Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Joining the herd? U.S. public opinion and vaccination requirements across educational settings during the COVID-19 pandemic

Simon F. Haeder
School of Public Policy, The Pennsylvania State University, 329 Pond Lab, University Park, PA 16802, United States

A R T I C L E   I N F O
Article history:
Received 21 December 2020
Received in revised form 15 March 2021
Accepted 16 March 2021
Available online 23 March 2021

Keywords:
COVID-19
Vaccines
Mandates

A B S T R A C T
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 COVID-19 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.

© 2021 Elsevier Ltd. All rights reserved.

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.
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 smallpox 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, disproportionately 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,
3.0.2.2. 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
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 mean of 4.09 (95% confidence interval 4.00 to 4.04) 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 3.86 (3.71 to 4.00) 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 3.86 (3.71 to 4.00) 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.
Effect of individual characteristics on support for vaccination mandates.

Among respondents, most were more inclined to support COVID-19 related requirements compared to general mandates. For example, 84 percent of respondents were more supportive of a COVID-19 mandate compared to a general mandate to vaccinate children in daycare centers. Moreover, higher levels of political knowledge were 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 1
Effect of individual characteristics on support for vaccination mandates.

| VARIABLES                        | Students general mandates | Students COVID-19 mandates | Teachers/staff COVID-19 mandates |
|----------------------------------|--------------------------|---------------------------|---------------------------------|
| Education                        |                          |                           |                                 |
| High School Graduate             |                          |                           |                                 |
|                                  | 0.260***                 | 0.279***                  | 0.327***                        |
| (0.094)                          | (0.110)                  | (0.134)                   | (0.117)                         |
| College                          | 0.026                    | -0.185                    | -0.116                          |
| (0.094)                          | (0.110)                  | (0.134)                   | (0.117)                         |
| University                       | 0.014                    | -0.098                    | -0.088                          |
|                                  | (0.016)                  | (0.017)                   | (0.018)                         |
| Race and Ethnicity               |                          |                           |                                 |
| White                            | 0.328***                 | 0.202                     | 0.368***                        |
| (0.122)                          | (0.139)                  | (0.135)                   | (0.157)                         |
| Black                            | 0.094                    | 0.085                     | 0.210                           |
| (0.141)                          | (0.164)                  | (0.157)                   | (0.183)                         |
| Hispanic                         | 0.060                    | 0.091                     | 0.161                           |
| (0.102)                          | (0.107)                  | (0.109)                   | (0.123)                         |
| Education                        |                          |                           |                                 |
| High School Graduate             | 0.261                    | 0.097                     | 0.373***                        |
| (0.159)                          | (0.171)                  | (0.177)                   | (0.192)                         |
| College                          | 0.044                    | -0.090                    | -0.236                          |
| (0.154)                          | (0.154)                  | (0.165)                   | (0.170)                         |
| Income Status                    |                          |                           |                                 |
| Employer-Sponsored Insurance     | -0.073                   | -0.004                    | 0.020                           |
| (0.095)                          | (0.095)                  | (0.094)                   | (0.106)                         |
| Medicare                         | -0.169                   | -0.010                    | -0.234                          |
| (0.103)                          | (0.108)                  | (0.107)                   | (0.124)                         |
| Medicaid                         | 0.057                    | 0.041                     | 0.123                           |
| (0.119)                          | (0.123)                  | (0.124)                   | (0.132)                         |
| Uninsured                        | -0.310**                 | -0.243*                   | -0.153                          |
| (0.134)                          | (0.134)                  | (0.135)                   | (0.132)                         |
| Other Demographics               |                          |                           |                                 |
| School as Healthcare Setting     | 0.227***                 | 0.217***                  | 0.261***                        |
| (0.031)                          | (0.032)                  | (0.033)                   | (0.032)                         |
| Health Status                    | 0.059*                   | 0.037                     | -0.202                          |
| (0.033)                          | (0.034)                  | (0.036)                   | (0.037)                         |
| Children in Household            | -0.160*                  | 0.010                     | 0.082                           |
| (0.083)                          | (0.088)                  | (0.097)                   | (0.098)                         |
| Rural                            | -0.092                   | -0.418                    | -0.652**                        |
| (0.204)                          | (0.164)                  | (0.214)                   | (0.234)                         |
| Age                              | 0.029**                  | 0.019                     | -0.011                          |
| (0.011)                          | (0.012)                  | (0.012)                   | (0.012)                         |
| Age Squared                      | -0.000                   | 0.000                     | 0.000                           |
| (0.000)                          | (0.000)                  | (0.000)                   | (0.000)                         |
| Female                           | 0.222***                 | 0.140**                   | -0.175**                        |
| (0.020)                          | (0.020)                  | (0.020)                   | (0.020)                         |
| Household Income                 | -0.001                   | -0.029                    | -0.046                          |
| (0.019)                          | (0.020)                  | (0.020)                   | (0.021)                         |
| Household Income Squared         | 0.000                    | 0.000                     | 0.000                           |
| (0.000)                          | (0.000)                  | (0.000)                   | (0.000)                         |
| Constant                         | 1.404***                 | 1.435***                  | 1.789***                        |
| (0.448)                          | (0.448)                  | (0.434)                   | (0.439)                         |
| State Indicators                 | Yes                      | Yes                       | Yes                             |
| Observations                     | 2.279                    | 2.277                     | 2.277                           |
| R-squared                        | 0.208                    | 0.203                     | 0.190                           |

