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Joining the herd? U.S. public opinion and vaccination requirements across educational settings during the COVID-19 pandemic

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ABSTRACT

With effective and safe COVID-19 vaccines beginning to be distributed across the United States, questions about who should receive the vaccine first have been the focus of public discussions. Yet, over the long-term, questions about the order of distribution will be displaced by questions about how to achieve high levels of vaccination rates. Historically, absent incentives or mandates, Americans have shown ambivalence, if not general antipathy, towards vaccinations, and vaccination rates have generally been low for many vaccines. There is evidence that vaccination requirements across educational settings are an effective policy instrument to increase vaccination rates. We administered a large national survey to assess American's attitudes towards vaccination requirements across three educational settings (daycare, K-12 schools, and universities) in general and for COVID-19 specifically. Partisanship, gender, race, rurality, and perceptions about the appropriate role schools should play in providing health services are substantive predictors of public opinion. While Americans generally support vaccination mandates across all three settings for both types of requirements, support is consistently and significantly lower for COVID19 requirements. The effect of partisanship is accentuated for COVID-19 requirements as compared to general requirements. Drop off in support between general and COVID-19 specific requirements are driven by partisanship, gender, political knowledge, rurality, and having children in the household. Nonetheless, mandates are supported by a majority of Americans. Assessing Americans' opinions of vaccination requirements in educational settings offers an important opportunity to explore the potential of mandates as policy instrument in the government's arsenal against COVID-19 and guide public policy on the issues.

1. Introduction

The coronavirus pandemic has created unprecedented turmoil and thrust previously almost unimaginable challenges upon the world. In the United States, a nation particularly affected, a recent survey indicated that only 1 in 10 Americans saw their personal lives as largely untouched [1]. As a growing body of research vividly shows, the pandemic and the ensuing lockdowns have indeed worsened existing social and health challenges, laid bare existing systemic inequalities, and cruelly emphasized the pivotal role social determinants of health play in the United States [2].

Yet the apparent development of a number of effective and safe vaccines offers a viable pathway out of the current quagmire, at least in the long-term. While vaccine shortages and vaccine hesitancy will ensure that the pandemic will be with us for months if not years to come [3], policymakers have no time to waste in exploring policy instruments at their disposal to increase vaccine take-up in the future. One of these potentially useful policy instruments are vaccination requirements, also known as mandates, in educational settings [4–6]. These mandates have a long history in the United States and have been used to reign in diseases from smallpox to measles [7]. However, states differ widely in the stringency of these mandates as well as in their enforcement, and they have certainly not been without controversy among the general population [8]. However, vaccination mandates have a proven track-record of increasing vaccination rates [8,9]. What we know little about, however, is how Americans feel about them in general, and even less so as they relate to COVID-19.

The analysis presented here offers one of the first comprehensive assessment of Americans' perception of vaccination mandates in daycare, K-12 schools, and colleges and university settings. Specifically, based on a large national survey, we assessed whether Americans' support differed for generalized as compared to COVID-19-specific mandates as well as for mandates focused on students as compared to those for teachers and staff.

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We also explored how individual characteristics of respondents were correlated with support for various mandates. Importantly, given its outsized role during the U.S. pandemic response [10,11], we particularly focused on the role of partisanship and its effect on public opinion.

We begin our assessment of vaccination requirements by briefly providing background on the emergence and evolution of vaccination mandates in the United States, scholarly assessments of their effectiveness, and their potential role in ending or alleviating the current pandemic. After describing the data and methods, we then present results for a number of models analyzing American public opinion on the issue. We conclude by highlighting the broader policy implications of our analysis.

1.1. Background on education and vaccinations

Grounded in the police power of the states, requirements to vaccinate children as a prerequisite for school attendance first emerged in the early 1800s when Massachusetts mandated small pox vaccination [4,5]. With the approval of the courts [4], mandates slowly expanded over time, albeit slowly and unevenly. A major driver of expansions occurred after two states, Alaska and California, employed strong vaccination mandates and consistent enforcement to reign in measles outbreaks in the 1970s [12]. Today, requirements differ widely by state and vaccine [8]. They have also expanded to daycare centers [13] as well as colleges and universities [6]. Yet despite their ascertained constitutionality and widespread adoption, mandates have long elicited vocal opposition from some Americans [4,7,14]. Policymakers have been responsive to these concerns by generally including religious and, in some cases, broad philosophical exemptions [15].

While most mandates and public attention have focused on the K-12 educational setting and, to a somewhat lesser degree, daycare, due to the nature of the population, as well as the types and frequency of interactions, colleges and universities are particularly challenged by infectious diseases [6,16,17]. Recent mumps outbreaks serve as an illustration of these challenges [18]. However, colleges and universities have generally paid little attention to this issue, and significant variation across the nation's campuses with regard to the establishment and enforcement of vaccination mandates have done little to improve the already low vaccination rates among college students, further exacerbating the potential for outbreaks [8,17,19].

Vaccination mandates, while most prominently focused on students, have also been used in some work settings. However, our knowledge about vaccination requirements in the workplace is more limited. Most studies have focused on experiences in the healthcare sector and generally show low vaccination rates [20,21]. Despite the apparent threat to operations, finances, and patients, healthcare providers have generally failed to impose strict mandates on their employees [21]. Tellingly, studies indicate similar hesitancy towards vaccination among the 7 million employees at the nation's 130,000 public schools [22].

The growth of vaccination mandates in schools and other settings has been supported by a growing body of research indicating their effectiveness as a policy instrument. Most of this work has focused on schools [5,8,12,23]. While the evidence is more limited for the childcare setting, studies seem to confirm findings from K-12 education: vaccination mandates appear to exert a substantial and positive effect on vaccination rates [5,12]. There is also some evidence that the benefits of school-based mandates extend to the larger community. Indeed, vaccination of school children has been shown to offer significant externalities in the form of lower numbers of community deaths [24], particularly among the elderly [25].

