ONLINE APPENDIX

SOCIETAL DISRUPTIONS AND CHILDHOOD ADHD DIAGNOSIS DURING THE COVID-19 PANDEMIC

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A SafeGraph and Administrative Policy Comparison

We first compare our state-level SafeGraph openness measure to state-level learning model policies as collected by COVID-19 School Data Hub (2022) (henceforth CSDH). We can only do this for the 41 states with weekly or monthly learning model data in CSDH, which we need to measure the share of Fall 2020 with in-person learning model (compared to virtual or hybrid learning options). Because our SafeGraph measure is based on visits to public elementary schools, we restrict to this level in the CSDH policy data when possible. There are 32 states that report school-level learning models, in which we keep only the public elementary schools as identified by their NCES School ID. For the 4 states with district-level-by-grade policy data, we keep only the learning model reported for Grade K-5. This leaves 5 states with only district-level policies in which we cannot separately identify elementary schools. After making these school or district restrictions, we calculate the share of the Fall 2020 semester that had a reported in-person learning model, and aggregate up to the state level. We then rank each state by in-person schooling policy and compare this rank to the analogous ranking based on our SafeGraph mobility measures. Figure A1 presents this state rank-rank comparison, with 45-degree line in red. The two rankings have a strong correlation of 0.813, suggesting that our school-openness measure derived from SafeGraph mobility data aligns closely with school or district level in-person school policies documented in the CSDH for the Fall of 2020.

With this analysis, we show that once aggregated to the state level, there is little difference in school-opening policies and actual in-person school visits. We choose to use the SafeGraph-derived openness grouping for our preferred state-level analysis as it allows us to include all states whereas CSDH only has weekly and/or monthly reports for 41 states.

We conduct a similar exercise within Indiana, where we compare SafeGraph derived school-openness and CSDH in-person reporting at the zip-tract level. For each Indiana public elementary school with reports in CSDH, we calculate the share of Fall 2020 that offered in-person learning. We then use the same aggregation method described in Section

IV to construct a weighted average in-person policy share for each zip-tract comprised of schools with learning model reports in CSDH.

While SafeGraph-derived openness and CSDH in-person policy differences were minimal in the state-level analysis, we do see deviations within Indiana, especially for zip-tracts with low opening status based on our SafeGraph mobility measure. This can be seen visually in Figure A2, where we show the box-and-whisker of zip-tract CSDH in-person share, separately for each decile of our SafeGraph school openness measure. A majority of zip-tracts that we would call "High-Opening" (those in SafeGraph decile 6-10) also report always in-person according to CSDH. However, for zip-tracts that we would call "Medium-Opening" or "Low-Opening" (those in SafeGraph decile 1-5), there is significant heterogeneity in the share of Fall 2020 that reported in-person learning mode.

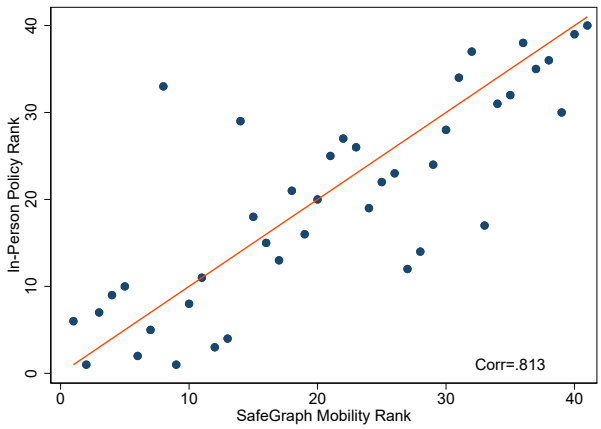
We think the main reason why the CSDH in-person share differs from our SafeGraph school-openness share, especially for the zip-tracts with low to medium openness levels, is due to lower demand for in-person instruction even when available. The Indiana Department of Education defines a school to be "in-person" if over half of the students receive 75% of their instruction in person.[29] This still allows for heterogeneity in visit levels to schools, which is likely captured by our SafeGraph school-openness measure, even when aggregated to the county-level.

Our main specification for the within-Indiana analysis uses zip-tract school-openness group derived from SafeGraph mobility data, aggregated up to the county level. This has an advantage over CSDH in-person policy reports because it captures the variation in in-person school *utilization* rather than the somewhat ad-hoc definition of in-person school *availability*. That said, we do note that there may be potential for this measure to bias our estimates in the low and medium opening groups if there is a correlation between likelihood of initial ADHD diagnosis and demand for in-person schooling. We think this is more likely to be correlated for children who already have ADHD rather than those not yet diagnosed, but we

[29]See the *Data Details for Indiana* sheet at www.covidschooldatahub.com/states/indiana for additional information on how learning models are defined by the state and categorized by CSDH.

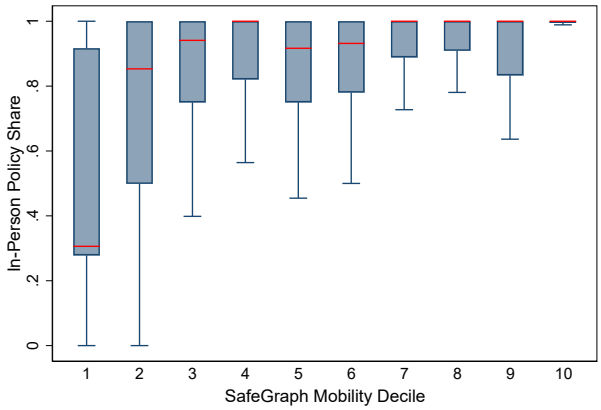
recognize there could be some confounding factors that link ADHD diagnosis potential and demand for in-person schooling. However, the direction of the bias is not clear.

Figure A1: SafeGraph and CSDH State Rank-Rank Comparison, Fall 2020



Note: Figure plots the state-level rank of SafeGraph school-openness for Fall 2020 (x-axis) and state-level rank of CSDH share in-person for Fall 2020 (y-axis) for the 41 states in which CSDH rank could be determined. Higher ranking corresponds to higher school-openness and higher share in-person, respectively. 45-degree line in red.

