
| Talk about problems | 0.694 | 0.390 | 0.304*** |
| | (0.425) | (0.471) | |
| Talk on the phone | 0.808 | 0.691 | 0.117*** |
| | (0.355) | (0.446) | |
| Visit house | 0.491 | 0.567 | -0.076*** |
| | (0.461) | (0.445) | |
| Hang out | 0.573 | 0.607 | -0.034*** |
| | (0.461) | (0.465) | |
| Spend weekend | 0.535 | 0.575 | -0.040*** |
| | (0.464) | (0.463) | |
| N | 6482 | 5561 | |

Source: Longitudinal Survey of Adolescent Health (Add Health), Harris et al. (2009), Wave I.
Talk about problems refers to the share of respondents who answered yes to the question Did you talk to [friend 1....5] about a problem during the past seven days ?
Talk on the phone refers to the share of respondents who answered yes to the question Did you talk to [friend 1....5] on the telephone during the past seven days?
Visit house refers to the share of respondents who answered yes to the question Did you go to [friend 1....5]'s house during the past seven days?
Hang out refers to the share of respondents who answered yes to the question Did you meet [friend 1....5] after school to hang out or go somewhere during the past seven days?
Spend weekend refers to the share of respondents who answered yes to the question Did you spend time with [friend 1....5] during the past weekend?
*** $p < 0.01$.

over time because it may reduce the chance for depressed females to go to college, to work, and, thus, to earn a high income which, in turn, leads to more depression. In other words, being randomly "exposed" to depressed peers when young may impact the probability of college attendance, of being employed and of earning high income in adulthood, which, in turn, may have an effect on future depression.

In order to provide suggestive evidence for this mechanism, we perform two separate analyses. First, we investigate whether adolescent's peer depression has, indeed, an impact on own college enrollment, work, and income in adulthood. Second, we examine the role of parents' socioeconomic background on long-term depression. Indeed, while peers may disappear after high school, parents do not. Consequently, it is important to understand how the family structure and background have an impact on long-term depression and if they mitigate the effect of peer depression.

### 5.2.1 The effect of peer depression on long-term outcomes

We explore the mechanism highlighted above—that is, whether peer depression in adolescence has an impact on adult outcomes. Specifically, we focus on whether peer depression affects post-secondary education (college attendance), employment, and income. In terms of

descriptive statistics, 81% of females go to college, 74% are employed, and average income is $30,000. The corresponding figures for males are 72% go to college, 85% are employed and average income is $42,000.

Table 8: Effects of peer depression on depression in adulthood: Other outcomes

| | Females | | | Males | | |
|---|---|---|---|---|---|---|
| | College | Work | Income | College | Work | Income |
| % own gender peers depressed | –.302*** | –.236** | –16.025* | –.104 | .181 | 1.386 |
| | (.096) | (.114) | (9.471) | (.109) | (.132) | (12.417) |
| Depressed in Wave I | –.085*** | –.036* | –4.402** | –.049* | –.039** | –2.177 |
| | (.020) | (.020) | (1.720) | (.025) | (.019) | (1.531) |
| $\bar{Y}$ | 0.812 | 0.737 | 30.077 | 0.722 | 0.847 | 42.286 |
| N | 6663 | 5567 | 6333 | 5736 | 4637 | 5459 |
| $R^2$ | .24 | .10 | .15 | .29 | .16 | .14 |

Source: Longitudinal Survey of Adolescent Health (Add Health), Harris et al. (2009)
College: The dependent variable is a dummy variable that is equal to 1 if in Wave IV the individual reports enrolling to college or obtaining a degree higher than the high school degree as highest level of qualification, and 0 otherwise.
Work: The dependent variable is a dummy variable that is equal to 1 if in Wave IV the individual reports to work, and 0 otherwise.
Income: The dependent variable is the income in thousands dollars reported in Wave IV.
All regressions contain the same control variables as Table 3, Columns 4 and 8, including grade fixed effects, school fixed effects, and school time trends.
Robust standard errors clustered at the school level are given in parentheses.
* $p < 0.10$.; ** $p < 0.05$.; *** $p < 0.01$.

The results of regressing the percentage of own gender peers who are depressed in adolescence on own outcomes in adulthood are displayed in Table 8.[14] We find that, for females, peer depression in adolescence influences long-term outcomes beyond depression. In particular, an increase in peer depression by one standard deviation is associated with a probability of college attendance that is 3.5 percentage points lower, a likelihood of working that is 2.8 percentage points lower, and a reduction in income of $1,870, which translates to a 6.2% reduction in income at the baseline. For males, there is no evidence of a long-term effect on other outcomes.