1.2. COVID-19 and vaccination mandates

While existing evidence indicates that, in general, children exhibit the lowest mortality and complication rates from COVID-19 infections [26], a significant and rapidly growing number of children have become infected by the coronavirus. By December, almost 1.6 million cases in children had been reported in the United States, and 154 children had died; more than 7,500 had been hospitalized [26]. To make things worse, pandemic-related lockdowns and long-distance learning have created significant amounts of hardships for students, parents, and teachers [27]. While little is known about COVID-19 outbreaks in daycare centers in the United States, more than 321,000 COVID-19 cases have been reported at the nation's college campuses [28]. In view of the large number of asymptomatic cases, these numbers are likely significant undercounts [29].

While immediate vaccine shortages have focused the public discussion on the appropriate preferences for allocation [3], long-term success in reigning in the pandemic requires the adoption of proven, evidence-based policy solutions to maximize vaccination rates. This particularly holds true given the aforementioned historical ambivalence, if not hesitancy, among Americans about vaccinations. Indeed, the partisan nature of Americans' perceptions of the pandemic [10,11] may well exacerbate existing trends towards increasing vaccination hesitancy [30,31]. Early signs have not been promising in this regard. While the public's willingness to become vaccinated appears to be increasing [32], without more authoritative policies the nation is unlikely to reach herd immunity levels any time soon.

Given what we know about their effectiveness, vaccination mandates may be a powerful policy instrument to improve vaccination rates once safe and effective vaccines become more widely available. Moreover, mandates may provide important externalities by improving vaccination rates among families with school children, or at least by offering additional protections from COVID-19 transmission between students and their families. These externalities may be particularly important in places like West Virginia where a large number of children living in kinship care arrangements, disproportionally with elderly relatives. However, likely for fear of electoral repercussions, a number of mayors and governors, both Republican and Democratic, have already indicated their unwillingness to mandate vaccinations in schools, and colleges and universities have been rather mute on the issue [33]. Assessing Americans' opinions on vaccination requirements in educational settings thus offers an important opportunity to explore the potential of mandates as policy instruments in the government's arsenal against COVID-19 and other pandemics that may follow.

2. Data and methods

2.1. Data

In order to assess how Americans feel about vaccination mandates across the aforementioned three educational settings, we developed an original survey that was administered through *Qualtrics*. Respondents were recruited from *Lucid*'s large, online, opt-in panel that provides incentives based on the amount of effort required and the population being sampled. Overall, 2,404 respondents completed the survey in late October and early November 2020 (a completion rate of 80%). Lucid has been shown to provide high-quality and valid samples for these types of analyses [34,35]. The approach is particularly valid for experiments and modeling relationships between variables, as we are doing here [34,35]. While the data are close to national benchmarks, we weighted them on reflect national population benchmarks on gender, race,

income, and education based on the U.S. Census 2017 Current Population Survey (see Appendix Table 1).

This study was determined to be exempt from human subjects review by the Pennsylvania State University Institutional Review Board.

2.2. Measures

2.2.1. Dependent variables

The main dependent variables for this analysis were derived from answers to a number of analogous questions about respondents' support for various vaccination mandates for students and teachers and staff. Importantly, we asked respondents about their opinion for three educational settings: (a) daycare, (b) K-12 schools, and (c) universities and colleges. Within each setting, we asked respondents whether students ought to be (1) "fully vaccinated in line with CDC guidelines to be allowed to attend school" and whether they ought to be (2) "vaccinated against COVID-19 to be allowed to attend class in-person" once "a safe and effective vaccine for COVID-19 becomes available." To better gauge the potential effect of COVID-19 on public opinion we also asked about a corresponding vaccination requirement for teachers and staff (3). Specifically, we asked "How about teachers and staff in [setting]? Should they be required to be vaccinated against COVID-19 to be allowed to attend class in-person?" In all cases, we provided respondents with a 5-point scale ("definitely not, "probably not," "might or might not," "probably yes," and "definitely yes"). In total, we thus obtained nine dependent variables: (1) support for general vaccination mandates for students in (a) daycare, (b) K-12 schools, and (c) colleges and universities, (2) support for COVID-19-related vaccination mandates for students in (a) daycare, (b) K-12 schools, and (c) colleges and universities, and (3) support for COVID-19-related vaccination mandates for teachers and staff in (a) daycare, (b) K-12 schools, and (c) colleges and universities. Finally, to analyze predictors of inconsistency between general and COVID-19-related mandates, we subtracted each respondents' response for general mandates in the three educational settings from their respective response for the corresponding COVID-19 mandates. Negative values indicate that the respondent is less favorable about a COVID-19 vaccination mandate as compared to the general mandate, while the opposite holds for positive values.

Fig. 1 displays the distribution of responses for our 9 main dependent variables. Several patterns stand out. First, outright opposition to any type of mandate is relatively limited, ranging from about 10 to 20 percent of respondents. Moreover, support ranges from more than 60 percent for general requirements to well over 50 percent for COVID-19 vaccinations. Third, opposition to vaccination requirements is consistently lower for general vaccination requirements as compared to any of the two COVID-19 related ones. The inverse holds for support. Finally, a sizable number of Americans, generally about 20 percent, fall into the middle category.