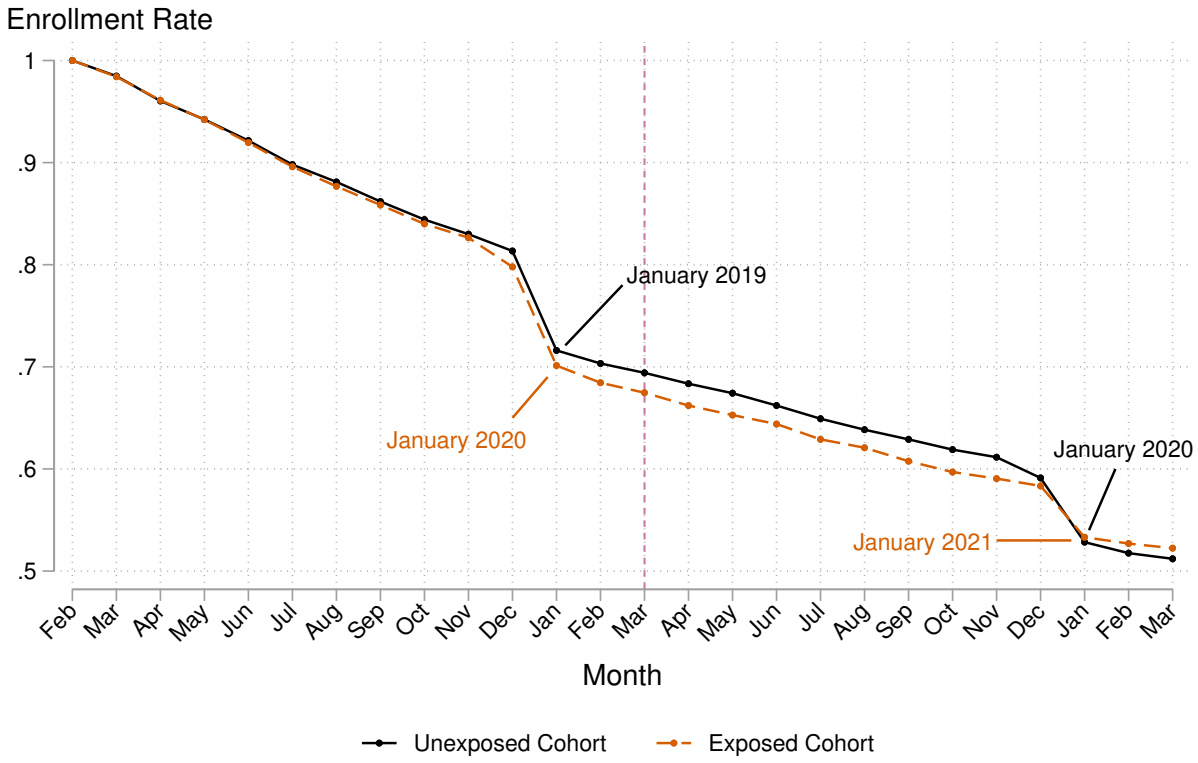
Figure A2: SafeGraph and CSDH County-Level Comparison, Fall 2020



Note: Box-and-whisker plot of CSDH in-person share for Fall 2020, by decile of SafeGraph school-openness for Fall 2020. Both CSDH in-person share and SafeGraph mobility are at the zip-tract level. Higher deciles correspond to higher rates of SafeGraph school-openness. Within each SafeGraph mobility decile, the median zip-tract's CSDH in-person share is denoted by the solid red line, the IQR in blue box, and the lower/upper adjacent values as whiskers.

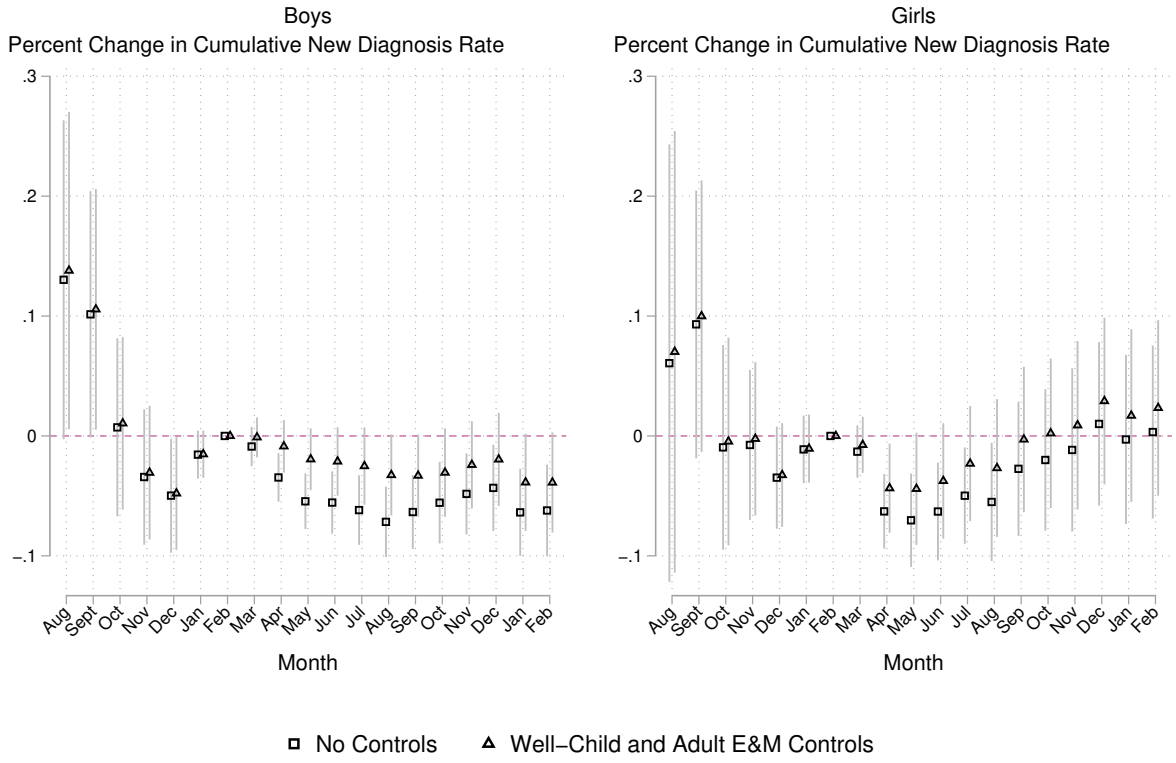
B Additional Tables and Figures

Figure B1: Enrollment by Cohorts (Optum)