We have shown that peer depression in adolescence affects both long-term outcomes (college attendance, employment, and earnings) and long-term depression. One potential explanation for these findings is that peer depression in grades 7-12 leads to increased depression in the short term, which, then, negatively affects these other adult outcomes, as suggested

[14]Note that the sample size varies across the columns of this table, thereby reflecting the fact that the employment and income questions are missing for a few of the observations in our sample.

by previous evidence (Fletcher, 2010, 2013, Goodman et al., 2011, Lundborg et al., 2014, Anderson et al., 2015). These negative effects on one's socio-economic outcomes can, in turn, lead to higher incidence of depression in adulthood. We cannot show that this is the unique chain of causality with our current analysis, but this is one plausible path. An alternative pathway is that peer depression affects short-term depression, which, in turn, simultaneously affects both long-term depression and outcomes. Then, given the two-way interaction between mental health and educational or labor-market outcomes, the two would tend to negatively reinforce each other. Note, however, that in both stories the policy implications are the same: exposure to depressed peers in adolescence has an impact on long-term depression and outcomes for females. Thus, attending a school with a high incidence of depression vis-a-vis one with a low incidence of depression could have a significant impact on a girl's long-term depression and capacity to go to college and work in the future. The policy implications of our findings are further discussed in the conclusion.

### 5.2.2 The role of parents' socioeconomic background on long-term depression

In order to better understand the mechanism highlighted above, we now examine whether parental background might mitigate the effect of peer depression on own long-term depression. Indeed, prior research has reported that parental support and involvement exert important influences on adolescents' mental health because of the influential role of the family at this stage (Stice et al., 2004). In this regard, family socioeconomic status may be particularly important for buffering the negative influence of peer depression in adolescence, as it has been documented that disadvantaged children and adolescents are more likely to develop mental health problems (Reiss, 2013). In Table 6, we depicted that the stronger the child/mother bond, the lower the short-term effect on own-depression. However, maternal bond did not reduce the impact of peer depression on short-term own-depression. We now explore whether the long-term peer effects can be moderated by own-family's socioeconomic status.

In order to carry out this analysis, we make use of two measures of socioeconomic status: family income and mother's occupation.[15] Specifically, we divide the sample into two groups on the basis of income: high- and low-family income (above and below median), while, for occupation, we divide it into four groups: (i) managerial/professional occupations; (ii) technical and office and sales workers; (iii) low skill occupations (e.g. restaurant worker, factory worker, farm worker etc., and (iv) homemaker.

We then estimate our main specification on these different samples. The results are presented in Table 9. For females, the results related to the household income reveal that the peer effect is large and statistically significant only for individuals in the low-household income

[15]We use mother's occupation and not father's as information for the latter is missing for a large number of the respondents.

group, whereas, for those in the high-income group, the effect is not significant. For occupation, the results show that the effect is stronger and statistically significant for individuals whose mother worked in a low-skill occupation; this effect weakens and becomes statistically insignificant as we move to technical occupations and professionals.[16] For males, none of the peer effects are statistically significant.

Table 9: Parental background

| | Females | | | | | | Males | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Income | | Mother's occupation | | | | Income | | Mother's occupation | | | |
| | Low | High | Home-maker | Blue collar | Tech./off. sales | Manag./ profess. | Low | High | Home-maker | Blue collar | Tech./off. sales | Manag./ profess. |
| % own-gender | .375*** | .137 | .199 | .437** | .227 | .154 | .203 | –.062 | –.437 | .140 | –.162 | .355 |
| peers depressed | (.142) | (.125) | (.399) | (.173) | (.248) | (.208) | (.144) | (.171) | (.559) | (.252) | (.230) | (.296) |
| $\bar{Y}$ | 0.262 | 0.194 | 0.276 | 0.250 | 0.212 | 0.182 | 0.189 | 0.144 | 0.205 | 0.172 | 0.158 | 0.141 |
| N | 3305 | 3358 | 989 | 2280 | 1707 | 1663 | 2750 | 2987 | 814 | 1871 | 1486 | 1543 |
| $R^2$ | .18 | .19 | .38 | .21 | .31 | .28 | .22 | .18 | .43 | .26 | .36 | .29 |

Source: Longitudinal Survey of Adolescent Health (Add Health), Harris et al. (2009), Waves I and IV.
The dependent variable is depression, defined as a dummy variable for whether the 10-item Center for Epidemiologic Studies Depression Scale is above 11.
All regressions contain the same control variables as Table 3, Columns 4 and 8, including grade fixed effects, school fixed effects, and school time trends.
Low (high) income: household income is below (above) sample median.
Mother's occupation groups are defined as in Table 1.
Robust standard errors clustered at the school level are given in parentheses.
* $p < 0.10$.; ** $p < 0.05$.; *** $p < 0.01$.

Observe that we are unable to directly examine the role of poor parental mental health, as this is not reported in the Add Health data. However, we cannot rule out that for some of the parents with low-socioeconomic indicators, mental health problems could be an underlying cause for their status. Therefore, parental mental health problems could be an additional reason for the pattern we see in Table 9.

In summary, we have shown that peer depression in adolescence can still have an impact on one's long-term depression, and have provided evidence consistent with a mechanism that this is because it reduces the likelihood of women to go to college and, thus, to work and to earn a good income which, in turn, leads to depression in adulthood.