2.2.2. Independent variables

In our analysis of American public opinion on educational vaccination mandates, we rely on a wide range of explanatory measures. First, partisanship has been a crucial factor shaping the U. S. response to the pandemic as well as public perceptions of it [10,11,32]. We thus collected information about respondents' partisanship using Lucid's 10-point scale (4 levels of partisanship for Democrats (Strong Democrat, Not very strong Democrat, Independent Democrat, Other - leaning Democrat) or Republicans (Strong Republican, Not very strong Republican, Independent Republican, Other - leaning Republican) each and 2 for neutral options (Independent – neither, Other - neither)). To facilitate analyses, we collapsed the scale into a 3-level measure, i.e. Democrats, Republicans, and non-partisans who serve as the reference category in the analyses below. We also included a measure of political knowledge in our study [36]. Political knowledge is measured with a standard scale developed from nine questions designed to tap knowledge of the political system. Third, as personal connections have been shown to influence public opinion on a number of health-related issues [36,37] we included an indicator for whether respondents have non-adult children living with them [38]. Fourth, there has long been a controversy about the appropriate intermingling of education and healthcare in the U.S. [4,39]. We included respondents' answers to the 5-point-scale-question whether they "believe that schools are the appropriate setting for providing health services." Fifth, respondents personal perceptions of risks related to COVID-19 may influence their support for public policies related to the pandemic [40]. We included two measures to account for this potential: respondents' self-rated health status (a 5-point scale from poor to excellent) and age as well as its squared term to allow for non-linear effects. Sixth, there is evidence that Americans from rural areas may be particularly hesitant to vaccinate [41]. To determine whether respondents lived in rural America, we categorized individuals as rural if they live in a zip code that falls into the rural category based on the U.S. Department of Agriculture's *Rural-Urban Commuting Area Codes*. Seventh, education levels have been found to affect perceptions about vaccines

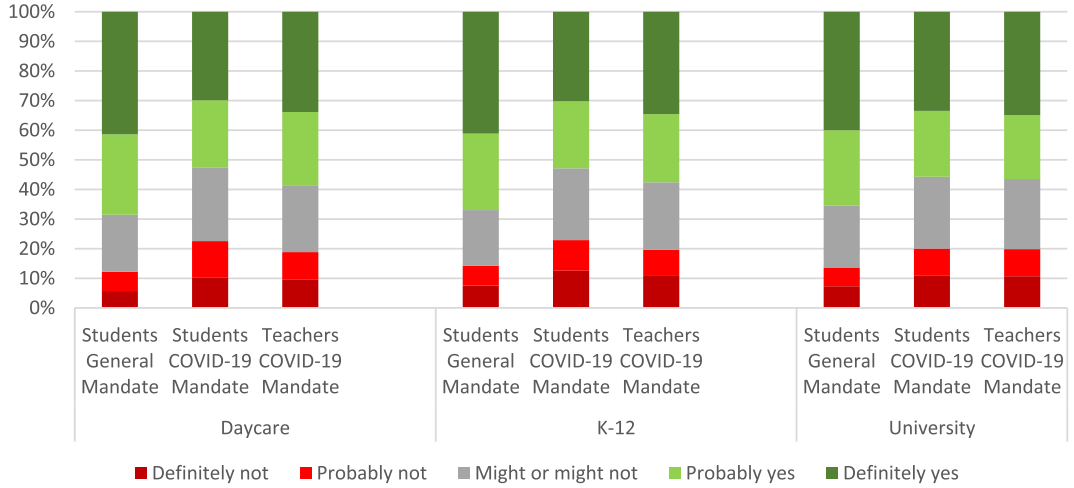

Fig. 1. Distribution of support of vaccination requirements.

[38,42,43]. We included indicators for High School Graduation, Some College, or College Graduation, with lack of high school graduation serving as the reference category. Eighth, several studies have shown that individuals with lower income may be more likely to oppose vaccinations [13,38]. Other studies have shown similar effects for higher income individuals, as well [44]. To account for this potentially non-linear effect, we include *Household Income* and its square (a 24-point scale ranging from less than $14,999 to a high of greater than $250,000). Ninth, because there is evidence that women generally perceive greater risks from vaccinations than men, we included a dichotomous measure for gender [45]. Tenth, numerous studies have shown that race and ethnicity may also play important roles in shaping public opinion about vaccines [13]. We thus included indicators for *White, Asian*, *Black* or *Hispanic* respondents. Finally, we also included indicators related to insurance coverage for Medicaid, Medicare, employer-sponsored coverage, and being uninsured. (Descriptive statistics are presented in Appendix Table 2).

2.3. Analyses

The analyses below rely on three major analytical approaches. First, we estimated a number of ordinary least squares (OLS) models to assess predictors of support for the three different types of mandates across the three educational settings. Standard tests for outliers and influential observations were satisfactory, and tests for multicollinearity indicated that it was not a problem in our models. Second, we utilized t-tests to assess whether support for vaccination requirements related to COVID-19 was lower than for general vaccination requirements, and whether support differed across educational setting. Third, to analyze whether the effect of partisanship is larger for vaccination requirements related to COVID-19 as compared to general vaccination requirements, we re-estimated a number of models utilizing seemingly unrelated regression (SUR), an approach developed by Arnold Zellner [46]. Joint estimation allows for contemporaneous correlation of errors across equations, and it may thus be more efficient than standard ordinary least square (OLS) regression. More importantly for the analyses here, it allows to statistically compare the effect size of coefficients across equations. We also used OLS to estimate predictors of inconsistency among individuals between general and COVID-19-related mandates.

3. Results

3.1. Public opinion and vaccination mandate

We first assessed the overall predictors of public opinion for the three types of mandates across the three types of educational settings (Table 1). To do so, we estimated 9 OLS models and included all independent variables described above. We also included indicators for each state to account for state-specific idiosyncrasies that might affect public opinion. Several results stand out. The analyses confirm that Democrats are consistently more supportive of all 9 vaccination mandates as compared to both moderates and Republicans; there is no apparent difference between moderates and Republicans. White Americans are also more likely to support any of the mandates, as do those who think that schools are the appropriate setting for providing health services. Asian Americans show larger support for COVID-19-related requirements. Support is also higher among older Americans. Interestingly, women are more supportive of general mandates but less supportive of COVID-19 related mandates. Finally, there is no effect for rural residents for general vaccination requirements. However, rural residents are less supportive of COVID-19 vaccination mandates for daycare and K-12 for students, as well as for K-12 in the case of teachers and staff.