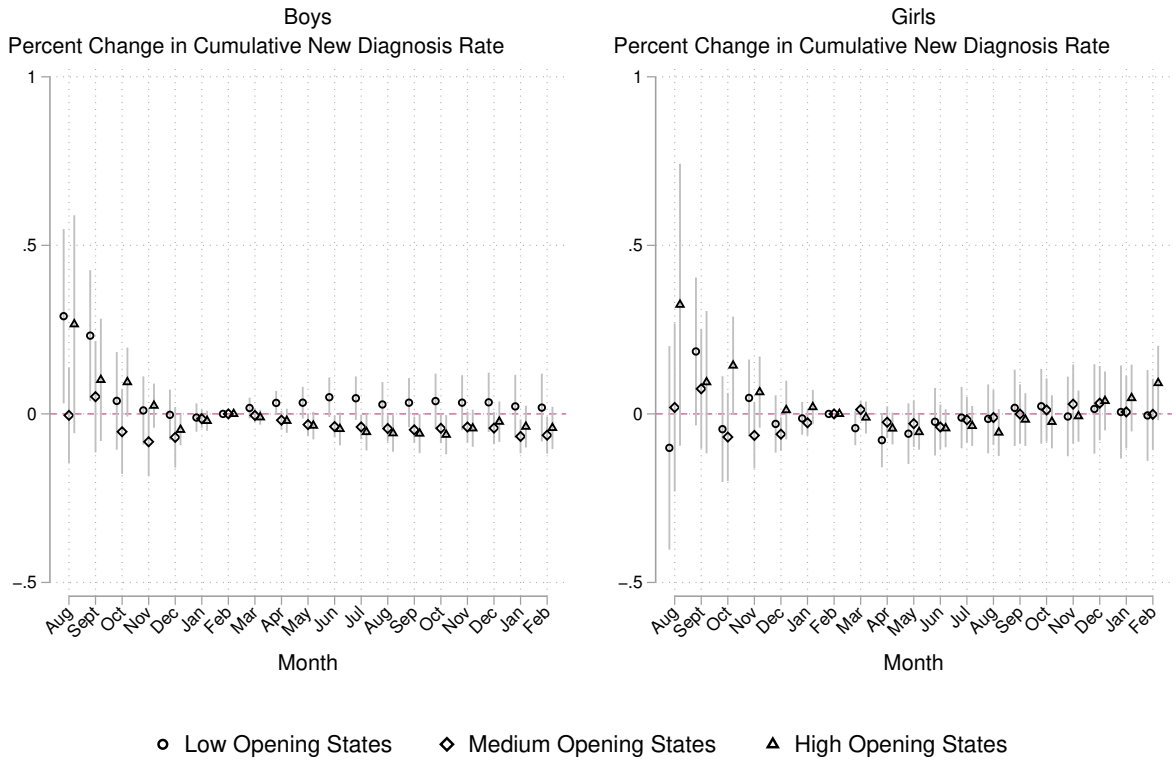
Note: Figure plots the fraction of elementary school aged children enrolled in an Optum covered plan in February of 2018 for the unexposed cohort and February of 2019 for the exposed cohort who remain enrolled in an Optum covered plan in each subsequent month through our study period.

Figure B2: Event Study Estimates for New Prescriptions, Nationwide (Optum)



Note: This figure presents percent changes derived from event study estimates of changes in cumulative new prescription rate between the exposed and unexposed cohort. Exposed cohort is children continuously enrolled between February 2019 and February 2021. Unexposed cohort is children continuously enrolled between February 2018 and February 2020. Sample includes children without an ADHD prescription during the six-month lookback period (February 2019-July 2019 and February 2018-July 2018 for the exposed and unexposed cohorts, respectively). February 2019/2020 is the reference period for the unexposed/exposed cohorts. Plotted percent changes are the exponentiated event study coefficients minus one. 95% confidence intervals are derived using the delta method. Standard errors are clustered at the state by cohort level.

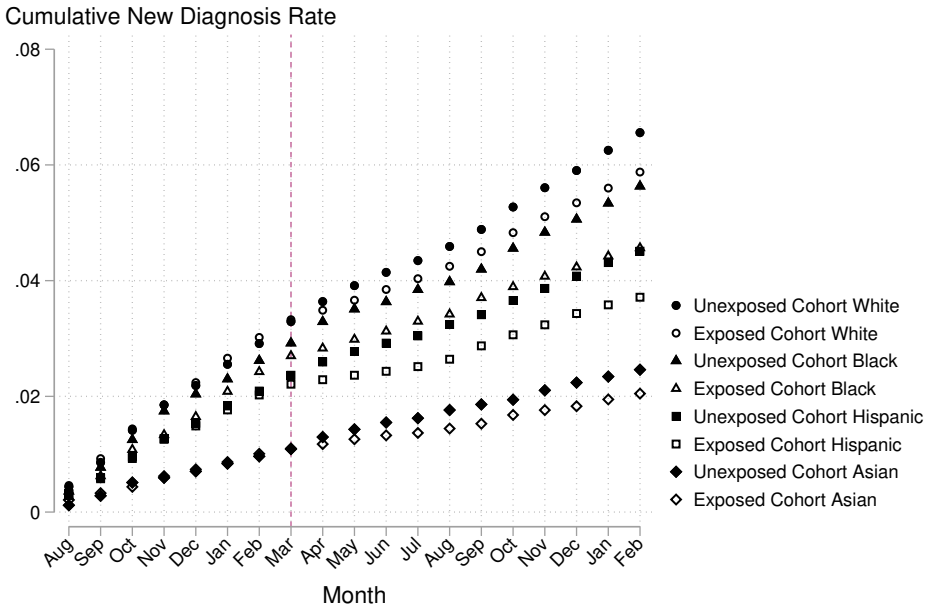
Figure B3: Event Study Estimates by State School Opening Level for New Prescriptions, Nationwide (Optum)