There may be other mechanisms that can explain why peer depression affects own long-turn depression. For example, girls who have been exposed to depressed peers in adolescence may have a higher likelihood of choosing depressed friends in adulthood and, thus, be depressed. We cannot test this mechanism as we do not have any information on peers and friendship relationships in Wave IV or even in Wave III. However, this does not contradict our story. Indeed, women who have been exposed to depressed peers in adolescence are less

[16] We fail to reject equality of the coefficients across the subgroups in any of the comparisons.

likely to go to college and to work in adulthood and may be more likely to associate with similar peers (homophily) and end up being depressed. What we believe and showed to be a crucial determinant of female's peer depression is the exposure of depressed peers in adolescence, because adolescence is a rather important phase in becoming an adult and it is a period where, for the first time, peers become more important than parents. This implies that adolescents are much more fragile, vulnerable, and much more likely to be influenced by peer depression; particularly girls as they tend to have a more emotion-focused and ruminative relationship with their peers. We also showed that the economic status of the parents can mitigate the effects of peer depression, thereby implying that the most likely adolescents to be influenced by peer depression are the girls who come from poor working-class families.

# 6 Concluding remarks and policy implications

Adolescence is a critical period for the development of one's mental health, as symptoms of depression, particularly for girls, tend to emerge during this period and continue and recur into adulthood. Depression is one of the most common, chronic, and costly illnesses affecting adolescents and adults worldwide. This paper contributes to our understanding of the long-term determinants of mental health by highlighting the causal role of peer depression in adolescence on females' long-term depression, after accounting for own adolescence depression.

We use data from a large representative longitudinal survey of adolescents in the United States, following individuals from adolescence to adulthood, and use an identification strategy that relies on within-school and across-cohorts idiosyncratic variation in the proportion of same-gender peers who are depressed. We find a significant and positive causal effect of exposure to depressed peers in school on depression experienced in adulthood for females but not for males. An increase by one standard deviation in the share of own-gender peers (schoolmates) who are depressed increases the probability of depression in adulthood by 2.6 percentage points for females (or 11.5% of mean depression).

Then, we investigate the possible mechanisms that may explain our results. First, we show that female's peer depression has also a strong positive impact on individual adolescent female depression (short-term effect) but no impact on boys' depression. We provide some evidence suggesting that girls interact with other girls in a different manner than boys do with boys. In particular, we find that girls are more likely to engage in communication with their female friends by discussing problems and talking on the phone. This may indicate that there is co-rumination among adolescent girls, that is, they tend to extensively discuss and revisit problems without coming up with solutions, thereby leading to symptoms of anxiety and depression.

Second, we investigate whether being randomly "exposed" to depressed peers when young

has an impact on the probability of college attendance, of being employed, and of earning a high income in adulthood. We find a clear negative impact of peer depression on these outcomes. We also find that the social background of the family matters, as girls from low-skilled and lower-occupation backgrounds are more susceptible to negative peer influences.

In terms of policy implications, our findings suggest that policies and interventions aimed at buffering the impact of peer effects on vulnerable adolescent girls can have long-lasting effects on the targeted individuals' mental health and broader socioeconomic outcomes. In particular, programs aimed at preventing the "contagion" of peer depression for girls coming from low socioeconomic status families may be effective in reducing long-term depression for females. It is well known that in the United States lower-income families tend to reside in poor segregated neighborhoods (see e.g., Wilson (1987) and Massey and Denton (1993)). Our results indicate that the combination of poverty and depression in the same neighborhood may magnify each other and lead to more depression. There is plenty of evidence that neighborhoods affect the mental health of families (Kawachi and Berkman, 2003, Ross et al., 2000, 2001). Therefore, given our results in this paper, a natural policy to improve women's mental health would be the Moving to Opportunity (MTO) programs that have been implemented in the United States, where the local government subsidizes housing to allow families to move from poor to richer neighborhoods (Katz et al., 2001, Kling et al., 2007, Chetty et al., 2016). It has been shown that, indeed, the MTO programs have a positive effect on the mental health and well-being of the families who moved to better and less-poor neighborhoods (Leventhal and Brooks-Gunn, 2003, Kling et al., 2007, Ludwig et al., 2012, Graif et al., 2016). In particular, Ludwig et al. (2008) and Osypuk et al. (2012) find that families receiving housing vouchers and moving to less-poor neighborhoods due to the MTO programs had important mental health benefits among adolescent girls but not among boys. Our estimates suggest that "moving" a girl who has a large share of depressed peers in high school (top quartile) to another school/area whose peer group has a low share of depressed peers (bottom quartile) will reduce her probability of being depressed in adulthood by 8 percentage points.

