

# Peer Effects in Adolescent Mental Health

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# Motivation

# The Importance of Peer Effects in Mental Health

- Mental health is a significant public health concern among adolescents and adults
  - One in three school children report some symptoms of mental health problems (Center for Behavioral Health Statistics and Quality 2022)
- The role of peers is also important to many policies and interventions
  - e.g., bussing and affirmative action
- Consequently, understanding the role of peers in mental health is important and could have implications on academic, health, and behavioral outcomes

# Research Questions

- 1 What are the effects of having friends with worse mental health on adolescents' mental health in school?
- 2 How do friends with worse mental health impact adolescents' academic, health, and behavioral outcomes?

# Background

- Estimating peer effects is hard (Manski 1993)
- Friendship formation is not random, and estimating peer effects is plagued with endogeneity issues (Manski 1993)
- Some economists used randomization to estimate a causal effect of peers (Sacerdote 2001; Zimmerman 2003)
- I will exploit the friends-of-friends method to estimate the mental health peer effects
  - This method builds on the works of Jackson and Rogers (2007) and Bramoullé, Djebbari, and Fortin (2009)

## There are significant peer effects in mental health

- Peers effects in mental health are significant and large
- A 1 standard deviation increase—worsening—in the mental health of peers is associated with 0.73 standard deviation increase in one's own mental health
  - Peer effects in mental health is larger among women and students with more friends
- Peer effects in mental health is also associated with negative academic, health, and behavioral outcomes
- A one standard deviation worsening in the mental health of peers is associated with a:
  - 0.33 points decrease in GPA
  - 15 percentage points increase in probability of missing school for health reasons
  - 40 percentage points increase in probability of smoking cigarettes
- Peer effects in mental health does not have any significant effect on long-term outcomes

# Data



# Add Health Data

- A nationally representative survey of adolescents from 1994 to 2018
- I use the in-school and in-home samples [Summary Statistics](#)
- I use the network data from Add Health to identify friends of friends to estimate peer effects
- Each student nominates 5 male and 5 female student friends
  - Friends of friends are the non-mutual friends' friends (friends once removed)

# Constructing a measure of mental health

- I use 15 questions commonly used by physicians for mental health screening, specifically the Center for Epidemiologic Studies Depression Scale (CES-D) (Radloff 1977)
- The CES-D scale is a test on symptoms associated with depression in which a person answers how frequently they have felt depression symptoms during the past week
- An adolescents' depression index ( $Depression_i$ ) is the standardized score they get on the questions
  - Friends' depression index ( $Depression_i^{friends}$ ) is the average depression score of the friends
  - Friends' of friends depression index ( $Depression_i^{friends\ of\ friends}$ ) is the average depression score of the non-mutual friends of friends

# Empirical Model

# Estimating Peer Effects

The equation of interest is:

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

Where for student  $i$  in school  $a$ :

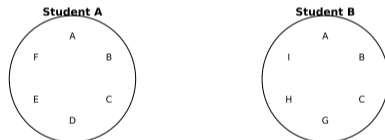
- $\text{Depression}_{ia}^{\text{friends}}$  is the average depression index among the friends
- $Y_{ia}$  is the outcome of interest
- $\lambda_1$  is the coefficient of interest
- Mental Health of friends could be endogenous, concern that OLS estimate of  $\lambda_1$  will not be consistent
- I use IV estimation using friends-of-friends as an instrument

## IV Approach

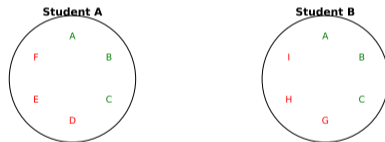
$$1^{\text{st}} \text{ stage: } Depression_{ia}^{\text{friends}} = \delta_{0a} + \theta_1 \text{Depression}_{ia}^{\text{friends-of-friends}} + \mathbf{X}'_{ia}\pi + \omega_a + r_{ia} \quad (1)$$

- $\text{Depression}_i^{\text{friends of friends}}$  is the average depression index among the non-mutual friends of friends

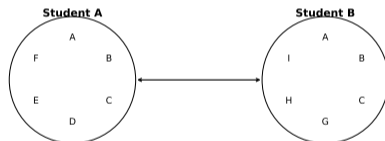
# How does the friends of friends method work?