Robust standard errors in parentheses *** p < 0.01, ** p < 0.05, * p < 0.10.
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 for teachers and staff model, and (2) 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 2
Comparison of respondents’ support for various mandates within each setting.

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

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

| Setting               | N     | Mean | 95% confidence interval | p-value |
|-----------------------|-------|------|-------------------------|---------|
| **General Requirement** |       |      |                         |         |
| Daycare vs. K-12      | 2,383 | 3.91 | 3.86 3.95 | 0.03    |
| Daycare vs. University | 2,388 | 3.84 | 3.79 3.89 | 0.00    |
| K-12 vs. University   | 2,385 | 3.88 | 3.83 3.93 | 0.01    |
| **COVID-19 Requirement** |     |      |                         |         |
| Daycare vs. K-12      | 2,384 | 3.53 | 3.48 3.59 | 0.21    |
| Daycare vs. University | 2,377 | 3.53 | 3.48 3.59 | 0.00    |
| K-12 vs. University   | 2,379 | 3.53 | 3.53 3.64 | 0.00    |
| **COVID Teachers Requirement** |     |      |                         |         |
| Daycare vs. K-12      | 2,391 | 3.66 | 3.60 3.71 | 0.01    |
| Daycare vs. University | 2,391 | 3.62 | 3.57 3.68 | 0.00    |
| K-12 vs. University   | 2,392 | 3.63 | 3.57 3.68 | 0.27    |
### 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    | 0.160          |
|                         | (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                   |
| **University**    |                   |                           |                         |
| Democrats         | 0.306             | 0.237                     | 0.676                   |
| Republicans       | 0.118             | 0.210                     | 0.641                   |
| **Student General** |                 |                           |                         |
| Democrats         | 0.0645            | 0.892                     | 0.571                   |
| Republicans       | **0.017**         | 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.