Several examples illustrate the substantive effect of these results. For example, holding all other variables at their mean, a 70-year-old White Democratic woman without children in the household in non-rural America has a predictive probability of supporting a general daycare vaccination requirement of 4.34 (95% confidence interval 4.15 to 4.55), whereas a 20-year-old non-White rural male with children in the household supporting the Republican Party has one of 3.15 (2.68 to 3.61). Similarly, with all other variables at their mean, the predictive probability for a Democrat is 4.09 (3.95 to 4.23) while it amounts to 3.86 (3.71 to 4.00) for a Republican. Results are similar for support for general vaccination requirements across the other settings. However, probabilities are markedly lower for COVID-19 requirements. Here, 70-year-old White Democratic non-rural male has a predicted mean of supporting the requirements of 4.16 (3.93 to 4.39). This compares to 2.07 (1.55 to 2.60) for a 20-year-old Non-White Republican woman. Once more, Democrats (3.64, 95% confidence interval 3.48 to 3.80) have a substantially higher probability of support than Republicans (3.21, 95% confidence interval 3.05 to 3.37). Results are similar for COVID-19 vaccination requirement for teachers and staff.

3.2. Comparing general and COVID-19-related mandates

Next, in order to statistically test whether average support for COVID-19-related mandates is lower than for general ones, we estimated a number of t-tests comparing Americans' support for general vaccination requirements for students to COVID-19 vaccination requirements for students (1) and teachers (2). We also compared COVID-19 vaccination requirements for students to those for teachers (3) across the three educational settings. The results are presented in Table 2. Most obviously, the results indicate relative consistent support for vaccination requirements ranging from 3.52 to 3.90 on a scale from 1 to 5. The results also indicate that support for general requirements is larger than for any of the two COVID-19 requirements; the results are highly statistically significant and substantive, ranging from 0.22 to 0.37. The data also show that support for imposing mandates on teachers is larger than for imposing mandates on students; however, the differences are substantively small.

To assess potentially differential effects of mandates in daycare, K-12 schools, and colleges and universities, we estimated another series of t-tests comparing the 3 types of vaccination requirements across each educational setting. The results are presented in Table 3. Once more, the results indicate that public support is largest for general vaccination requirements as compared to those addressing COVID-19. For general requirements, support for student mandates is highest in daycares and lowest for colleges and universities. For COVID-19 student mandates, the analyses find no differences between daycare and K-12 schools while support is highest for post-secondary education. Finally, for teacher and staff mandates, support is highest in daycare and no differences could be discerned among the other two settings. Yet while 7 of the 9 tests have statistically significant findings, the differences are substantively small and never exceed 0.06 on a scale from 1 to 5. In short, the combined findings from Table 2 and Table 3 indicate that the major distinguishing factor is whether the requirements is related to COVID-19, and not the educational setting or whether the mandates address students or teachers and staff.

As has been shown, support for COVID-19 specific vaccination mandates is consistently lower than for general vaccination requirements. This, of course, means that at least some individuals support general vaccination requirements, yet are in opposition to these types of mandates when it comes to COVID-19; at the same time, the opposite may hold for others. And indeed, across the three educational settings only about 50 percent of respondents

Table 1
Effect of individual characteristics on support for vaccination mandates.