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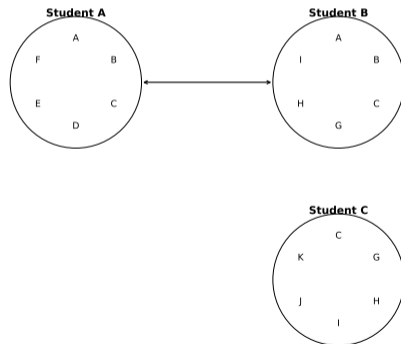


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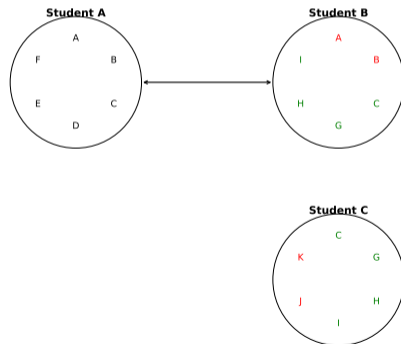




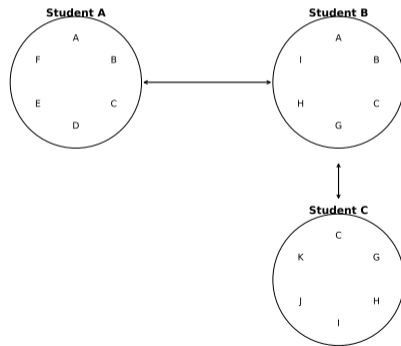
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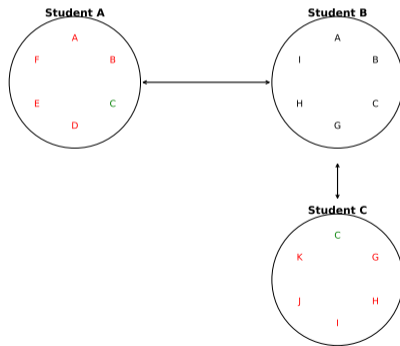
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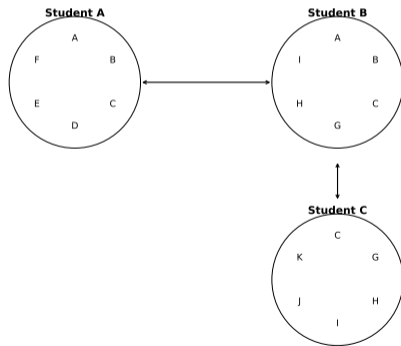
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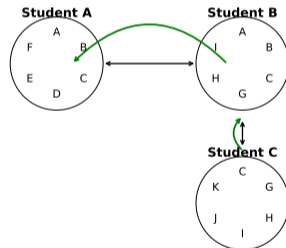


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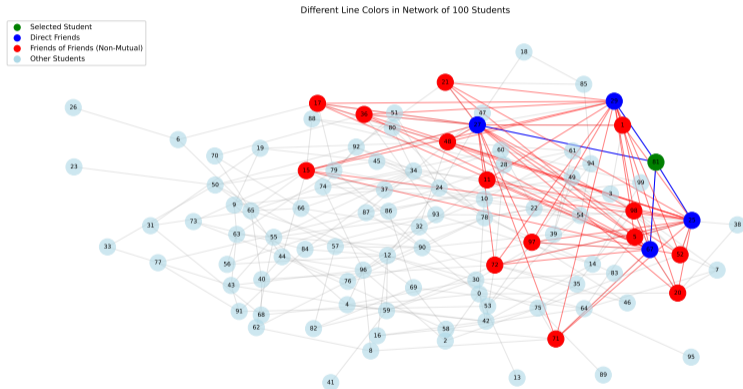


# How does the friends of friends method work?

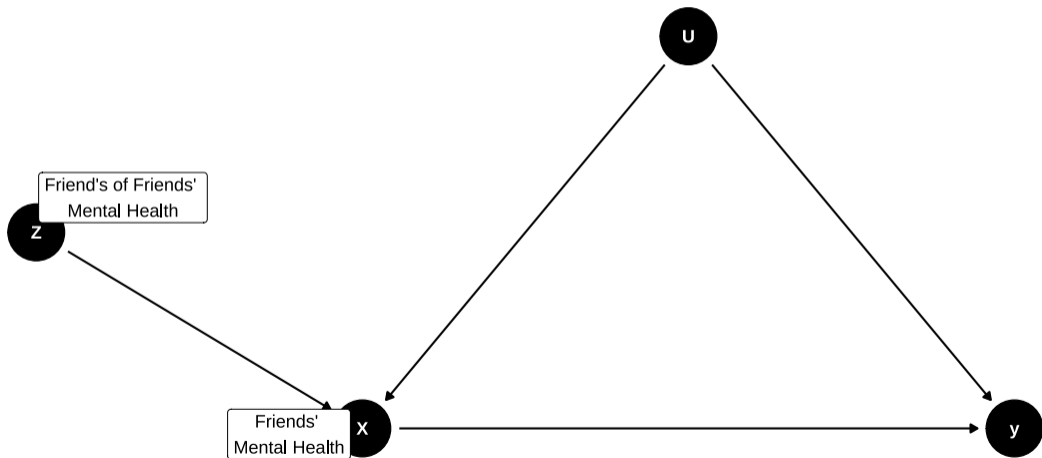
- **Student A** is only **affected** by **Student C** through **Student B**