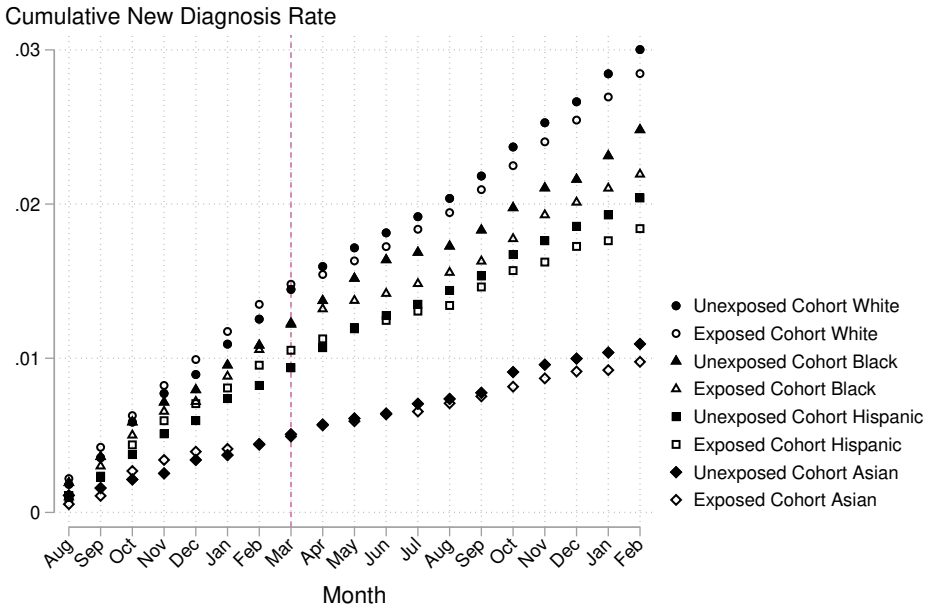
Note: This figure presents percent changes derived from event study estimates of changes in cumulative new prescription rate between the exposed and unexposed cohort, interacted with state school opening level. Exposed cohort is children continuously enrolled between February 2019 and February 2021. Unexposed cohort is children continuously enrolled between February 2018 and February 2020. Sample includes children without an ADHD prescription during the six-month lookback period (February 2019-July 2019 and February 2018-July 2018 for the exposed and unexposed cohorts, respectively). February 2019/2020 is the reference period for the unexposed/exposed cohorts. Plotted percent changes are the exponentiated event study coefficients for each state school opening group minus one. 95% confidence intervals are derived using the delta method. Standard errors are clustered at the state by cohort level.

Figure B4: Cumulative New Diagnoses by Cohort and Race

(a) Boys



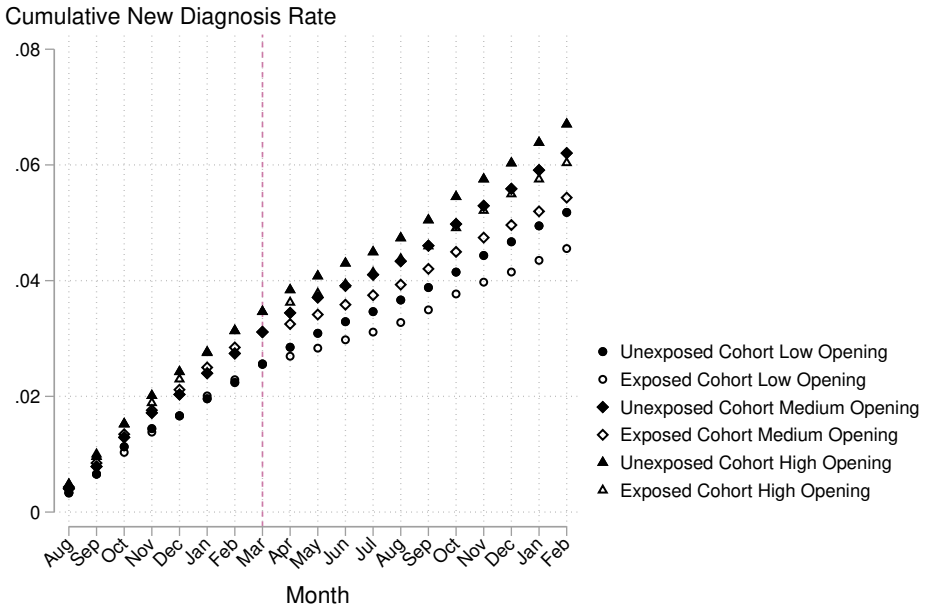
(b) Girls



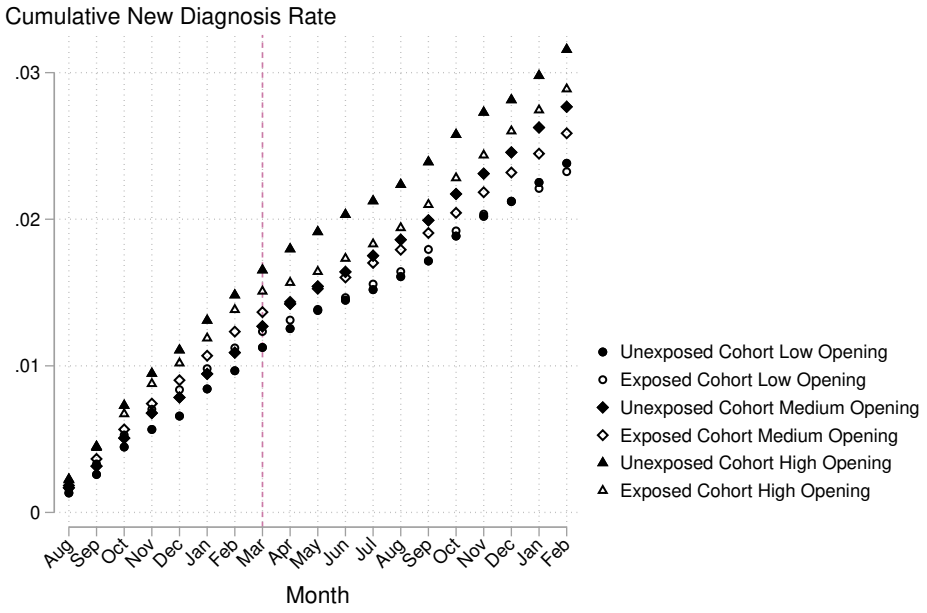
Note: Exposed cohort is children continuously enrolled between February 2019 and February 2021. Unexposed cohort is children continuously enrolled between February 2018 and February 2020. Sample includes children without an ADHD diagnosis during the six-month lookback period (February 2019-July 2019 and February 2018-July 2018 for the exposed and unexposed cohorts, respectively).