		Students general mandates			Students COVID-19 mandates			Teachers/staff COVID-19 mandates		
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	VARIABLES	Daycare	K12	University	Daycare	K12	University	Daycare	K12	University
Political Variables	Democrat	0.260***	0.317***	0.279***	0.244**	0.278**	0.327***	0.267**	0.271**	0.353***
		(0.094)	(0.104)	(0.100)	(0.120)	(0.134)	(0.117)	(0.118)	(0.120)	(0.121)
	Republicans	0.026	0.119	0.053	−0.185	−0.116	−0.093	−0.143	−0.119	−0.018
		(0.094)	(0.104)	(0.099)	(0.120)	(0.130)	(0.117)	(0.117)	(0.117)	(0.121)
	Political Knowledge	0.014	0.055***	0.018	−0.038**	−0.027	−0.011	−0.007	−0.008	0.006
		(0.016)	(0.017)	(0.017)	(0.017)	(0.018)	(0.017)	(0.017)	(0.017)	(0.017)
Race and Ethnicity	White	0.328***	0.404***	0.202	0.452***	0.444***	0.368**	0.411***	0.478***	0.356**
		(0.122)	(0.139)	(0.135)	(0.164)	(0.170)	(0.157)	(0.159)	(0.157)	(0.165)
	Black	−0.049	0.002	−0.192	0.085	0.162	0.210	0.194	0.114	0.081
		(0.141)	(0.164)	(0.157)	(0.185)	(0.199)	(0.183)	(0.183)	(0.187)	(0.192)
	Hispanic	0.060	0.025	0.045	0.091	0.025	0.161	0.050	0.156	0.183
		(0.102)	(0.107)	(0.109)	(0.127)	(0.137)	(0.123)	(0.119)	(0.122)	(0.125)
	Asian	0.261	0.267	0.097	0.591***	0.455**	0.373*	0.582***	0.571***	0.451**
		(0.159)	(0.171)	(0.177)	(0.196)	(0.209)	(0.205)	(0.195)	(0.199)	(0.203)
Education	High School Graduate	−0.055	−0.059	−0.006	0.081	0.184	−0.028	0.206	0.093	0.217
		(0.153)	(0.156)	(0.164)	(0.157)	(0.183)	(0.159)	(0.164)	(0.167)	(0.166)
	Some College	0.056	−0.010	0.041	0.062	0.195	−0.134	0.205	0.031	0.118
		(0.153)	(0.153)	(0.163)	(0.160)	(0.186)	(0.159)	(0.168)	(0.166)	(0.168)
	College	0.044	−0.006	−0.011	0.080	0.236	−0.048	0.187	0.029	0.152
		(0.154)	(0.154)	(0.165)	(0.161)	(0.185)	(0.162)	(0.170)	(0.168)	(0.170)
Insurance Status	Employer-Sponsored Insurance	−0.073	−0.044	0.004	−0.053	0.169	0.020	0.017	−0.139	−0.023
		(0.095)	(0.095)	(0.094)	(0.110)	(0.117)	(0.108)	(0.102)	(0.106)	(0.109)
	Medicare	−0.169	−0.053	−0.078	0.010	0.140	−0.081	0.020	−0.053	−0.003
		(0.103)	(0.108)	(0.107)	(0.127)	(0.134)	(0.124)	(0.119)	(0.118)	(0.124)
	Medicaid	0.057	0.028	−0.103	0.041	0.325**	0.076	0.075	0.004	0.001
		(0.119)	(0.123)	(0.124)	(0.138)	(0.152)	(0.136)	(0.132)	(0.132)	(0.134)
	Uninsured	−0.310**	−0.300**	−0.243*	−0.308**	−0.089	−0.153	−0.112	−0.334**	−0.228
		(0.134)	(0.134)	(0.135)	(0.149)	(0.161)	(0.148)	(0.141)	(0.149)	(0.148)
Other Demographics	School as Healthcare Setting	0.227***	0.234***	0.217***	0.242***	0.257***	0.261***	0.233***	0.277***	0.279***
		(0.031)	(0.032)	(0.032)	(0.033)	(0.034)	(0.033)	(0.032)	(0.034)	(0.033)
	Health Status	0.059*	0.064*	0.044	0.037	0.022	−0.020	−0.014	0.022	0.018
		(0.033)	(0.034)	(0.036)	(0.036)	(0.040)	(0.037)	(0.037)	(0.038)	(0.038)
	Children in Household	−0.160*	−0.137	−0.214**	0.101	0.044	0.082	0.054	0.006	−0.017
		(0.083)	(0.088)	(0.089)	(0.097)	(0.098)	(0.097)	(0.094)	(0.095)	(0.095)
	Rural	−0.092	0.012	−0.097	−0.418*	−0.652***	−0.255	−0.236	−0.360*	−0.164
		(0.204)	(0.164)	(0.158)	(0.214)	(0.253)	(0.234)	(0.225)	(0.212)	(0.221)
	Age	0.029***	0.039***	0.019	0.011	−0.000	−0.013	−0.007	0.010	−0.008
		(0.011)	(0.012)	(0.012)	(0.012)	(0.013)	(0.012)	(0.012)	(0.012)	(0.012)
	Age Squared	−0.000	−0.000**	−0.000	0.000	0.000	0.000**	0.000**	0.000	0.000*
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	Female	0.222***	0.151**	0.140**	−0.175**	−0.186**	−0.142*	−0.120*	−0.170**	−0.143**
		(0.063)	(0.066)	(0.068)	(0.073)	(0.077)	(0.073)	(0.071)	(0.072)	(0.072)
	Household Income	−0.001	−0.018	−0.024	−0.029	−0.046**	−0.029	−0.048**	−0.036*	−0.049**
		(0.019)	(0.020)	(0.020)	(0.021)	(0.022)	(0.021)	(0.021)	(0.021)	(0.021)
	Household Income Squared	0.000	0.001	0.002*	0.001	0.002**	0.002**	0.003***	0.002**	0.003***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	Constant	1.404***	0.785	1.640***	1.435***	1.449***	1.789***	1.746***	1.211***	1.419***
		(0.448)	(0.484)	(0.494)	(0.434)	(0.473)	(0.439)	(0.416)	(0.421)	(0.479)
	State Indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Observations	2,279	2,277	2,282	2,277	2,279	2,273	2,281	2,281	2,282
	R-squared	0.208	0.230	0.190	0.171	0.172	0.186	0.186	0.197	0.193

Robust standard errors in parentheses *** p < 0.01, ** p < 0.05, * p < 0.10.

offered consistent responses, while around 30 percent were less supportive; conversely, 15 percent of respondents were more inclined to support COVID-19 related requirements as compared to the general counterpart. As mentioned above, to explore these differences, we subtracted each respondents' responses for general mandates in the three settings from their respective responses for the corresponding COVID-19 mandates. Negative values indicate that the respondent is less favorable about a COVID-19 vaccination mandates while the opposite holds for positive values. We then estimated a series of OLS models relying on the same independent variables as before (Table 4).

Once more, partisanship emerges as a significant predictor for all three educational settings. However, the effect appears to be confined to Republicans who are significantly more likely to downgrade their support depending on the target of the mandate. The effect is just above standard levels of significance for colleges and universities. Moreover, higher levels of political knowledge are also associated with reductions in support for mandates, and the reduction in support is smaller for men than women. Respondents with children in their household, on the other hand, are more likely to increase their support for COVID-19 mandates as compared to general mandates. Finally, rural residents are more likely to be less supportive of K-12 mandates.

3.3. Increasing effect of partisanship for COVID-19

Finally, to assess whether partisanship has a more substantive effect on public opinion for requirements related to COVID-19 as compared to general ones, we re-estimated the previous OLS models displayed in Table 1 utilizing seemingly unrelated regres-

Table 2
Comparison of respondents' support for various mandates within each setting.

		N	**Mean**	95% confidence interval		p-value
Daycare	Student Vaccinations vs.	2,384	**3.90**	3.86	3.95	0.00
	Student Vaccinations COVID-19	2,384	**3.53**	3.48	3.58	
	Student Vaccinations vs.	2,388	**3.90**	3.86	3.95	0.00
	Teacher Vaccinations COVID-19	2,388	**3.65**	3.60	3.71	
	Student Vaccinations COVID-19 vs.	2,386	**3.53**	3.48	3.59	0.00
	Teacher Vaccinations COVID-19	2,386	**3.66**	3.60	3.71	
		N	**Mean**	95% Confidence Interval	p-value	
K-12	Student Vaccinations vs.	2,382	**3.88**	3.83	3.93	0.00
	Student Vaccinations COVID-19	2,382	**3.52**	3.47	3.58	
	Student Vaccinations vs.	2,385	**3.88**	3.83	3.92	0.00
	Teacher Vaccinations COVID-19	2,385	**3.63**	3.57	3.68	
	Student Vaccinations COVID-19 vs.	2,389	**3.52**	3.47	3.58	0.00
	Teacher Vaccinations COVID-19	2,389	**3.62**	3.57	3.68	
		N	**Mean**	95% Confidence Interval	p-value	
University	Student Vaccinations vs.	2,380	**3.84**	3.79	3.89	0.00
	Student Vaccinations COVID-19	2,380	**3.58**	3.53	3.64	
	Student Vaccinations vs.	2,390	**3.84**	3.79	3.89	0.00
	Teacher Vaccinations COVID-19	2,390	**3.62**	3.56	3.67	
	Student Vaccinations COVID-19 vs.	2,381	**3.58**	3.53	3.64	0.01
	Teacher Vaccinations COVID-19	2,381	**3.62**	3.56	3.67	