# A bigger network



# IV Estimation of Peer Effects in Mental Health as a Directed Acyclic Graph





# Results

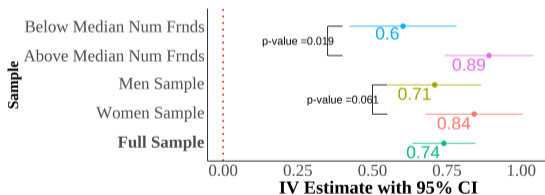
## IV Estimation of Peer Effects in Mental Health

	Mental Health (1) OLS (Reduced Form)	Friends Depression (2) First Stage	Mental Health (3) IV
Friends Depression			0.739*** (0.053)
Friends of Friends Depression	0.191*** (0.017)	0.259*** (0.019)	
Observations	53,725	53,725	53,725
First Stage F-statistic			1,675.97
Social Multiplier			3.84

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

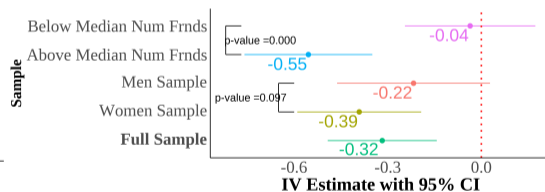
# Peer Effects of Friends' Mental Health on Own Mental Health and GPA

Plot 1: Own Mental Health



Averages (SD): Full sample 21.170 (11.000), Women 23.940 (10.960), Men 18.590 (10.090),  
Above Median Num Frnds 22.330 (10.340), Below Median Num Frnds 20.040 (11.480).

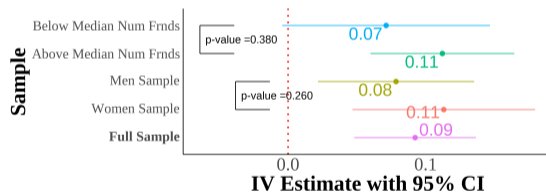
Plot 2: GPA



Averages (SD): Full sample 2.860 (0.790), Women 2.940 (0.760), Men 2.780 (0.810),  
Above Median Num Frnds 2.910 (0.770), Below Median Num Frnds 2.800 (0.810).

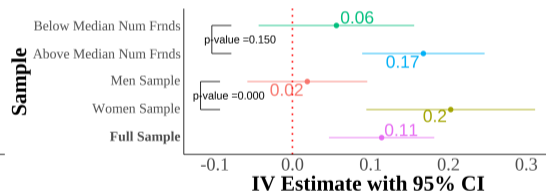
# Peer Effects of Friends' Mental Health on Health Outcomes

**Plot 1: Poor Health**



Averages: Full sample 0.070, Women 0.080, Men 0.060,  
Above Median Num Frnds 0.060, Below Median Num Frnds 0.080.

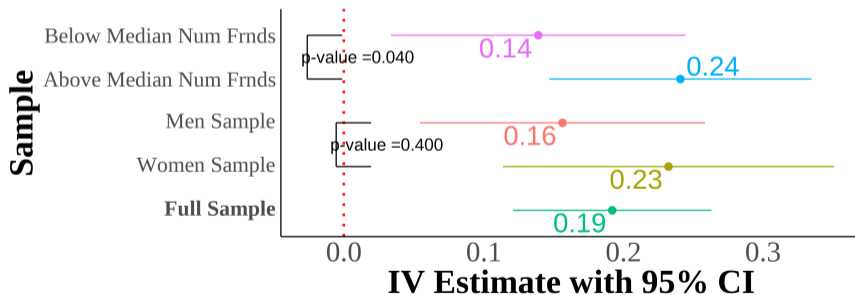
**Plot 2: Feeling Sick**



Averages: Full sample 0.300, Women 0.370, Men 0.220,  
Above Median Num Frnds 0.310, Below Median Num Frnds 0.280.

# Peer Effects of Friends' Mental Health on Health Outcomes (cont.)

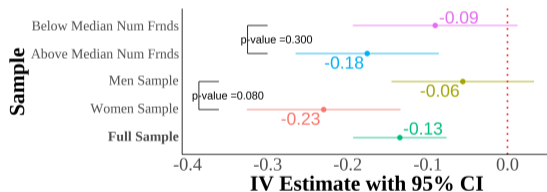
## Plot 1: Feeling Tired



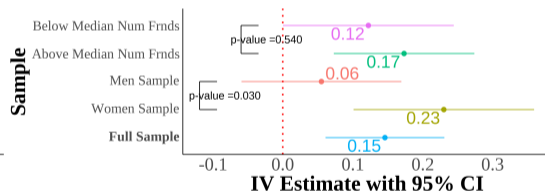
Averages: Full sample 0.550, Women 0.580, Men 0.530,  
Above Median Num Frnds 0.570, Below Median Num Frnds 0.530.