Figure B5: Cumulative New Diagnoses by Cohort and State School Opening Level

(a) Boys



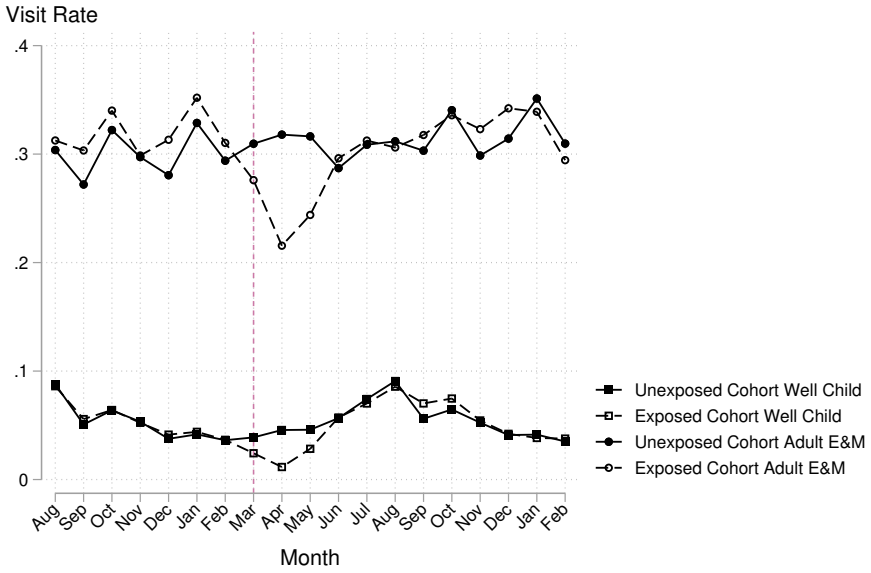
(b) Girls



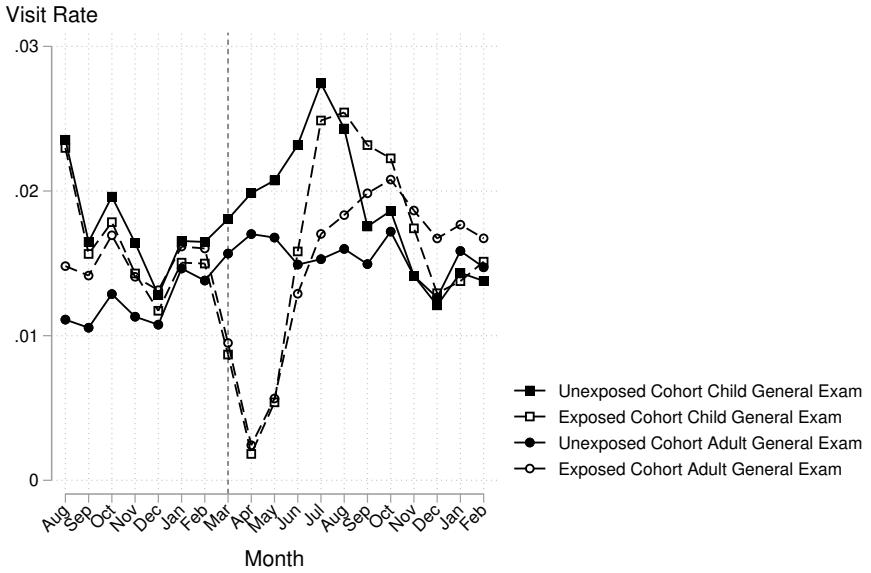
Note: Exposed cohort is children continuously enrolled between February 2019 and February 2021. Unexposed cohort is children continuously enrolled between February 2018 and February 2020. Sample includes children without an ADHD diagnosis during the six-month lookback period (February 2019-July 2019 and February 2018-July 2018 for the exposed and unexposed cohorts, respectively).

Figure B6: General Healthcare Utilization

(a) Nationwide (Optum)

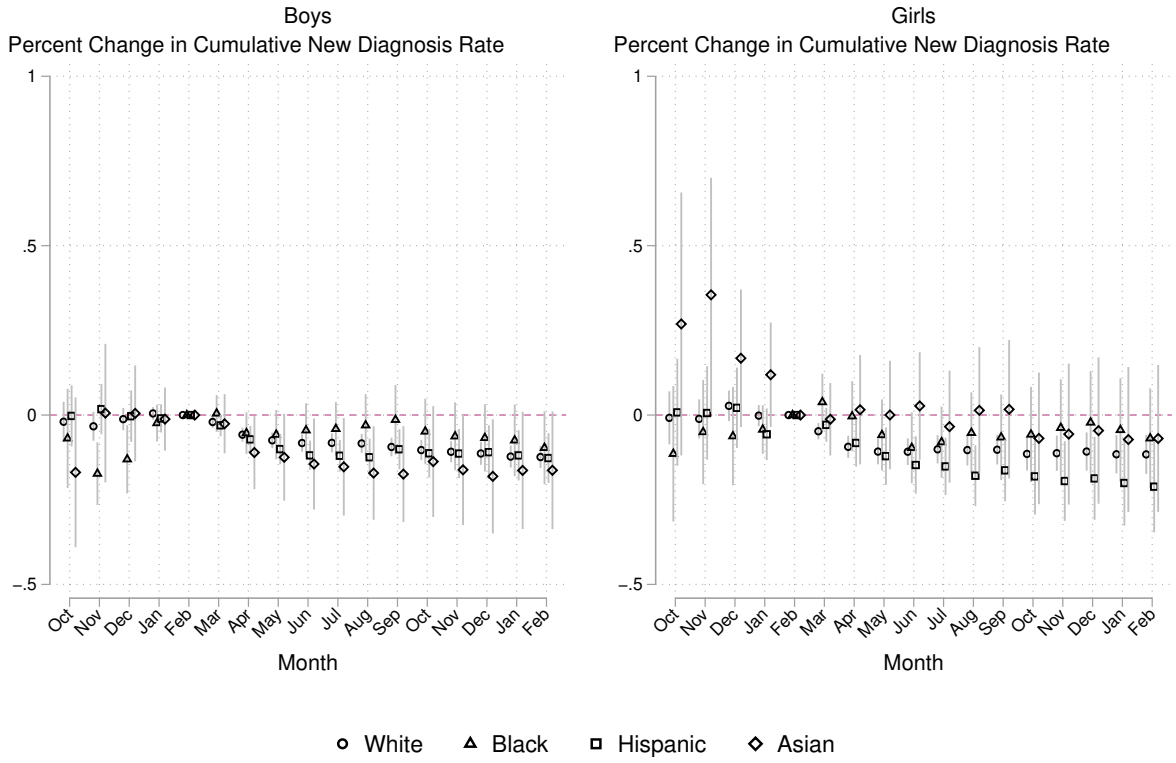


(b) Indiana (INPC)



