

Impacts of Teaching Modality on U.S. COVID-19 Spread in Fall 2020 Semester

Syed Badruddoza and Modhurima Dey Amin*

Table 1. Average treatment effects on COVID-19 cases
Dependent variable: % change in cases compared to cases in two weeks before reopening date

Model	Y variable	0-15 Days	15-30 Days	30-45 Days	45-60 Days
OLS	1. In-person=1 online=0	36.858*** (13.083)	37.161* (19.142)	56.757** (28.883)	24.678 (36.541)
	2. In-person=1 hybrid=0	23.91* (12.831)	16.166 (21.865)	31.045 (27.445)	9.016 (32.789)
	3. Hybrid=1 online=0	3.926 (9.359)	8.976 (13.767)	12.243 (13.597)	15.946 (27.215)
Propensity score matching	1. In-person=1 online=0	33.354*** (11.762)	24.244 (18.444)	43.527 (29.46)	-9.35 (60.772)
	2. In-person=1 hybrid=0	27.735* (15.514)	19.49 (21.877)	28.16 (31.549)	5.321 (41.575)
	3. Hybrid=1 online=0	10.449 (12.253)	17.531 (19.448)	19.615 (18.689)	32.863 (32.435)
Nearest neighbor	1. In-person=1 online=0	29.279** (12.003)	23.173* (13.156)	43.4* (22.465)	57.066* (31.346)
	2. In-person=1 hybrid=0	22.998* (12.23)	19.07 (20.26)	40.196 (30.132)	22.824 (40.986)
	3. Hybrid=1 online=0	4.228 (11.026)	7.968 (13.628)	7.408 (12.638)	12.306 (22.407)
Multivariate distance	1. In-person=1 online=0	35.804*** (10.484)	46.616*** (14.468)	76.103*** (26.419)	80.343** (35.549)
	2. In-person=1 hybrid=0	22.926* (12.259)	15.932 (21.189)	44.634 (29.102)	36.798 (38.67)
	3. Hybrid=1 online=0	11.984 (9.822)	26.817* (15.896)	25.913* (14.336)	36.217 (25.807)

Note: 1,076 colleges. Robust standard errors in parentheses. ***p <.01, ** p<.05, * p<0.1.