Our paper suggests a precise mechanism for why moving to less-poor neighborhoods may improve the mental health of families, particularly adolescent girls. This is because, in the new neighborhood, adolescent girls are likely to meet new peers who are less likely to be depressed than in the previous neighborhood, since families have higher incomes[17] and, as we showed in Table 9, are less sensitive to their peer depression. Further, Chetty et al. (2016) find that the gains from moving to lower-poverty areas decline steadily with the age of the child at the time of the move. Every extra year of childhood spent in a low-poverty environment appears to be

[17]Indeed, in Wave I, we have checked whether adolescent girls are less depressed if they belong to higher-income families. We find that the share of depressed girls with below median household income is 28.1% while, it is 21.1%, for above median household income, with the difference being highly statistically significant (p-value $< 0.001$).

beneficial. Consequently, this could suggest that moving families with very young children, particularly girls, to lower-poverty areas would significantly improve their mental health: the younger, the better. This is in accordance with the early childhood literature that shows that intervention in early life may have a significant impact on mental health in adulthood (Heckman, 2006, 2007, Almond and Currie, 2011, Adhvaryu et al., 2019).

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# Online Appendix

## Peers, Gender, and Long-Term Depression

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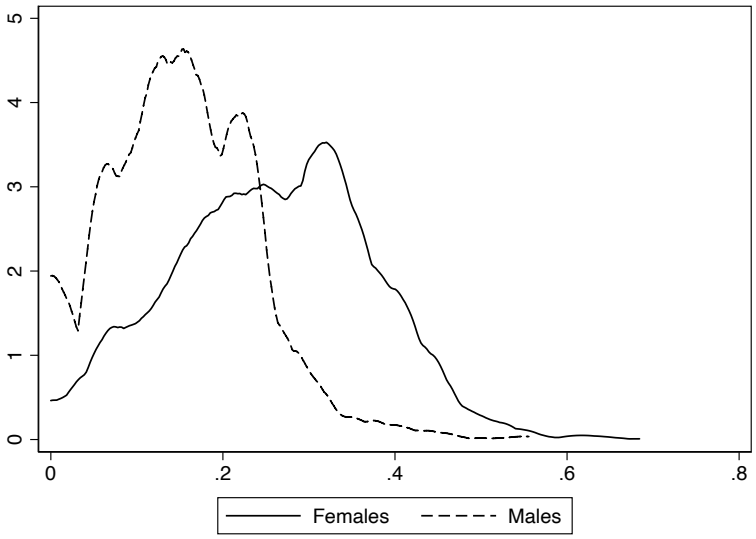
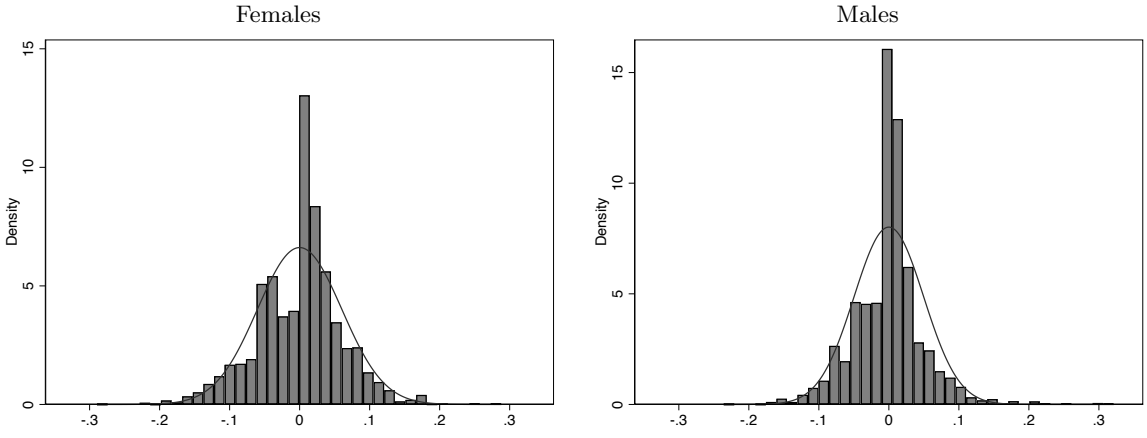
Figure A1: Distribution of % of Peers with Depression




Source: Longitudinal Survey of Adolescent Health (Add Health), Harris et al. (2009), Wave I.
The figure plots the kernel density of the variable "% own gender peers depressed" for females and males.

Figure A2: Residual Distribution of % of Peers with Depression




Source: Longitudinal Survey of Adolescent Health (Add Health), Harris et al. (2009), Wave I.
The figures plot the relative frequency of the residual "% own gender peers depressed" calculated as predicted residuals of a regression of average level in peer depression on grade and school fixed effects and school-specific time trend, separately for females and males.