Table A1

| Variable        | Survey data (Raw) | Survey data (Weighted) | Benchmark | Benchmark source |
|-----------------|-------------------|------------------------|-----------|------------------|
| Female          | 51%               | 50%                    | 51%       | CPS 2018         |
| College degree  | 26%               | 34%                    | 34%       | CPS 2018         |
| Black           | 11%               | 12%                    | 13%       | CPS 2018         |
| Hispanic        | 68%               | 65%                    | 62%       | CPS 2018         |
| White           | 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 | 2,395| 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       |
| Medicaid                 | 2,404| 0.72  | 0.45  | 0       | 1       |
| **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**   |      |       |       |         |         |
| School as Healthcare Setting | 2,310| 10.01 | 7.59  | 1       | 24      |
| **Health Status**        |      |       |       |         |         |
| 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*** (0.879) | 1.707*** (0.558)         |
| Republicans                        | −0.532 (0.854)   | −0.239 (0.544)           |
| Political Knowledge                | 0.014 (0.126)    | 0.014 (0.083)            |
| **Race and Ethnicity**             |                  |                          |
| White                              | 3.327*** (1.190) | 2.154*** (0.733)         |
| Black                              | 0.546 (1.353)    | 0.207 (0.835)            |
| Hispanic                           | 0.705 (0.862)    | 0.376 (0.549)            |
| Asian                              | 3.528*** (1.435) | 1.999*** (0.901)         |
| **Education**                      |                  |                          |
| High School Graduate               | 0.727 (1.186)    | 0.175 (0.782)            |
| Some College                       | 0.578 (1.206)    | 0.203 (0.791)            |
| College                            | 0.584 (1.215)    | 0.251 (0.794)            |
| **Insurance Status**               |                  |                          |
| Employer-Sponsored Insurance       | −0.069 (0.739)   | 0.072 (0.481)            |
| Medicare                           | −0.277 (0.833)   | −0.229 (0.546)           |
| Medicaid                           | 0.515 (0.906)    | 0.432 (0.590)            |
| Uninsured                          | −2.175** (1.054) | −1.416** (0.714)         |
| **Other Demographics**             |                  |                          |
| School as Healthcare Setting       | 2.210*** (0.251) | 1.437*** (0.164)         |
| Health Status                      | 0.219 (0.271)    | 0.200 (0.175)            |
| Children in Household              | −0.225 (0.701)   | −0.235 (0.451)           |
| Rural                              | −2.148 (1.475)   | −1.349 (0.907)           |

(continued on next page)
Table A3 (continued)

| Variables                          | All mandates | Student mandates only |
|------------------------------------|--------------|-----------------------|
| Age                                | 0.073        | 0.083                 |
| Age Squared                        | 0.001        | 0.000                 |
| Female                             | −0.416       | 0.009                 |
| Household Income                   | −0.278*      | −0.148                |
| Household Income Squared           | 0.016**      | 0.009**               |
| Constant                           | 13.019***    | 8.460***              |
| 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.

References

[1] Pew Research Center. Most Americans Say Coronavirus Outbreak Has Impacted Their Lives. Pew Research Center Social & Demographic Trends 2020.

[2] Lynch J. Health equity, social policy, and promoting recovery from COVID-19. J Health Poli Poli Law 2020.

[3] Gollust SE, Saloner B, Hest R, Blewett LA. US adults’ preferences for public allocation of a vaccine for coronavirus disease 2019. JAMA Network Open. 2020;3:e2023020-e.

[4] Jackson CL. State laws on compulsory immunization in the United States. Public Health Rep 1969;84:787.

[5] Davis MM, Maglia MA. Associations of daycare and school entry vaccination requirements with varicella immunization rates. Vaccine 2005;23:3053–60.

[6] Ruhanen AL, Williams WW, Atkinson WL, Cook IC, Collins M. The impact of college prematriculation immunization requirements on risk for measles outbreaks. JAMA J Am Med Assoc 1994;272:1127–32.

[7] Diekema DS. Personal belief exemptions from school vaccination requirements. Annu Rev Public Health 2014;35:275–92.

[8] Bugenske S, Stokley S, Kennedy A, Dorell C. Middle school vaccination requirements and adolescent vaccination coverage. Pediatrics 2012;129:1056–63.

[9] Calo WA, Gilkey MB, Shah PD, Moss JL, Brewer NT. Parents’ support for school-entry requirements for human papillomavirus vaccination: a national study. Cancer Epidemiology and Prevention Biomarkers 2016;25:1317–25.