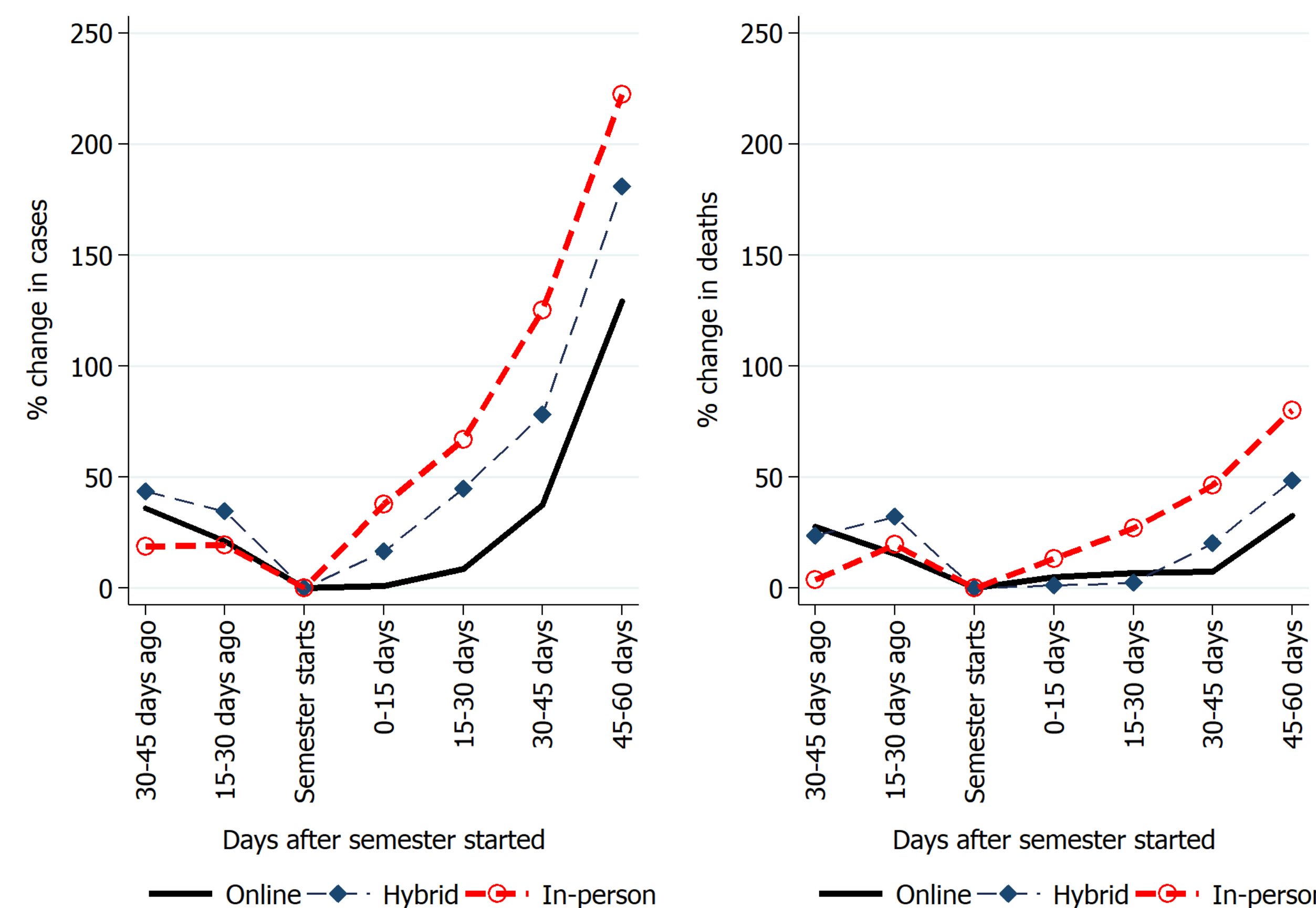
Table 2. Average treatment effects on COVID-19 deaths
Dependent variable: % change in deaths compared to deaths in two weeks before reopening date

Model	Y variable	0-15 Days	15-30 Days	30-45 Days	45-60 Days
OLS	1. In-person=1 online=0	3.975 (11.306)	11.827 (14.333)	21.892 (15.466)	23.073 (23.729)
	2. In-person=1 hybrid=0	21.275** (10.503)	21.38 (14.31)	18.535 (14.962)	33.799 (21.19)
	3. Hybrid=1 online=0	-6.581 (8.087)	-.669 (10.439)	6.383 (11.451)	-9.539 (14.376)
Propensity score matching	1. In-person=1 online=0	7.145 (10.605)	17.779 (14.319)	22.205 (16.189)	20.743 (22.832)
	2. In-person=1 hybrid=0	24.792* (13.829)	6.472 (17.36)	17.24 (16.556)	24.224 (22.72)
	3. Hybrid=1 online=0	-9.36 (8.408)	-2.508 (10.887)	2.843 (12.536)	-12.06 (16.792)
Nearest neighbor	1. In-person=1 online=0	12.327 (10.021)	8.927 (12.061)	2.846 (14.09)	-2.206 (24.319)
	2. In-person=1 hybrid=0	13.62 (11.963)	2.361 (18.819)	12.037 (15.225)	22.998 (18.622)
	3. Hybrid=1 online=0	-8.46 (8.354)	2.521 (12.537)	-2.041 (11.866)	-10.883 (14.9)
Multivariate distance	1. In-person=1 online=0	15.253* (9.05)	26.339** (11.318)	33.944*** (12.922)	38.431* (21.175)
	2. In-person=1 hybrid=0	15.947 (10.184)	18.682 (14.156)	19.245 (14.125)	35.242* (19.719)
	3. Hybrid=1 online=0	.618 (7.834)	7.894 (10.975)	15.029 (11.398)	1.367 (15.997)

Note: 1,076 colleges. Robust standard errors in parentheses. ***p <.01, ** p<.05, * p<0.1.