Table A1: Probability of dropping out of the survey

| | wave I / Wave IV | | wave I / Wave II | |
|---|---|---|---|---|
| | Females | Males | Females | Males |
| % own-gender peers depressed | −.129 | −.141 | −.014 | −.107 |
| | (.084) | (.113) | (.080) | (.105) |
| Depressed in Wave I | .006 | .001 | −.030*** | −.033* |
| | (.016) | (.020) | (.011) | (.019) |
| Race: White | −.004 | −.006 | −.039 | .015 |
| | (.021) | (.025) | (.024) | (.022) |
| Race: African American | −.060** | .013 | −.038 | .013 |
| | (.029) | (.035) | (.031) | (.026) |
| Race: Asian | .108** | .049 | −.069** | −.001 |
| | (.042) | (.046) | (.033) | (.028) |
| Ethnicity: Hispanic | .025 | .015 | −.062*** | −.046* |
| | (.022) | (.031) | (.022) | (.024) |
| Number of siblings | .002 | −.000 | −.017*** | .011** |
| | (.004) | (.005) | (.003) | (.004) |
| Picture Vocabulary Test score | −.002*** | −.002*** | −.001 | −.001 |
| | (.000) | (.001) | (.000) | (.000) |
| Mother's educ: Missing | .041* | .012 | .027 | .068* |
| | (.024) | (.033) | (.024) | (.035) |
| Mother's educ: High school / some college | .019 | −.013 | −.017 | −.005 |
| | (.019) | (.020) | (.016) | (.026) |
| Mother's educ: College degree or above | .035 | .004 | −.037** | −.011 |
| | (.022) | (.024) | (.016) | (.030) |
| Mother's occup: Managerial / professional | −.002 | −.064** | −.024 | .021 |
| | (.021) | (.026) | (.017) | (.022) |
| Mother's occup: Technical / office / sales | −.010 | −.017 | −.021 | .031 |
| | (.020) | (.024) | (.016) | (.021) |
| Mother's occup: Blue collar | .011 | −.027 | −.013 | .052*** |
| | (.018) | (.022) | (.014) | (.019) |
| Father not present | .033** | .007 | .003 | −.002 |
| | (.014) | (.015) | (.014) | (.014) |
| Household income (thousand dollars) | −.000 | −.000 | .000 | −.000** |
| | (.000) | (.000) | (.000) | (.000) |
| N | 8550 | 8102 | 7011 | 6072 |
| $R^2$ | .10 | .09 | .47 | .45 |

Source: Longitudinal Survey of Adolescent Health (Add Health), Harris et al. (2009), Waves I, II and IV.

The dependent variable is the probability of not being interviewed in Wave IV (Coulmns 1 and 2) or in Wave II (Columns 3 and 4), conditioning on being part of the selected sample in Wave I.

All regressions contain the same control variables as Table 3, Columns 4 and 8, including grade fixed effects, school fixed effects, and school time trends.

Robust standard errors clustered at the school level are given in parentheses.

* $p < 0.10$.; ** $p < 0.05$.; *** $p < 0.01$.

Table A2: CES-D-10 questionnaire

| | |
|---|---|
| 1) | You were bothered by things that don't usually bother you. |
| 2) | You felt that you could not shake off the blues, even with help from your family and your friends. |
| 3) | You felt you were just as good as other people. |
| 4) | You had trouble keeping your mind on what you were doing. |
| 5) | You felt depressed. |
| 6) | You felt that you were too tired to do things. |
| 7) | You were happy. |
| 8) | You enjoyed life. |
| 9) | You felt sad. |
| 10) | You felt that people disliked you. |

Source: Longitudinal Survey of Adolescent Health (Add Health), Harris et al. (2009), Waves I and IV.
Scores to the answers vary from 0 to 3. Scores for answers to questions 3, 7 and 8 are reverse coded.

Table A3: Individual depression – Transition matrix

| | Depressed in Wave IV | | | | | |
|---|---|---|---|---|---|---|
| | Females | | | Males | | |
| Depressed in Wave I | No | Yes | Total | No | Yes | Total |
| No | 4119 | 891 | 5010 | 4233 | 695 | 4928 |
| Yes | 1027 | 626 | 1653 | 555 | 254 | 809 |
| Total | 5146 | 1517 | 6663 | 4788 | 949 | 5737 |

Source: Longitudinal Survey of Adolescent Health (Add Health), Harris et al. (2009), Waves I and IV.
Depression is defined as a dummy variable for whether the 10-item Center for Epidemiologic Studies Depression Scale is above 11.

Table A4: Raw and residual variation in peer depression

Females

| | Mean | SD | Min | Max | N |
|---|---|---|---|---|---|
| Raw variable | 0.256 | 0.117 | 0.000 | 0.684 | 6663 |
| Demeaning grade/school FE | 0.000 | 0.078 | -0.321 | 0.379 | 6663 |
| Demeaning grade/school FE and school trends | 0.000 | 0.060 | -0.289 | 0.288 | 6663 |

Males

| | Mean | SD | Min | Max | N |
|---|---|---|---|---|---|
| Raw variable | 0.150 | 0.088 | 0.000 | 0.556 | 5737 |
| Demeaning grade/school FE | 0.000 | 0.065 | -0.217 | 0.328 | 5737 |
| Demeaning grade/school FE and school trends | -0.000 | 0.050 | -0.236 | 0.321 | 5737 |

Source: Longitudinal Survey of Adolescent Health (Add Health), Harris et al. (2009), Waves I and IV.

Raw variable indicates the average level in peer depression.