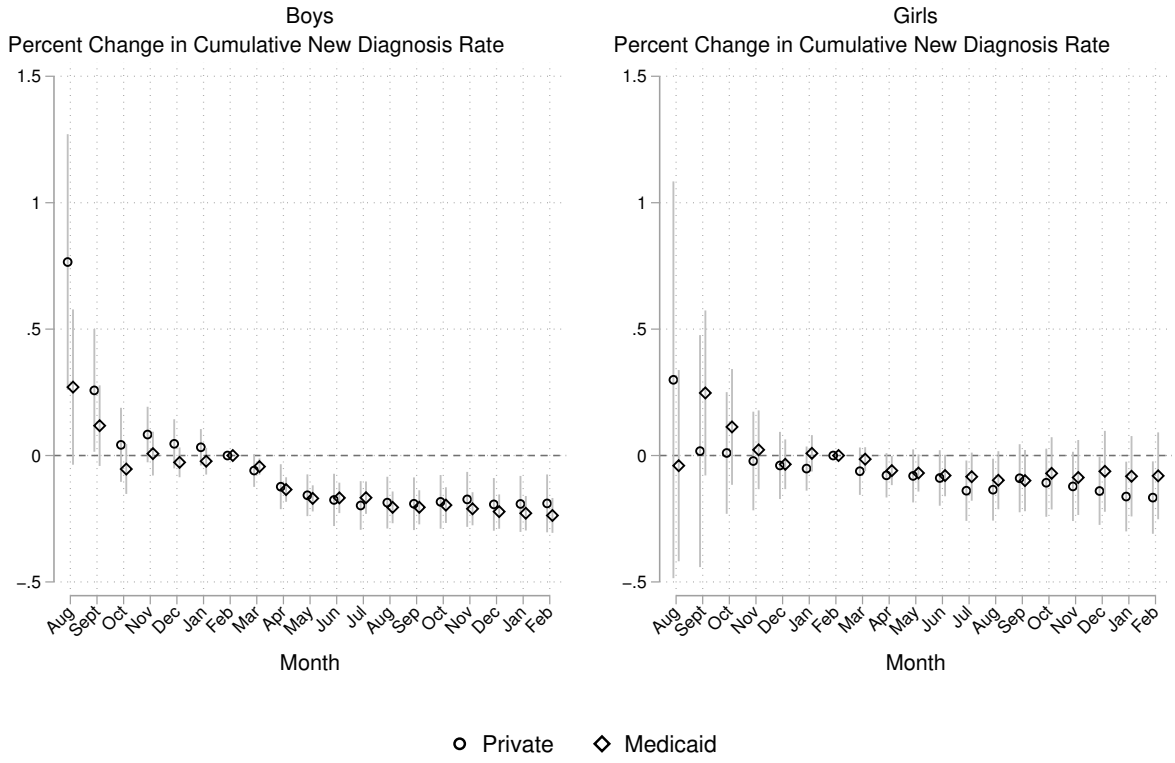
Note: In Panel A, exposed cohort is continuously enrolled between February 2019 and February 2021. Unexposed cohort is continuously enrolled between February 2018 and February 2020. Well Child visits and Adult E&M visits are identified using CPT codes. In Panel B, exposed cohort is patients with at least one INPC encounter between February 2019 and July 2019. Unexposed cohort is patients with at least one INPC encounter between February 2018 and July 2018. General Exams are determined by ICD-10 Z codes associated with visits in INPC database.

Figure B7: Event Study Estimates by Race and Ethnicity



Note: This figure presents percent changes derived from event study estimates of changes in cumulative new diagnosis rate between the exposed and unexposed cohort, interacted with race and ethnicity indicators. Exposed cohort is children continuously enrolled between February 2019 and February 2021. Unexposed cohort is children continuously enrolled between February 2018 and February 2020. Sample includes children without an ADHD diagnosis during the six-month lookback period (February 2019-July 2019 and February 2018-July 2018 for the exposed and unexposed cohorts, respectively). February 2019/2020 is the reference period for the unexposed/exposed cohorts. Plotted percent changes are the exponentiated event study coefficients for each race/ethnicity group minus one. 95% confidence intervals are derived using the delta method. Standard errors are clustered at the state by cohort level.

Figure B8: Event Study Estimates by Payer, Indiana (INPC)



Note: This figure presents percent changes derived from event study estimates of changes in cumulative new diagnosis rate between the exposed and unexposed cohort, interacted with payer. Exposed cohort is children with at least one INPC encounter between February 2019 and July 2019. Exposed cohort is children with at least one INPC encounter between February 2018 and July 2018. Sample includes children without an ADHD diagnosis during the six-month lookback period (February 2019-July 2019 and February 2018-July 2018 for the exposed and unexposed cohorts, respectively). February 2019/2020 is the reference period for the unexposed/exposed cohorts. Plotted percent changes are the exponentiated event study coefficients minus one. 95% confidence intervals are derived using the delta method. Standard errors are clustered at the county by cohort level.