# Peer Effects of Friends' Mental Health on Health Outcomes (cont.)

Plot 1: Therapy

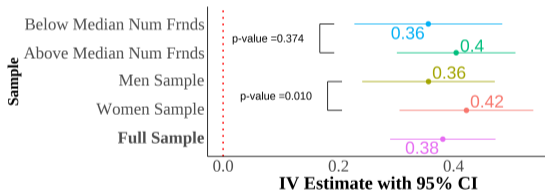


Plot 2: Miss School for Health Reasons



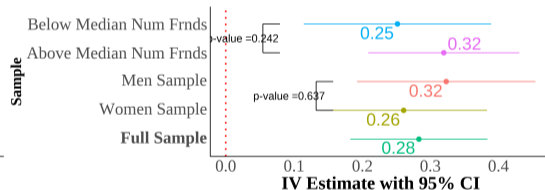
# Peer Effects of Friends' Mental Health on Behavioral Outcomes

Plot 1: Smoking Cigarettes



Averages: Full sample 0.360, Women 0.350, Men 0.360,  
Above Median Num Frnds 0.380, Below Median Num Frnds 0.320.

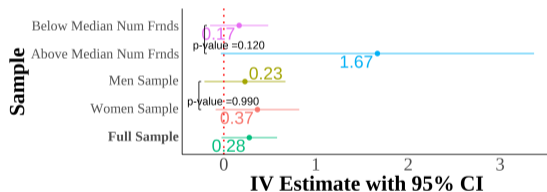
Plot 2: Intoxication



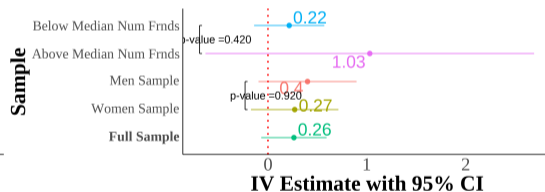
Averages: Full sample 0.310, Women 0.290, Men 0.330,  
Above Median Num Frnds 0.340, Below Median Num Frnds 0.270.

# Peer Effects of Friends' Mental Health on BMI

Plot 1: BMI (w1)



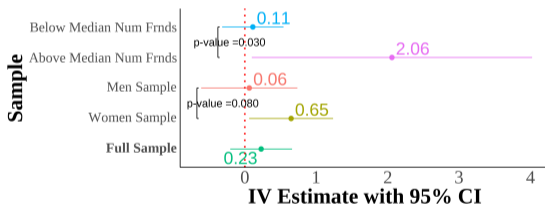
Plot 2: BMI (w2)





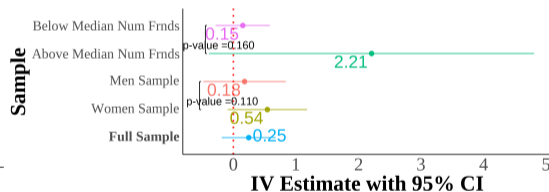
# Peer Effects of Friends' Mental Health on BMI (cont.)

Plot 1: BMI (w3)



Averages: Full sample 25.800 (5.860), Women 25.590 (6.340), Men 26.020 (5.260), Above Median Num Frnds 25.830 (5.840), Above Median Num Frnds 28.310 (6.860), Below Median Num Frnds 28.280 (6.930).

Plot 2: BMI (w4)

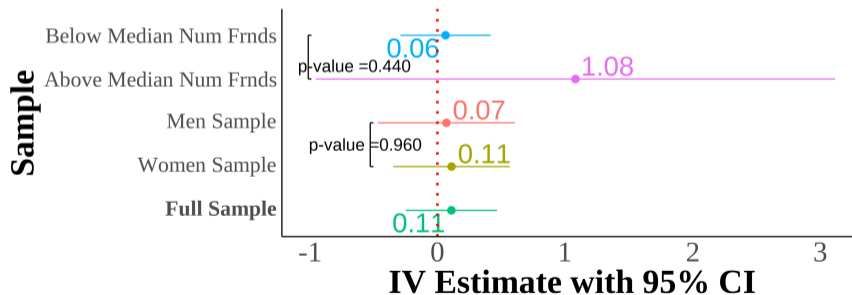


Averages: Full sample 28.300 (6.900), Women 28.320 (7.540), Men 28.270 (6.090),

Above Median Num Frnds 28.310 (6.860), Below Median Num Frnds 28.280 (6.930).