Table 3
Comparison of respondents' support for various mandates across each setting.

		N	**Mean**	95% Confidence Interval		p-value
General Requirement	Daycare vs.	2,383	**3.91**	3.86	3.95	0.03
	K-12	2,383	**3.88**	3.83	3.93	
	Daycare vs.	2,388	**3.91**	3.86	3.95	0.00
	University	2,388	**3.84**	3.79	3.89	
	K-12 vs.	2,385	**3.88**	3.83	3.93	0.01
	University	2,385	**3.84**	3.79	3.89	
		N	**Mean**	95% Confidence Interval		p-value
COVID-19 Requirement	Daycare vs.	2,384	**3.53**	3.48	3.59	0.21
	K-12	2,384	**3.52**	3.47	3.57	
	Daycare vs.	2,377	**3.53**	3.48	3.59	0.00
	University	2,377	**3.58**	3.53	3.64	
	K-12 vs.	2,379	**3.52**	3.47	3.58	0.00
	University	2,379	**3.58**	3.53	3.64	
		N	**Mean**	95% Confidence Interval		p-value
COVID Teachers Requirement	Daycare vs.	2,391	**3.66**	3.60	3.71	0.01
	K-12	2,391	**3.62**	3.57	3.68	
	Daycare vs.	2,391	**3.66**	3.60	3.71	0.00
	University	2,391	**3.62**	3.56	3.67	
	K-12 vs.	2,392	**3.63**	3.57	3.68	0.27
	University	2,392	**3.62**	3.56	3.67	

sion (SUR). As mentioned above, this approach allows us to statistically compare the effect size of coefficients across equations. Table 5 presents the p-values for various Wald tests doing just that; the top of the table contains the values for tests within the three educational settings while the bottom contains those across educational settings. Illustratively, we simultaneously estimated regressions for the three dependent variables assessing support for mandates in daycare (general, COVID-19, and COVID-19 for teachers and staff). We then compared the three respective coefficients for Democrats to determine whether they are statistically different from each other (i.e. we compared (1) the coefficient for Democrats from the general vaccination mandate model to that of the COVID-19 vaccination mandate model, (2) the coefficient for Democrats from the general vaccination mandate model to that of the COVID-19 vaccination mandate for teachers and staff model, and (3) the coefficient for Democrats from the COVID-19 vaccination mandate model to that of the COVID-19 teachers and staff vaccination mandate model). We repeated the process for the coefficient for Republicans. Next, we analogously compared partisanship for the K-12 and university setting. Finally, we repeated the process once more across educational settings.

Several findings stand out. First, partisanship has no differential effect across educational setting, as all p-values are highly insignificant (bottom results). That is, the effect of partisanship does not differ between daycare and K-12 schools, daycare and universities, and K-12 schools and universities. Second, Republican partisanship exerts a larger effect on COVID-19 related requirements as compared to the general mandates in daycare and K-12 schools. For colleges and universities, the p-value is just above standard levels of statistical significance. The finding that partisanship exerts a more substantive effect on COVID-19 mandates as compared to general requirements is further supported by the fact that the results are not statistically significant for comparisons between COVID-19 requirements between teachers and staff and students (third column). In short, COVID-19 has increased the effect of partisanship among Republican, but not Democratic, partisans with regard to daycare and K-12 schools.

Table 4
Effect of individual characteristics on inconsistent support for vaccination mandates.

	Variables	(1) Daycare	(2) K-12	(3) University
Political Variables	Democrat	−0.017	−0.026	0.037
		(0.101)	(0.126)	(0.103)
	Republicans	−0.212**	−0.235*	−0.151
		(0.106)	(0.128)	(0.108)
	Political Knowledge	−0.054***	−0.086***	−0.030*
		(0.017)	(0.019)	(0.017)
Race and Ethnicity	White	0.126	−0.004	0.144
		(0.150)	(0.166)	(0.145)
	Black	0.132	0.117	0.361**
		(0.176)	(0.196)	(0.175)
	Hispanic	0.024	0.013	0.105
		(0.124)	(0.138)	(0.116)
	Asian	0.331*	0.150	0.263
		(0.179)	(0.204)	(0.192)
Education	High School Graduate	0.135	0.261	−0.031
		(0.155)	(0.183)	(0.173)
	Some College	0.004	0.200	−0.171
		(0.156)	(0.182)	(0.173)
	College	0.036	0.227	−0.040
		(0.157)	(0.178)	(0.177)
Insurance Status	Employer-Sponsored Insurance	0.020	0.226*	0.017
		(0.108)	(0.124)	(0.113)
	Medicare	0.180	0.198	0.000
		(0.123)	(0.134)	(0.136)
	Medicaid	−0.014	0.300*	0.183
		(0.143)	(0.171)	(0.158)
	Uninsured	0.004	0.191	0.070
		(0.145)	(0.158)	(0.143)
Other Demographics	School as Healthcare Setting	0.016	0.020	0.043
		(0.031)	(0.035)	(0.031)
	Health Status	−0.023	−0.044	−0.060
		(0.035)	(0.040)	(0.038)
	Children in Household	0.257***	0.179*	0.297***
		(0.092)	(0.101)	(0.094)
	Rural	−0.326	−0.683**	−0.159
		(0.263)	(0.278)	(0.230)
	Age	−0.018	−0.038***	−0.033**
		(0.012)	(0.014)	(0.014)
	Age Squared	0.000	0.000***	0.000***
		(0.000)	(0.000)	(0.000)
	Female	−0.398***	−0.353***	−0.276***
		(0.072)	(0.079)	(0.073)
	Household Income	−0.028	−0.029	−0.008
		(0.020)	(0.023)	(0.021)
	Household Income Squared	0.001	0.001	0.001
		(0.001)	(0.001)	(0.001)
	Constant	−0.017	−0.026	0.037
		(0.101)	(0.126)	(0.103)
	State Indicators	Yes	Yes	Yes
	Observations	2,271	2,271	2,270
	R-squared	0.122	0.132	0.115