[10] Gollust SE, Nagler RB, Fowler EF. The emergence of COVID-19 in the US: A public health and political communication crisis. J Health Poli Poli Law 2020.

[11] Haeder SF, Gollust SE. From poor to worse: health policy and politics scholars’ assessment of the U.S. COVID-19 response and its implications. World Med Polit 2020;12:454–81.

[12] Lopez AS, Kolasa MS, Seward JF. Status of school entry requirements. Annu Rev Public Health 2014;35:275–92.

[13] Bond L, Davie G, Carlin JB, Lester R, Nolan T. The Japanese experience with vaccinating schoolchildren against influenza. N Engl J Med 2001;344:889–96.

[14] American Academy of Pediatrics. Association CsH. Children and COVID-19: Their Lives. Pew Research Center Social & Demographic Trends 2020.

[15] Anderson SA, Caseman K, Haeder SF, Mathur A, Ulmen K. When adolescents are in school during COVID-19: coordination between school-based health centers and education is key. J Adolesc Health 2020;67:745–6.

[16] New York Times. Tracking the Coronavirus at U.S. Colleges and Universities. New York: New York Times; 2020.

[17] Mizumoto K, Faber K, Zarebski A, Chowell G. Estimating the asymptomatic proportion of coronavirus disease 2019 (COVID-19) cases on board the diamond princess cruise ship, Yokohama, Japan, 2020. Eurosurveillance. 2020;25:1–5.

[18] Daley MF, Narwaney KJ, Shoup JA, Wagner NM, Glanz JM. Addressing parents’ vaccine concerns: a randomized trial of a social media intervention. Am J Prev Med 2018;55:44–54.

[19] Larson Hj, Jarrett C, Eckerberger E, Smith D, Paterson P. Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: a systematic review of published literature, 2007–2012. Vaccine 2014;32:2150–9.

[20] Funk C, Tyson A. Intent to Get a COVID-19 Vaccine Rises to 60% as Confidence Continues to Rise. Pew Research Center; 2020.

[21] Schnell L. College campuses drove major COVID-19 outbreaks. Now, will they require the vaccine? USA Today 2020.

[22] Coppock A, McClellan OA. Validating the demographic, political, psychological, and experimental results obtained from a new source of online survey respondents. Research & Politics 2019;6:1–14.

[23] Kennedy C, Mercer A, Keeter S, Hatley N, McGeeney K, Gimenez A. Evaluating Online Nonprobability Surveys. Washington, DC: Pew Research Center; 2016.

[24] Haeder SF, Sylvester S, Callaghan TH. Lingering legacies: public attitudes about medicare beneficiaries and work requirements. J Health Polit Law Policy. 2020.

[25] Kennedy-Hendrickx A, Barry CL, Gollust SE, Esminger ME, Chisolm MS, McIntyre EE. Social stigma toward persons with prescription opioid use disorder: associations with public support for punitive and public health-oriented policies. Psychiatric Services 2017;68:462–9.

[26] Kempe A, Saville AW, Albertson C, Zimet G, Breck A, Helmkamp L, et al. Parental hesitancy about routine childhood and influenza vaccinations: a national study. JAMA 2002;286:58–64.

[27] Orenstein WA, Hinman AR. The immunization system in the United STATES: the role of school immunization laws. Vaccine 1999;17:S19–24.

[28] Costin LO, Salmon DA, Larson HJ. Mandating COVID-19 vaccines. JAMA J Am Med Assoc 2020.

[29] Caleb S, Thompson D, Haimowitz R, Ciotoli C, Dannenbaum M, Fu LY. How colleges intervene to increase student body vaccination coverage. J Am Coll Health 2020;1:8.

[30] Fawole OA, Snivatsa T, Fasano C, Freemster KA. Evaluating variability in immunization requirements and policy among US colleges and universities. J Adolesc Health 2018;63:286–92.