# Peer Effects of Friends' Mental Health on BMI (cont.)

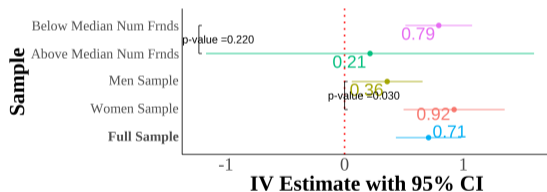
Plot 1: BMI (w5)



Averages: Full sample 29.710 (7.420), Women 29.770 (8.030), Men 29.620 (6.540),  
 Above Median Num Frnds 29.670 (7.420), Below Median Num Frnds 29.770 (7.440).

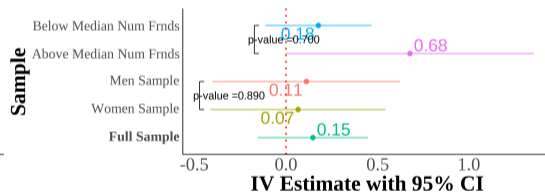
# Peer Effects of Friends' Mental Health on Own Mental Health

Plot 1: Mental Health Index (w1)



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

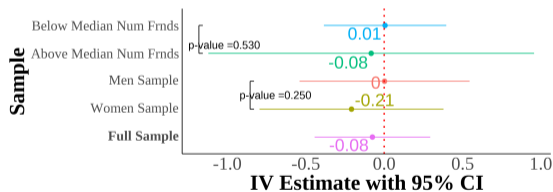
Plot 2: Mental Health Index (w2)



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

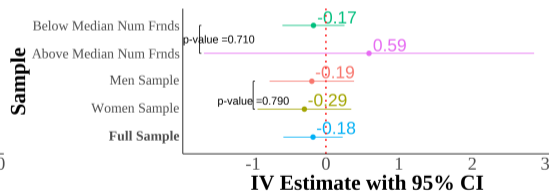
# Peer Effects of Friends' Mental Health on Own Mental Health (cont.)

Plot 1: Mental Health Index (w3)



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

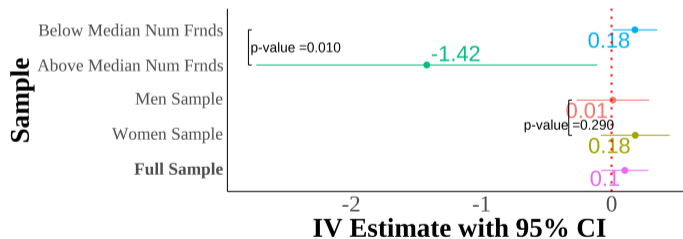
Plot 2: Mental Health Index (w4)



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

# Peer Effects of Friends' Mental Health on Own Mental Health (cont.)

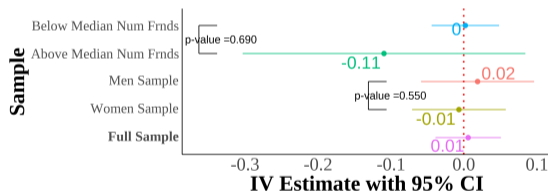
Plot 1: Mental Health Index (w5)



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

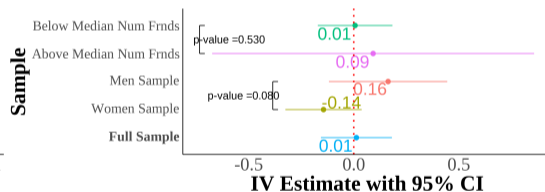
# Peer Effects of Friends' Mental Health on Educational Outcomes

Plot 1: Finishing High School



Averages: Full sample 0.960, Women 0.970, Men 0.950,  
Above Median Num Frnds 0.960, Below Median Num Frnds 0.960.

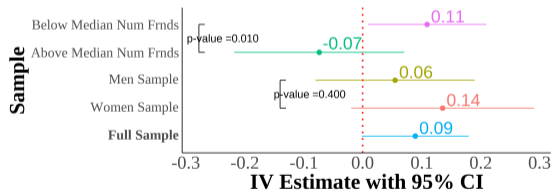
Plot 2: Finishing College



Averages: Full sample 0.690, Women 0.730, Men 0.650,  
Above Median Num Frnds 0.700, Below Median Num Frnds 0.700.

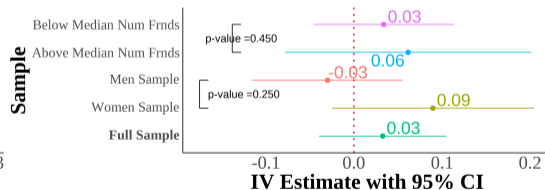
# Peer Effects of Friends' Mental Health on Disability and Welfare Programs Take Up

**Plot 1: Received Income from Disability, Unemployment, and Social Security Benefits (w3)**



Averages: Full sample 0.040, Women 0.030, Men 0.040,  
Above Median Num Frnds 0.040, Below Median Num Frnds 0.040.