* Syed Badruddoza and Modhurima Dey Amin are faculty at the Department of Agricultural and Applied Economics at Texas Tech University.
* Correspondence may be sent to Syed.Badruddoza@ttu.edu

Figure 1. Mean COVID-19 cases and deaths by teaching modalities



What?

We study the impact of college reopening and teaching modalities in Fall 2020 on county-level COVID-19 cases and deaths using the information of 1,076 U.S. colleges.

Why?

- College students mainly fall in the age cohort of 18 to 29 years, which has a lower death rate from COVID-19, but a greater chance of socialization than the older age cohorts.
- COVID-19 may spread from college campuses to the community. Colleges need insights into choosing a teaching modality to combat a future disease-induced crisis.
- Do full or partial remote instructional methods help mitigate the spread? If so, by how much?

How?

- Key variables were manually obtained from college websites in Fall 2020. Major other variables are from U.S. Census, National Center for Education Statistics, New York Times, and Health.gov.
- A source of identification is different colleges reopened on different dates between July and October.
- We match college and county characteristics using several methods (see Tables 1 and 2) and calculate the average treatment effects of three teaching modalities: in-person, online, and hybrid on COVID-19 outcomes up to two months after college reopening in separate cross-sections.
- We break the analysis into 15-day intervals to address the problems regarding incubation period and threshold selection, and take the % difference of COVID-19 outcomes from 0-15 days before the reopening date to remove the effect of large initial values.

What did we find?

- In pairwise comparison, colleges reopened with in-person teaching mode were found to have about 36% point more cases within 15 days of reopening, compared to those reopened online, and the gap widens over time at a decreasing rate.
- Death rates follow the pattern with a time lag.
- Cases rose after reopening regardless of teaching modality.
- However, colleges with hybrid mode catch the pattern of in-person mode after some time.
- Using logistic regressions (Table 3) we also find that greater endowment and student population, and fewer republican votes in the county are major predictors of choosing remote teaching modes over in-person.

So what? Who cares?

- Colleges with small endowments need special policy attention to combat a disease-induced crisis.
- The risk of spreading a communicable disease can be partially mitigated with an initiative from the colleges by increasing distance education elements in classes.
- Political affiliation might play a role in the containment of COVID-19 or any other rapidly communicable diseases.

Table 3. Predictors of teaching modality
Logistic regression results

Variables	In-person=1 online=0	Hybrid=1 online=0	In-person=1 hybrid=0
% stayed home	-0.0405 (0.0383)	-0.0589 (0.0381)	0.0225 (0.0329)
Log enrollment	-0.409*** (0.149)	-0.0650 (0.155)	-0.314** (0.137)
Log cost of attendance	0.451 (0.571)	0.336 (0.551)	0.0146 (0.559)
Log endowment per student	-0.280*** (0.107)	-0.263** (0.117)	-0.0662 (0.0902)
Log student-faculty ratio	-0.459 (0.335)	-0.874** (0.396)	0.318 (0.323)
Public=1, 0 otherwise	-1.079* (0.556)	-0.856 (0.541)	-0.386 (0.535)
Log total population	-0.498*** (0.188)	-0.410** (0.188)	-0.0859 (0.167)
Black population (%)	0.00756 (0.0111)	-0.00238 (0.0105)	0.0197* (0.0115)
Log household income	0.290 (0.563)	0.247 (0.540)	0.215 (0.572)
Republican votes (%)	0.0502*** (0.0131)	0.0158 (0.0124)	0.0323*** (0.0119)
Mask ordinance=1, 0 otherwise	-0.690** (0.315)	-0.368 (0.341)	-0.456* (0.260)
Log cases in Spring 2020	0.331* (0.181)	0.301 (0.194)	0.0271 (0.154)
Log deaths in Spring 2020	-0.171 (0.149)	-0.112 (0.155)	-0.0819 (0.122)
Temperature in reopening month	-0.0253 (0.0250)	-0.00453 (0.0217)	-0.0286 (0.0230)
Constant	5.165 (8.633)	4.480 (8.786)	1.073 (8.108)
Observations (colleges)	532	456	538

Figure 2. Matching of major variables