Demeaning grade/school FE indicates the average level in peer depression calculated as predicted residuals of a regression of average level in peer depression on grade and school fixed effects.

Demeaning grade/school FE and school trends indicates the average level in peer depression calculated as predicted residuals of a regression of average level in peer depression on grade and school fixed effects and school-specific time trends.

Table A5: Effects of peer depression on depression in adulthood – additional peer controls

| | Females | | | Males | | |
|---|---|---|---|---|---|---|
| % own-gender peers depressed | .233** | .219** | .231** | .125 | .126 | .132 |
| | (.107) | (.108) | (.098) | (.118) | (.112) | (.111) |
| Depressed in Wave I | .203*** | .201*** | .202*** | .192*** | .193*** | .194*** |
| | (.019) | (.019) | (.019) | (.025) | (.025) | (.025) |
| Race: White | –.041 | –.049 | –.049 | –.059** | –.065** | –.065** |
| | (.036) | (.036) | (.036) | (.029) | (.027) | (.027) |
| Race: African American | –.027 | –.039 | –.040 | –.023 | –.022 | –.022 |
| | (.039) | (.040) | (.040) | (.035) | (.034) | (.034) |
| Race: Asian | –.018 | –.039 | –.036 | –.031 | –.037 | –.036 |
| | (.052) | (.050) | (.050) | (.051) | (.051) | (.050) |
| Ethnicity: Hispanic | –.009 | –.006 | –.005 | –.067** | –.066** | –.065** |
| | (.037) | (.037) | (.037) | (.031) | (.030) | (.030) |
| Number of siblings | .006 | .006 | .005 | –.005 | –.005 | –.005 |
| | (.005) | (.005) | (.005) | (.006) | (.006) | (.006) |
| Picture Vocabulary Test score | –.002*** | –.002*** | –.002*** | –.002*** | –.002*** | –.002*** |
| | (.001) | (.001) | (.001) | (.001) | (.001) | (.001) |
| Mother's educ: Missing | .009 | .009 | .012 | .041 | .043 | .046 |
| | (.048) | (.048) | (.047) | (.047) | (.048) | (.048) |
| Mother's educ: High school / some college | –.038* | –.038* | –.038* | –.009 | –.006 | –.005 |
| | (.021) | (.021) | (.020) | (.023) | (.023) | (.023) |
| Mother's educ: College degree or above | –.048* | –.050* | –.050* | –.012 | –.009 | –.009 |
| | (.026) | (.026) | (.026) | (.025) | (.025) | (.025) |
| Mother's occup: Managerial / professional | –.016 | –.015 | –.016 | –.026 | –.025 | –.024 |
| | (.025) | (.024) | (.024) | (.023) | (.024) | (.024) |
| Mother's occup: Technical / office / sales | –.012 | –.012 | –.011 | –.021 | –.021 | –.021 |
| | (.023) | (.023) | (.023) | (.021) | (.021) | (.021) |
| Mother's occup: Blue collar | .003 | .001 | .002 | –.026 | –.025 | –.024 |
| | (.020) | (.020) | (.020) | (.019) | (.019) | (.019) |
| Father not present | .036** | .037** | .042** | .025 | .025 | .020 |
| | (.017) | (.017) | (.017) | (.018) | (.018) | (.017) |
| Household income (thousand dollars) | –.000 | –.000 | –.000 | –.000 | –.000 | –.000 |
| | (.000) | (.000) | (.000) | (.000) | (.000) | (.000) |
| Share of peers whose mother's education is missing | .067 | .036 | .072 | .056 | .085 | .121 |
| | (.198) | (.191) | (.188) | (.197) | (.199) | (.204) |
| Share of peers whose mother's education is high school / some college | .042 | .039 | .018 | –.092 | –.050 | –.024 |
| | (.130) | (.131) | (.134) | (.158) | (.167) | (.173) |
| Share of peers whose mother's education is college degree or above | .191 | .159 | .141 | .215 | .252 | .243 |
| | (.194) | (.189) | (.194) | (.176) | (.184) | (.184) |
| Share of peers whose mother's occupation is blue collar | –.018 | –.062 | –.047 | .146 | .169 | .203 |
| | (.164) | (.159) | (.163) | (.143) | (.143) | (.139) |
| Share of peers whose mother's occupation is technical / office / sales | –.051 | –.059 | –.049 | .082 | .089 | .088 |
| | (.157) | (.158) | (.167) | (.145) | (.144) | (.147) |
| Share of peers whose mother's occupation is managerial / professional | –.102 | –.105 | –.128 | .045 | .071 | .093 |
| | (.145) | (.139) | (.143) | (.166) | (.162) | (.158) |
| Share of White peers | | –.208 | –.202 | | –.175 | –.166 |
| | | (.167) | (.165) | | (.155) | (.155) |
| Share of African American peers | | –.291 | –.310 | | .003 | .017 |
| | | (.214) | (.223) | | (.195) | (.193) |
| Share of Asian peers | | –.575* | –.494* | | –.213 | –.200 |
| | | (.306) | (.279) | | (.190) | (.197) |
| Share of Hispanic peers | | .107 | .128 | | .002 | .022 |
| | | (.154) | (.158) | | (.118) | (.121) |
| Average picture vocabulary test of peers | | | .004 | | | –.001 |
| | | | (.004) | | | (.003) |
| Average number of siblings of peers | | | –.019 | | | .006 |
| | | | (.025) | | | (.030) |
| Share of peers whose father is not present | | | .162 | | | –.136 |
| | | | (.101) | | | (.104) |
| Average household income of peers | | | –.000 | | | .001 |
| | | | (.001) | | | (.001) |
| Grade fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| School fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| School time trends | Yes | Yes | Yes | Yes | Yes | Yes |
| Controls for peers mother's education / occupation | Yes | Yes | Yes | Yes | Yes | Yes |
| Controls for peers race / ethnicity | No | Yes | Yes | No | Yes | Yes |
| Additional peer controls | No | No | Yes | No | No | Yes |
| N | 6663 | 6663 | 6663 | 5737 | 5737 | 5737 |
| $R^2$ | .13 | .13 | .13 | .14 | .14 | .14 |