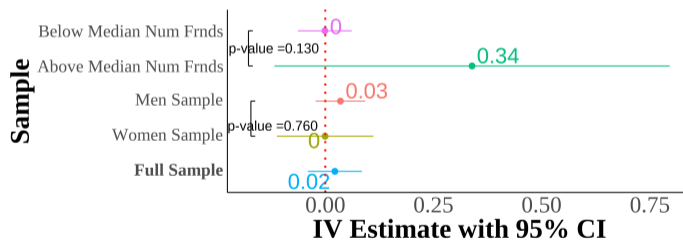
**Plot 2: Received Food Stamps (w3)**



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

# Peer Effects of Friends' Mental Health on Disability and Welfare Programs Take Up (cont.)

Plot 1: Received Welfare Payments (w3)



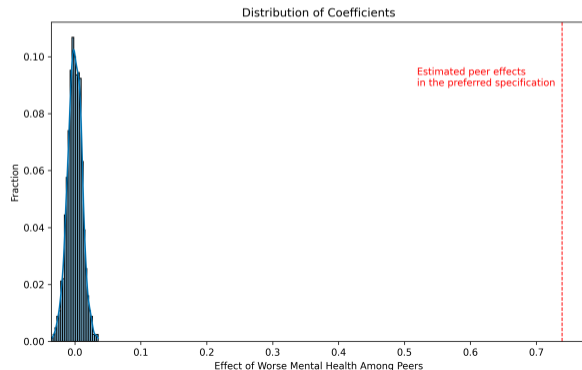
Averages: Full sample 0.030, Women 0.050, Men 0.010,  
Above Median Num Frnds 0.030, Below Median Num Frnds 0.030.



## Robustness Checks

# Placebo Regression

- I conduct a placebo regression to test the validity of the instrument
- I ran 2,500 simulations estimating peer effects in mental health if pupils were assigned friends at random



## IV Estimation Using non-Friends' Mental Health as an Instrument

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

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

## Conclusion

# I find significant peer effects in mental health of adolescents

- I find that having friends with worse mental health significantly affects the mental health of adolescents negatively
  - A one standard deviation worsening in friends' mental health worsen own mental health by 0.74 standard deviations
  - These effects are larger among girls and students with more friends
- Peer effects in mental health have significant negative effects on contemporaneous outcomes but not on future outcomes
- I find that peer effects in mental health worsen contemporaneous health, behavioral, and academic outcomes
- I find that peer effects in mental health do not affect future health, behavioral, and educational outcomes

# Thank you!

# Appendix

# Summary Statistics of Add Health Sample: Demographic and Educational Characteristics

	Mean	Std.Dev.	Range	Sample.Size
<b>Demographic</b>				
Age	15.00	1.71	[10, 19]	85,267
Female	0.50	0.50	[0, 1]	84,792
White	0.61	0.49	[0, 1]	85,267
Black	0.19	0.39	[0, 1]	85,267
Asian	0.07	0.25	[0, 1]	85,267
Native American	0.05	0.23	[0, 1]	85,267
Other	0.10	0.30	[0, 1]	85,267
Married (w5)	0.41	0.49	[0, 1]	20,854
<b>Educational Outcomes</b>				
GPA	2.86	0.79	[1, 4]	54,023
Number of Friends	6.53	3.64	[0, 10]	85,267

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# Summary Statistics of Add Health Sample: Health Outcomes

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	Mean	Std.Dev.	Range	Sample.Size
<b>Demographic</b>				
Poor Health	0.07	0.26	[0, 1]	81,287
Feel Sick	0.30	0.46	[0, 1]	79,652
Feel Tired	0.55	0.50	[0, 1]	79,611
Miss School for Health Reasons	0.45	0.50	[0, 1]	78,110
Ever Saw a Therapist	0.63	0.48	[0, 1]	79,444
Miss School	0.45	0.50	[0, 1]	78,136

[Summary Statistics](#)

# Summary Statistics of Add Health Sample: Behavioral Risk Outcomes

	Mean	Std.Dev.	Range	Sample.Size
<b>Behavioral Risk Outcomes</b>				
Skip School	0.30	0.46	[0, 1]	79,646
<i>During the last 12 months</i>				
Smoke	0.36	0.48	[0, 1]	79,916
Get Intoxicated	0.31	0.46	[0, 1]	79,263
Freq. Drink Alcohol	1.69	1.84	[0, 6]	20,854
Freq. High on Drugs	0.12	0.62	[0, 4]	20,854
<i>During the last month</i>				
Freq. marijuana (w1)	1.92	17.44	[0, 900]	20,854
Freq. marijuana (w3)	2.66	17.07	[0, 999]	20,854
Freq. marijuana (w4)	0.46	1.41	[0, 6]	20,854
Freq. Hang Out w/ Frnds	2.96	2.69	[0, 7]	20,854
Hurt Others b/c Drunk Including Unprot. Sex (w4)	0.61	0.49	[0, 1]	6,419
Hurt Others b/c High Including Unprot. Sex (w4)	0.24	0.43	[0, 1]	4,241
Hurt Others b/c Drugs Including Unprot. Sex (w4)	0.43	0.50	[0, 1]	1,647
Paid for Sex (w4)	0.02	0.14	[0, 1]	13,504