Table B1: Unexposed and Exposed Cohort Demographic Comparisons

	Unexposed	**Exposed**	**Difference**
Expected Grade	2.563	2.574	0.01110**
Female	0.495	0.495	-0.00027
White	0.717	0.718	0.00113
Black	0.071	0.071	-0.00020
Asian	0.079	0.079	0.00014
Hispanic	0.133	0.132	-0.00107
HH Income $\leq$ 74K	0.264	0.266	0.00197

Note: This table presents observable demographic means for the unexposed and exposed cohorts, conditional on having no ADHD diagnosis in the respective look-back periods. The third column corresponds to the difference in means across each cohort. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B2: Difference in Differences Estimates of New Prescriptions by State School Opening Level, Nationwide (Optum)

(a) Fixed Effect Poisson Coefficient Estimates

	(1) boys	(2) boys	(3) girls	(4) girls
Pandemic	-0.0220	0.00581	-0.00324	-0.0108
	(0.0204)	(0.0362)	(0.0329)	(0.0620)
Pandemic X Medium Opening		-0.0183		0.0397
		(0.0483)		(0.0842)
Pandemic X High Opening		-0.0633		-0.0374
		(0.0468)		(0.0729)
Observations	42370	42370	41819	41819

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < .01$

(b) Overall Percent Changes

	(1) boys	(2) boys	(3) girls	(4) girls
Pandemic	-0.0218		-0.00323	
	(0.0199)		(0.0328)	
LowOpening		0.00583		-0.0108
		(0.0364)		(0.0613)
MediumOpening		-0.0124		0.0293
		(0.0328)		(0.0600)
HighOpening		-0.0559*		-0.0471
		(0.0293)		(0.0383)
Observations	42370	42370	41819	41819

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < .01$

Note: This table presents difference in difference estimates by state school opening levels. Panel A presents Poisson regression coefficients. Panel B presents the percent change for each group by exponentiating the appropriate sum of coefficients and subtracting one. 95% confidence intervals are derived using the delta method. Standard errors are clustered at the state by cohort level.

Table B3: Difference in Differences Estimates by Grade, Nationwide (Optum)

(a) Fixed Effect Poisson Coefficient Estimates

	(1) K	(2) 1	(3) 2	(4) 3	(5) 4	(6) 5
Boys	-0.213**	-0.0920**	-0.0942**	-0.0901**	-0.0449	-0.102***
	(0.0842)	(0.0405)	(0.0367)	(0.0371)	(0.0343)	(0.0375)
Observations	6726	6745	6802	7163	7125	6992
Girls	-0.0927	-0.129*	-0.0338	-0.192***	-0.0615	-0.128***
	(0.114)	(0.0752)	(0.0583)	(0.0611)	(0.0481)	(0.0481)
Observations	6517	6821	6650	6612	6859	6840

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < .01$

(b) Overall Percent Changes

	(1) K	(2) 1	(3) 2	(4) 3	(5) 4	(6) 5
Boys	-0.192***	-0.0879**	-0.0899***	-0.0862**	-0.0439	-0.0970***
	(0.0680)	(0.0369)	(0.0334)	(0.0339)	(0.0328)	(0.0339)
Observations	6726	6745	6802	7163	7125	6992
Girls	-0.0886	-0.121*	-0.0333	-0.175***	-0.0596	-0.120***
	(0.104)	(0.0661)	(0.0563)	(0.0504)	(0.0452)	(0.0423)
Observations	6517	6821	6650	6612	6859	6840

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < .01$

Note: This table presents difference in difference estimates by expected grade. Panel A presents Poisson regression coefficients. Panel B presents the percent change for each group by exponentiating the appropriate sum of coefficients and subtracting one. 95% confidence intervals are derived using the delta method. Standard errors are clustered at the state by cohort level.

Table B4: State Stability and Openness Group Tabulation

		Stability		
		Low	Medium	High
Openness	Low	6	2	9
	Medium	4	7	6
	High	7	8	2

Note: This table presents the cross-tabulation of State Openness Group and State Stability Group. Cells represent the number of states belonging to each Open-Stability pair. For example, there are 9 states with both Low Openness and High Stability during the Fall 2020 semester. See Section IV for details on how Openness and Stability groupings are determined.

Table B5: Difference in Differences Estimates by Payer, Indiana (INPC)

(a) Fixed Effect Poisson Coefficient Estimates

	(1) boys	(2) girls
Pandemic	-0.258***	-0.118
	(0.0748)	(0.0839)
Pandemic X Medicaid	0.0475	0.0135
	(0.0756)	(0.128)
Observations	30495	25859

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < .01$

(b) Overall Percent Changes

	(1) boys	(2) girls
Private	-0.228***	-0.111
	(0.0578)	(0.0745)
Medicaid	-0.190***	-0.0994
	(0.0345)	(0.0718)
Observations	30495	25859

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < .01$

Note: This table presents difference in difference estimates by payer. Panel A presents Poisson regression coefficients. Panel B presents the percent change for each group by exponentiating the appropriate sum of coefficients and subtracting one. 95% confidence intervals are derived using the delta method. Standard errors are clustered at the state by cohort level.

Table B6: Difference in Differences Estimates by Grade, Indiana (INPC)

(a) Fixed Effect Poisson Coefficient Estimates

	(1) K	(2) 1	(3) 2	(4) 3	(5) 4	(6) 5
Boys	-0.161	-0.129	-0.254***	-0.296***	-0.173**	-0.192**
	(0.102)	(0.136)	(0.0740)	(0.0684)	(0.0724)	(0.0928)
Observations	1672	1786	1672	1824	1710	1881
Girls	-0.140	0.0236	-0.149	-0.128	0.0977	-0.151
	(0.155)	(0.106)	(0.128)	(0.155)	(0.0963)	(0.110)
Observations	1121	1292	1463	1292	1558	1330

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < .01$

(b) Overall Percent Changes

	(1) K	(2) 1	(3) 2	(4) 3	(5) 4	(6) 5
Boys	-0.149*	-0.121	-0.224***	-0.256***	-0.159***	-0.175**
	(0.0868)	(0.120)	(0.0574)	(0.0509)	(0.0609)	(0.0766)
Observations	1672	1786	1672	1824	1710	1881
Girls	-0.131	0.0239	-0.139	-0.121	0.103	-0.140
	(0.135)	(0.108)	(0.111)	(0.137)	(0.106)	(0.0947)
Observations	1121	1292	1463	1292	1558	1330

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < .01$

Note: This table presents difference in difference estimates by expected grade. Panel A presents Poisson regression coefficients. Panel B presents the percent change for each group by exponentiating the appropriate sum of coefficients and subtracting one. 95% confidence intervals are derived using the delta method. Standard errors are clustered at the state by cohort level.