Robust standard errors in parentheses *** p < 0.01, ** p < 0.05, * p < 0.10.

Table 5
Differential effect of partisanship on vaccination requirements: P-values from various Wald Tests.

		General vs. COVID	**General vs. COVID Teacher**	**COVID vs. COVID Teacher**
Daycare	Democrats	0.398	0.292	0.739
	Republicans	**0.065**	0.298	0.267
	Republicans	**0.017**	0.131	0.154
University	Democrats	0.306	0.237	0.676
	Republicans	0.118	0.210	0.641
		Daycare vs. K-12	**Daycare vs. University**	**K-12 vs. University**
Student General	Democrats	0.645	0.892	0.571
	Republicans	0.530	0.928	0.624
Student COVID-19	Democrats	0.706	0.627	0.405
	Republicans	0.676	0.512	0.300
Teacher COVID-19	Democrats	0.948	0.671	0.730
	Republicans	0.856	0.866	0.993

p-values are based on results from various Wald tests estimated after seemingly unrelated regressions.

4. Discussion

We administered a large national survey to assess American's attitudes towards vaccination requirements across three educational settings (daycare, K-12 schools, and colleges and universities) in general and for COVID-19 specifically. To our knowledge, the analyses presented above are the first major assessments of public opinion of this type. Overall, support for vaccination mandates is relatively high, yet drops substantially for a potential COVID-19-related requirement. Even then, more than 50 percent of Americans support such a mandate. Partisanship, gender, race, rurality, and perceptions about the appropriate role schools should play in providing health services are substantive predictors of public opinion. The effect of partisanship is accentuated for COVID-19 requirements as compared to general requirements and drop off in support between general and COVID-19 specific requirements are driven by partisanship, gender, political knowledge, and having children in the household.

The findings hold important policy implications that can inform policymakers' decisions as we move to reign in the current pandemic as well as pandemics that occur in the future. For one, the findings should encourage policymakers to strongly consider imposing this evidence-based policy supported by a majority of Americans. At the same time, efforts to provide Americans with more information about the safety and effectiveness of the vaccines should be undertaken to alleviate valid fears. Third, national and state Republican leaders should spearhead campaigns to specifically target Republican partisans. In view of his continued support among Republicans, former President Trump would be an incredible asset to these efforts. Fourth, efforts should also target women because they make roughly 80 percent of the healthcare decisions for their children [47], as well as ethnic and racial minorities who have been disproportionately affected by the pandemic and would likewise disproportionally benefits from vaccinations. However, there seems to be little investments in these efforts so far, despite the fact that minorities are more skeptical of the vaccine [48]. Finally, all possible efforts should be undertaken to reduce and eliminate potential barriers for vaccinations. In addition to providing the vaccine free of charge, policymakers ought to consider ways to reduce the personal cost of getting vaccinated. This includes the ease of scheduling appointments, avoiding long travel times, and offering convenient opening hours. School-based vaccination campaigns [49] as well as school-based health centers [50] have proven their effectiveness in this regard.

To be sure, requiring children, teachers, and staff to be vaccinated impedes on their personal freedom. Yet a slew of public health interventions already do. Most states mandate motorcycle helmets and seat belts. Of course, states already require a number of vaccinations for school entry, and some states, like West Virginia and California, allow but few exemptions. Notably, as the existing literature on vaccination rates in school settings and beyond has shown, education-only requirements [8] and recommendations [5] have only limited effects. Conversely, vaccination mandates have proven that they can be an important arrow in the nation's public health quiver. However, as the experience from California's recent strengthening of vaccination mandates illustrates [51], enforcement of mandates and monitoring of displacement effects is crucial. Of course, other strategies like monetary incentives [13] and social media and information campaigns [23,30,52] have been shown to have positive effects and should be employed to supplement mandates. Given the tremendous public health challenge we are confronting in COVID-19, multi-pronged solutions are crucial.

There are, of course, limitations to this study. These include all standard limitations related to survey research in general as well as to online, opt-in panels in particular. The survey also only provides a snapshot view of American public opinion and, while it is nationally representative, it does not apply to any specific local context. We also asked respondents about vaccination requirements "in line with CDC guidelines." Of course, states differ widely with regard to mandates and exemptions and not all states use CDC guidelines as the foundation for mandates. Some of the respondents may thus have used their state's circumstances as a reference point. Finally, at the time of the survey, no viable and safe COVID-19 vaccine had been made available to the public.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix

See Fig. A1, Tables A1–A3.

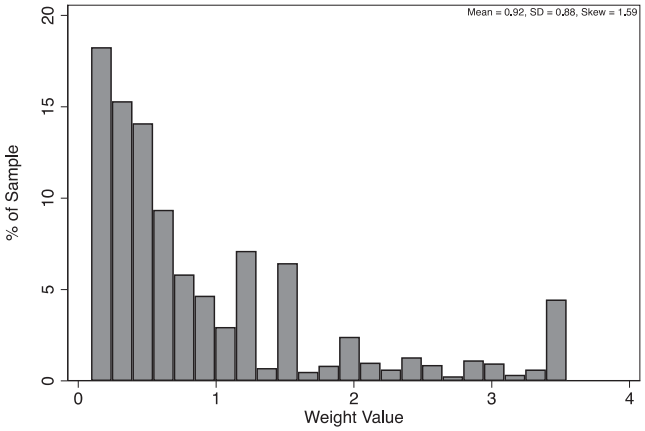

Fig. A1. Distribution of weights.