# Summary Statistics of Add Health Sample: Mental Health Outcomes

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

[Summary Statistics](#)
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## Summary Statistics by Different Samples: Demographics

	Full Sample	Friends	Friends of Friends
Age	15.02	14.98	14.98
Female	0.50	0.51	0.51
White	0.61	0.62	0.62
Black	0.19	0.19	0.19
Asian	0.07	0.07	0.07
Native American	0.05	0.05	0.05
Other	0.10	0.09	0.09

## Summary Statistics by Different Samples: Educational Outcomes

	Full Sample	Friends	Friends of Friends
GPA	2.86	2.88	2.88
Number of Friends	6.20	6.52	6.57

## Summary Statistics by Different Samples: Health Outcomes

	Full Sample	Friends	Friends of Friends
Poor Health	0.07	0.07	0.07
Feel Sick	0.30	0.30	0.30
Feel Tired	0.55	0.56	0.56
Miss School for Health Reasons	0.45	0.44	0.44
Ever Saw a Therapist	0.63	0.64	0.64
Miss School	0.45	0.44	0.44

# Summary Statistics by Different Samples: Behavioral Risk Outcomes

	Full Sample	Friends	Friends of Friends
Skip School	0.30	0.29	0.29
<i>During the last 12 months</i>			
Smoke	0.36	0.36	0.36
Get Intoxicated	0.31	0.31	0.31
Freq. Drink Alcohol	1.69	1.74	1.75
Freq. High on Drugs	0.12	0.12	0.12
<i>During the last month</i>			
Freq. marijuana (w1)	1.92	1.76	1.74
Freq. marijuana (w3)	2.66	2.69	2.71
Freq. marijuana (w4)	0.46	0.46	0.46
Freq. Hang Out w/ Frnds	2.96	3.04	3.05
Hurt Others b/c Drunk Including	0.61	0.61	0.61
Unprot. Sex (w4)			
Hurt Others b/c High Including	0.24	0.24	0.24
Unprot. Sex (w4)			
Hurt Others b/c Drugs Including	0.43	0.42	0.43
Unprot. Sex (w4)			
Paid for Sex (w4)	0.02	0.02	0.02

# Montiel-Pflueger Robust Weak Instrument Test

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

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[Robust Weak Instrument Test](#)[Back](#)



## IV with Trimmed Sample [Back](#)

	Mental Health (1) OLS (Reduced Form)	Friends Depression (2) First Stage	Mental Health (3) IV
Friends Depression			0.839*** (0.061)
Friends of Friends Depression	0.229*** (0.022)	0.272*** (0.018)	
Observations	41, 868	41, 868	41, 868
First Stage F-statistic			1,422.54

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

## IV with *Grade* × *School* Fixed Effects [Back](#)

	Mental Health (1) OLS (Reduced Form)	Friends Depression (2) First Stage	Mental Health (3) IV
Friends Depression			0.669*** (0.057)
Friends of Friends Depression	0.159*** (0.018)	0.238*** (0.020)	
Observations	53,508	53,508	53,508
School × Grade FE	X	X	X
First Stage F-statistic			1,386.2

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

## IV with Mutual and Non-Mutual Friends of Friends [Back](#)

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

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

Non-mutual + Mutual FoF

## IV with Reciprocal Friends [Back](#)

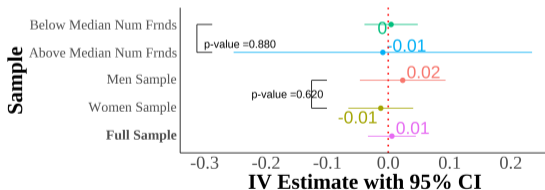
	Mental Health (1) OLS (Reduced Form)	Friends Depression (2) First Stage	Mental Health (3) IV
Friends Depression			0.590*** (0.078)
Non-Friends Depression	0.105*** (0.013)	0.178*** (0.013)	
Observations	27,848	27,848	27,848

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

# Peer Effects of Friends' Mental Health on Employment Outcomes

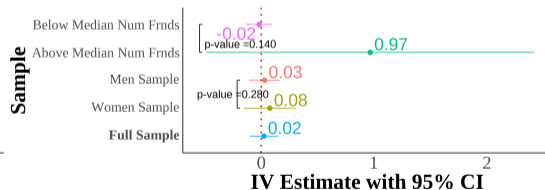
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[Labor Market Outcomes](#)

**Plot 1: Employment Status (w4)**



Averages: Full sample 0.750, Women 0.780, Men 0.710,  
Above Median Num Frnds 0.760, Below Median Num Frnds 0.740.