Source: Longitudinal Survey of Adolescent Health (Add Health), Harris et al. (2009), Waves I and IV.
The dependent variable is depression, defined as a dummy variable for whether the 10-item Center for Epidemiologic Studies Depression Scale is above 11.
% own gender peers depressed is the share of students who are depressed among all students of the same gender and in the same school and grade as that of the respondent. The respondent is excluded from the calculations of the % own gender peers depressed.
The dependent variable is measured at the time of Wave IV; all control variables are measured at the time of Wave I. The excluded category for race is: Other races (American Indian and Other Race). The excluded category for mother's education is: Less than high school. Excluded category for mother's occupation is: Homemaker.
Controls for peers mother's education / occupation are: share of peers whose mother's education is missing, share of peers whose mother's education is high school / some college, share of peers whose mother's education is college degree or above, share of peers whose mother's occupation is managerial / professional, share of peers whose mother's occupation is technical / office / sales, share of peers whose mother's occupation is blue collar.
Controls for peers race / ethnicity are: share of White peers, share of African American peers, share of Asian peers, share of Hispanic peers.
Additional peer controls are: average number of siblings of peers, average picture vocabulary test of peers, share of peers whose father is not present, average household income of peers.
Robust standard errors clustered at the school level are given in parentheses.
* $p < 0.10$.; ** $p < 0.05$.; *** $p < 0.01$.

## Table A6: Placebo test of peer depression on depression in adulthood

| | Females | | | | Males | | | |
|---|---|---|---|---|---|---|---|---|
| % own-gender placebo peers depressed | −.046 | −.046 | −.047 | −.046 | .081 | .081 | .085 | .080 |
| | (.081) | (.081) | (.079) | (.080) | (.101) | (.101) | (.096) | (.097) |
| Depressed in Wave I | .214*** | .214*** | .202*** | .195*** | .203*** | .203*** | .190*** | .188*** |
| | (.019) | (.019) | (.019) | (.019) | (.026) | (.026) | (.026) | (.026) |
| Race: White | | | −.045 | −.040 | | | −.057** | −.058** |
| | | | (.036) | (.036) | | | (.028) | (.028) |
| Race: African American | | | −.019 | −.027 | | | −.012 | −.022 |
| | | | (.039) | (.039) | | | (.035) | (.035) |
| Race: Asian | | | −.015 | −.018 | | | −.031 | −.030 |
| | | | (.053) | (.052) | | | (.050) | (.050) |
| Ethnicity: Hispanic | | | .003 | −.008 | | | −.058* | −.065** |
| | | | (.036) | (.037) | | | (.030) | (.031) |
| Number of siblings | | | .006 | .006 | | | −.005 | −.005 |
| | | | (.005) | (.005) | | | (.006) | (.006) |
| Picture Vocabulary Test score | | | −.003*** | −.002*** | | | −.002*** | −.002*** |
| | | | (.001) | (.001) | | | (.001) | (.001) |
| Mother's educ: Missing | | | | .008 | | | | .042 |
| | | | | (.048) | | | | (.047) |
| Mother's educ: High school / some college | | | | −.038* | | | | −.004 |
| | | | | (.021) | | | | (.024) |
| Mother's educ: College degree or above | | | | −.055** | | | | −.016 |
| | | | | (.026) | | | | (.026) |
| Mother's occup: Managerial / professional | | | | −.012 | | | | −.030 |
| | | | | (.024) | | | | (.024) |
| Mother's occup: Technical / office / sales | | | | −.011 | | | | −.026 |
| | | | | (.024) | | | | (.021) |
| Mother's occup: Blue collar | | | | .004 | | | | −.032* |
| | | | | (.019) | | | | (.019) |
| Father not present | | | | .036** | | | | .026 |
| | | | | (.017) | | | | (.018) |
| Household income (thousand dollars) | | | | −.000 | | | | −.000 |
| | | | | (.000) | | | | (.000) |
| Grade fixed effects | No | Yes | Yes | Yes | No | Yes | Yes | Yes |
| School fixed effects | No | Yes | Yes | Yes | No | Yes | Yes | Yes |
| School time trends | No | Yes | Yes | Yes | No | Yes | Yes | Yes |
| N | 6663 | 6663 | 6663 | 6663 | 5737 | 5737 | 5737 | 5737 |
| $R^2$ | .12 | .12 | .13 | .13 | .13 | .13 | .14 | .14 |