Table B7: Difference in Differences Estimates by Type of New ADHD Diagnosis, Nationwide (Optum) Boys

(a) Fixed Effect Poisson Coefficient Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
	Inatentive		Any Hyperactive		Other	
Pandemic	-0.0884**	0.0254	-0.0819***	-0.0925*	-0.107***	-0.0681
	(0.0410)	(0.0630)	(0.0222)	(0.0483)	(0.0378)	(0.0591)
Pandemic X Medium Opening		-0.185**		0.00250		-0.0779
		(0.0803)		(0.0553)		(0.0847)
Pandemic X High Opening		-0.0827		0.0306		0.00287
		(0.103)		(0.0588)		(0.0858)
Observations	41781	41781	42674	42674	42066	42066

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < .01$

(b) Overall Percent Changes

	(1)	(2)	(3)	(4)	(5)	(6)
	Inatentive		Any Hyperactive		Other	
Pandemic	-0.0846**		-0.0786***		-0.101***	
	(0.0375)		(0.0205)		(0.0339)	
LowOpening		0.0257		-0.0884**		-0.0658
		(0.0646)		(0.0440)		(0.0552)
MediumOpening		-0.148***		-0.0861***		-0.136***
		(0.0457)		(0.0275)		(0.0515)
HighOpening		-0.0557		-0.0600*		-0.0632
		(0.0793)		(0.0327)		(0.0579)
Observations	41781	41781	42674	42674	42066	42066

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < .01$

Note: This table presents difference in difference estimates by state school opening levels. Panel A presents Poisson regression coefficients. Panel B presents the percent change for each group by exponentiating the appropriate sum of coefficients and subtracting one. 95% confidence intervals are derived using the delta method. Standard errors are clustered at the state by cohort level.

Table B8: Difference in Differences Estimates by Type of New ADHD Diagnosis, Nationwide (Optum) Girls

(a) Fixed Effect Poisson Coefficient Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
	Inatentive		Any Hyperactive		Other	
Pandemic	-0.181***	-0.153	-0.0706*	-0.147**	-0.129**	-0.173**
	(0.0473)	(0.0957)	(0.0383)	(0.0590)	(0.0592)	(0.0826)
Pandemic X Medium Opening		-0.0365		0.0256		0.0326
		(0.110)		(0.0808)		(0.135)
Pandemic X High Opening		-0.0348		0.213***		0.103
		(0.139)		(0.0807)		(0.124)
Observations	40546	40546	40983	40983	41819	41819

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < .01$

(b) Overall Percent Changes

	(1)	(2)	(3)	(4)	(5)	(6)
	Inatentive		Any Hyperactive		Other	
Pandemic	-0.166***		-0.0681*		-0.121**	
	(0.0394)		(0.0356)		(0.0520)	
LowOpening		-0.142*		-0.137***		-0.159**
		(0.0821)		(0.0510)		(0.0695)
MediumOpening		-0.172***		-0.114**		-0.131
		(0.0495)		(0.0515)		(0.0893)
HighOpening		-0.171**		0.0683		-0.0673
		(0.0834)		(0.0642)		(0.0865)
Observations	40546	40546	40983	40983	41819	41819

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < .01$

Note: This table presents difference in difference estimates by state school opening levels. Panel A presents Poisson regression coefficients. Panel B presents the percent change for each group by exponentiating the appropriate sum of coefficients and subtracting one. 95% confidence intervals are derived using the delta method. Standard errors are clustered at the state by cohort level.

Table B9: Difference in Differences Estimates by Type of New ADHD Diagnosis, Indiana (INPC) Boys

(a) Fixed Effect Poisson Coefficient Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
	Inattentive		Any Hyperactive		Other	
Pandemic	-0.196*	-0.104	-0.185***	-0.277***	-0.213***	-0.254***
	(0.115)	(0.124)	(0.0574)	(0.0248)	(0.0551)	(0.0350)
Pandemic X Medium Opening		0.0484		0.180*		0.105
		(0.177)		(0.0937)		(0.0985)
Pandemic X High Opening		-0.447*		0.108		0.0820
		(0.249)		(0.0965)		(0.151)
Observations	5928	5928	11780	11780	15238	15048

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < .01$

(b) Overall Percent Changes

	(1)	(2)	(3)	(4)	(5)	(6)
	Inattentive		Any Hyperactive		Other	
Pandemic	-0.178*		-0.169***		-0.192***	
	(0.0948)		(0.0477)		(0.0445)	
LowOpening		-0.0989		-0.242***		-0.224***
		(0.112)		(0.0188)		(0.0272)
MediumOpening		-0.0542		-0.0924		-0.138*
		(0.126)		(0.0848)		(0.0789)
HighOpening		-0.424***		-0.155**		-0.158
		(0.125)		(0.0754)		(0.122)
Observations	5928	5928	11780	11780	15238	15048

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < .01$

Note: This table presents difference in difference estimates by county school opening levels. Panel A presents Poisson regression coefficients. Panel B presents the percent change for each group by exponentiating the appropriate sum of coefficients and subtracting one. 95% confidence intervals are derived using the delta method. Standard errors are clustered at the county by cohort level.

Table B10: Difference in Differences Estimates by Type of New ADHD Diagnosis, Indiana (INPC) Girls

(a) Fixed Effect Poisson Coefficient Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
	Inattentive		Any Hyperactive		Other	
Pandemic	0.259*	0.284**	-0.141*	-0.243***	-0.144	-0.160
	(0.143)	(0.110)	(0.0722)	(0.0567)	(0.104)	(0.172)
Pandemic X Medium Opening		0.718***		0.167		0.104
		(0.224)		(0.131)		(0.252)
Pandemic X High Opening		-0.291		0.161		-0.100
		(0.215)		(0.145)		(0.270)
Observations	6840	6840	9519	9519	11951	11818

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < .01$

(b) Overall Percent Changes

	(1)	(2)	(3)	(4)	(5)	(6)
	Inattentive		Any Hyperactive		Other	
Pandemic	0.296		-0.131**		-0.134	
	(0.186)		(0.0627)		(0.0898)	
LowOpening		0.328**		-0.216***		-0.148
		(0.147)		(0.0444)		(0.146)
MediumOpening		1.722***		-0.0740		-0.0543
		(0.532)		(0.115)		(0.172)
HighOpening		-0.00709		-0.0796		-0.229
		(0.208)		(0.117)		(0.164)
Observations	6840	6840	9519	9519	11951	11818

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < .01$

Note: This table presents difference in difference estimates by county school opening levels. Panel A presents Poisson regression coefficients. Panel B presents the percent change for each group by exponentiating the appropriate sum of coefficients and subtracting one. 95% confidence intervals are derived using the delta method. Standard errors are clustered at the county by cohort level.