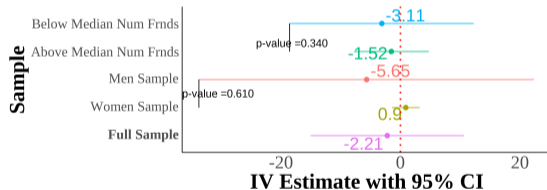
**Plot 2: Employment Status (w5)**



Averages: Full sample 0.840, Women 0.810, Men 0.880,  
Above Median Num Frnds 0.840, Below Median Num Frnds 0.840.

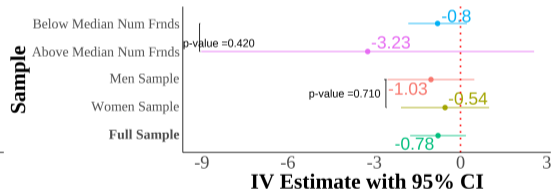
# Peer Effects of Friends' Mental Health on Earnings [Back](#)

**Plot 1: Hourly Earnings (w3)**



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

**Plot 2: Log Total Personal Earnings (w4)**

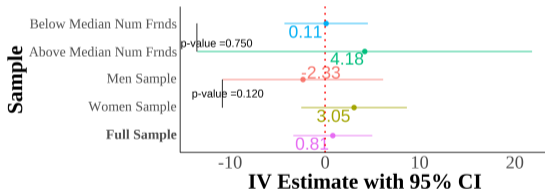


Averages: Full sample 35292.710 (44976.270), Women 29370.380 (38364.930), Men 41984.550 (50615.050),  
Above Median Num Frnds 36060.850 (46329.160), Below Median Num Frnds 34842.610 (44311.460).

# Peer Effects of Friends' Mental Health on Hours Worked

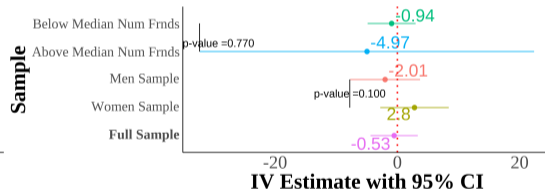
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Plot 1: Weekly Hours Worked (w4)



Averages: Full sample 41.140 (11.310), Women 38.760 (10.380), Men 43.830 (11.720),  
Above Median Num Frnds 41.220 (11.400), Below Median Num Frnds 41.120 (11.320).

Plot 2: Weekly Hours Worked (w5)

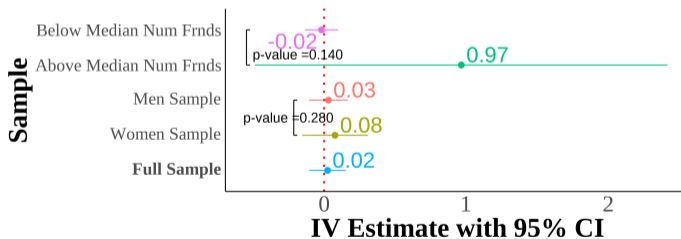


Averages: Full sample 42.850 (12.450), Women 39.960 (11.950), Men 46.300 (12.150),  
Above Median Num Frnds 42.880 (12.430), Below Median Num Frnds 42.900 (12.370).

# Peer Effects of Friends' Mental Health on Employment Outcomes

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Plot 1: Employment Status (w5)



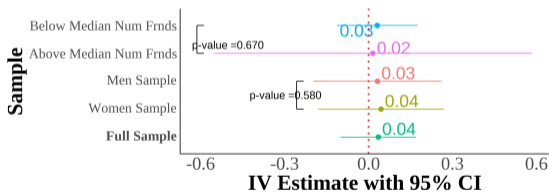
Averages: Full sample 0.840, Women 0.810, Men 0.880,  
Above Median Num Frnds 0.840, Below Median Num Frnds 0.840.



# Peer Effects of Friends' Mental Health on Full-Time Employment

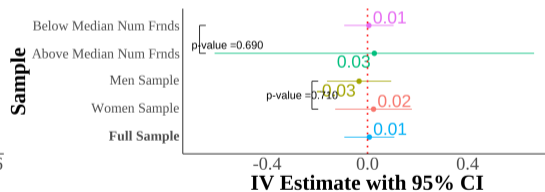
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Plot 1: Worked Full Time (w4)



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

Plot 2: Worked Full Time (w5)



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

## References

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