Source: Longitudinal Survey of Adolescent Health (Add Health), Harris et al. (2009), Waves I and IV.
The dependent variable is depression, defined as a dummy variable for whether the 10-item Center for Epidemiologic Studies Depression Scale is above 11.

All regressions contain the same control variables as Table 3, Columns 4 and 8, including grade fixed effects, school fixed effects, and school time trends.
Robust standard errors clustered at the school level are given in parentheses.
* $p < 0.10$.; ** $p < 0.05$.; *** $p < 0.01$.

Table A7: Effects of peer depression on depression in adulthood - Short run, Wave IV sample

| | Females | | | Males | | |
|---|---|---|---|---|---|---|
| % own-gender peers depressed | .261** | | .371*** | .165 | | .216 |
| | (.111) | | (.138) | (.114) | | (.133) |
| Bond with mother above median | | −.022 | .023 | | −.013 | .008 |
| | | (.016) | (.030) | | (.014) | (.019) |
| Bond with mother above median × % own-gender peers depressed | | | −.178 | | | −.152 |
| | | | (.118) | | | (.127) |
| N | 5074 | 5072 | 5072 | 4339 | 4338 | 4338 |
| $R^2$ | .24 | .24 | .24 | .25 | .25 | .25 |

Source: Longitudinal Survey of Adolescent Health (Add Health), Harris et al. (2009), Waves I and II.
The dependent variable is depression, defined as a dummy variable for whether the 10-item Center for Epidemiologic Studies Depression Scale is above 11, measured in Wave II.
The dependent variable is measured at the time of Wave II; all control variables are measured at the time of Wave I.
The sample is the same of Table 6, but restricted to individuals observed in Wave IV.
All regressions contain the same control variables as Table 3, Columns 4 and 8, including grade fixed effects, school fixed effects, and school time trends.
Robust standard errors clustered at the school level are given in parentheses.
* $p < 0.10$.; ** $p < 0.05$.; *** $p < 0.01$.

Table A8: Gender Differences in Own-Gender Friend Socialization among Adolescents

| | All friends | | | | Same school/grade | | | |
|---|---|---|---|---|---|---|---|---|
| | Females | | Males | | Females | | Males | |
| Activities / with: | Females | Males | Females | Males | Females | Males | Females | Males |
| Talk about problems | 0.694 | 0.581 | 0.439 | 0.390 | 0.675 | 0.468 | 0.391 | 0.340 |
| | (0.425) | (0.461) | (0.471) | (0.457) | (0.435) | (0.473) | (0.470) | (0.443) |
| Talk on the phone | 0.808 | 0.669 | 0.651 | 0.691 | 0.803 | 0.525 | 0.564 | 0.662 |
| | (0.355) | (0.437) | (0.446) | (0.421) | (0.362) | (0.471) | (0.472) | (0.435) |
| Visit house | 0.491 | 0.305 | 0.356 | 0.567 | 0.462 | 0.207 | 0.245 | 0.517 |
| | (0.461) | (0.430) | (0.445) | (0.450) | (0.458) | (0.384) | (0.405) | (0.460) |
| Hang out | 0.573 | 0.422 | 0.433 | 0.607 | 0.588 | 0.372 | 0.388 | 0.614 |
| | (0.461) | (0.464) | (0.465) | (0.453) | (0.460) | (0.460) | (0.462) | (0.455) |
| Spend weekend | 0.535 | 0.442 | 0.425 | 0.575 | 0.495 | 0.300 | 0.320 | 0.516 |
| | (0.464) | (0.465) | (0.463) | (0.457) | (0.469) | (0.437) | (0.442) | (0.465) |
| N | 6482 | 5830 | 4719 | 5561 | 1480 | 723 | 753 | 1197 |

Source: Longitudinal Survey of Adolescent Health (Add Health), Harris et al. (2009), Wave I.
Talk about problems refers to the share of respondents who answered yes to the question Did you talk to [friend 1....5] about a problem during the past seven days ?
Talk on the phone refers to the share of respondents who answered yes to the question Did you talk to [friend 1....5] on the telephone during the past seven days?
Visit house refers to the share of respondents who answered yes to the question Did you go to [friend 1....5]'s house during the past seven days?
Hang out refers to the share of respondents who answered yes to the question Did you meet [friend 1....5] after school to hang out or go somewhere during the past seven days?
Spend weekend refers to the share of respondents who answered yes to the question Did you spend time with [friend 1....5] during the past weekend?
*** $p < 0.01$.