Table A1
Comparison of raw and weighted qualtrics data to national benchmarks.

Variable	Survey data (Raw)	Survey data (Weighted)	Benchmark	Benchmark source
Female	51%	50%	51%	CPS 2018
College degree	26%	34%	31%	CPS 2018
Black	11%	12%	13%	CPS 2018
White	68%	65%	62%	CPS 2018
Hispanic	11%	16%	18%	CPS 2018
Democrat	38	38	34%	ANES (Wgt.)
Republican	35	36	28%	ANES (Wgt.)
Independent	27	26	32%	ANES (Wgt.)
Mean age	44	46	47	ANES (Wgt.)
Median income	$35 – 49,999	$50 – 74,999	$55 – 59,999	ANES (Wgt.)

Note: Comparison of the data to known population benchmarks. CPS = Current Population Survey (US Census, 2018). ANES = American National Election Study (2016). Preference is given to CPS considering its sample size and representativeness, but make use of weighted ANES data whenever it was not possible to use CPS (i.e. CPS does not ask questions about Party ID). Weights in column two adjust for gender, education, race, age, and income. Party ID is **not included** in the weighting formula, and is shown only due to the potential interests of those who might use or otherwise consume this data. N (Survey Data) = 2,404.

Table A2
Descriptive statistics.

		N	Mean	SD	Minimum	Maximum
Support General Requirement	Daycares	2,393	3.90	1.20	1	5
	K-12 Schools	2,389	3.88	1.23	1	5
	Colleges and Universities	2,394	3.84	1.23	1	5
Support Student COVID-19 Requirement	Daycares	2,391	3.53	1.32	1	5
	K-12 Schools	2,393	3.52	1.34	1	5
	Colleges and Universities	2,385	3.58	1.32	1	5
Support Teacher and Staff COVID-19 Requirement	Daycares	2,395	3.66	1.30	1	5
	K-12 Schools	2,396	3.62	1.34	1	5
	Colleges and Universities	2,396	3.62	1.34	1	5
Political Variables	Democrats	2,400	0.45	0.50	0	1
	Republicans	2,400	0.42	0.49	0	1
	Political Knowledge	2,404	4.77	2.29	0	8
Insurance Status	Employer-Sponsored Insurance	2,404	0.37	0.48	0	1
	Medicare	2,404	0.22	0.41	0	1
	Medicaid	2,404	0.14	0.35	0	1
	Uninsured	2,404	0.12	0.32	0	1
Education	High School Graduate	2,404	0.21	0.41	0	1
	Some College	2,404	0.29	0.46	0	1
	College Graduate	2,404	0.47	0.50	0	1
Race and Ethnicity	White	2,404	0.72	0.45	0	1
	Black	2,404	0.12	0.33	0	1
	Hispanic	2,404	0.11	0.32	0	1
	Asian	2,404	0.06	0.24	0	1
Other Demographics	Female	2,404	0.51	0.50	0	1
	Household Income	2,310	10.01	7.59	1	24
	School as Healthcare Setting	2,392	3.41	1.17	1	5
	Health Status	2,400	3.31	1.03	1	5
	Kids in the Household	2,404	0.78	0.41	0	1
	Age	2,403	44.23	16.58	18	99
	Rural	2,404	0.02	0.15	0	1

Table A3
Effect of individual characteristics on public opinion of vaccination mandates (cumulative).

	Variables	(1) All mandates	(2) Student mandates only
Political Variables	Democrat	2.656***	1.707***
		(0.879)	(0.558)
	Republicans	−0.532	−0.239
		(0.854)	(0.544)
	Political Knowledge	0.014	0.014
		(0.126)	(0.083)
Race and Ethnicity	White	3.327***	2.154***
		(1.190)	(0.733)
	Black	0.546	0.207
		(1.353)	(0.835)
	Hispanic	0.705	0.376
		(0.862)	(0.549)
	Asian	3.528**	1.999**
		(1.435)	(0.901)
Education	High School Graduate	0.727	0.175
		(1.186)	(0.782)
	Some College	0.578	0.203
		(1.206)	(0.791)
	College	0.584	0.251
		(1.215)	(0.794)
Insurance Status	Employer-Sponsored Insurance	−0.069	0.072
		(0.739)	(0.481)
	Medicare	−0.277	−0.229
		(0.833)	(0.546)
	Medicaid	0.515	0.432
		(0.906)	(0.590)
	Uninsured	−2.175**	−1.416**
		(1.094)	(0.714)
Other Demographics	School as Healthcare Setting	2.210***	1.437***
		(0.251)	(0.164)
	Health Status	0.219	0.200
		(0.271)	(0.175)
	Children in Household	−0.225	−0.255
		(0.701)	(0.451)
	Rural	−2.148	−1.349
		(1.475)	(0.907)

(*continued on next page*)

Table A3 (*continued*)

Variables	(1) All mandates	(2) Student mandates only
Age	0.073	0.083
	(0.086)	(0.056)
Age Squared	0.001	0.000
	(0.001)	(0.001)
Female	−0.416	0.009
	(0.521)	(0.336)
Household Income	−0.278*	−0.148
	(0.154)	(0.100)
Household Income Squared	0.016**	0.009**
	(0.007)	(0.004)
Constant	13.019***	8.460***
	(3.231)	(2.287)
State Indicators	Yes	Yes
Observations	2,233	2,243
R-squared	0.232	0.230

Robust standard errors in parentheses *** p < 0.01, ** p < 0.05, * p < 0.10.

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