[31] Marin M, Quinnisk P, Shinabukuro T, Sawyer C, Brown C, LeBaron CW. Mumps vaccination coverage and vaccine effectiveness in a large outbreak among college students—Iowa, 2006. Vaccine 2008;26:3601–7.

[32] Jewett A, Bell T, Cohen NJ, Buckley K, Leino EV, Even S, et al. US college and university student health screening requirements for tuberculosis and vaccine-preventable diseases, 2012. J Am Coll Health 2016;64:409–15.

[33] Poland GA, Tosh P, Jacobson RM. Requiring influenza vaccination for health care workers: seven truths we must accept. Vaccine 2005;23:2251–5.

[34] Bhatia SG, Hagar D, Crome P, Lammert JK. Mandatory influenza vaccination of healthcare workers: a 5-year study. Infect Control Hosp Epidemiol 2010;31:881.

[35] Macintosh J, Luthy KE, Beckstrand RL, Eden LM, Orton J. Vaccination perceptions of school employees in a rural school district. Vaccine 2014;32:4766–71.

[36] Cataldi JR, Kerns ME, O’Leary ST. Evidence-based strategies to increase vaccination uptake: a review. Curr Opin Pediatr 2020;32:151–9.

[37] Monte A5, Davenport FM, Napier JA, Francis TJ. Modification of an outbreak of influenza in Tecumseh, Michigan by vaccination of schoolchildren. J Infect Dis 1970;122:16–25.

[38] Reichert TA, Sugaya N, Fedson DS, Glezen WP, Simonsen L, Tashiro M. The Japanese experience with vaccinating schoolchildren against influenza. N Engl J Med 2001;344:889–96.

[39] American Academy of Pediatrics. Association CsH. Children and COVID-19: State Data Report. Itasca, IL: American Academy of Pediatrics; 2020.

[40] Anderson SA, Caseman K, Haeder SF, Mathur A, Ulmen K. When adolescents are in school during COVID-19: coordination between school-based health centers and education is key. J Adolesc Health 2020;67:745–6.

[41] Haeder SF, Gollust SE, Esminger ME, Chisolm MS, McIntyre EE. Social stigma toward persons with prescription opioid use disorder: associations with public support for punitive and public health-oriented policies. Psychiatric Services 2017;68:462–9.

[42] Kempe A, Saville AW, Albertson C, Zimet G, Breck A, Helmkamp L, et al. Parental hesitancy about routine childhood and influenza vaccinations: a national study. JAMA 2002;286:58–64.

[43] Fisher R, Danza P, McCarthy J, Tiezzi L. Provision of contraception in New York city school-based health centers: impact on teenage pregnancy and avoided costs, 2008–2017. Perspectives on Sexual and Reproductive Health. 2019;51:201–9.

[44] Mehran E, Karimi A, Barzegary A, Vahedi F, Afsahi AM, Dadas O, et al. Predictors of mortality in patients with COVID-19—A systematic review. Eur J Integrative Med 2020;10:1226.

[45] Altman D. Real Progress Is Possible On Vaccine Hesitancy. San Francisco, CA: Kaiser Family Foundation; 2020.

[46] Motta M, Callaghan T, Sylvester S. Knowing less but presuming more: daunting-kruger effects and the endorsement of anti-vaccine policy attitudes. Soc Soc Med 2018;211:274–81.

[47] Simpson JE, Hills RA, Allowes D, Rassmussen L. Uptake of meningococcal vaccine in Arizona schoolchildren after implementation of school-entry immunization requirements. Public Health Rep 2013;128:37–45.

[48] McNutt L-A, Desemone C, DeNicola E, El Chebli H, Nadeau JA, Bednarczyk RA, et al. Affluence as a predictor of vaccine refusal and underimmunization in California private kindergartens. Vaccine 2016;34:1733–8.
[45] Baumgaertner B, Carlisle JE, Justwan F. The influence of political ideology and trust on willingness to vaccinate. PLoS ONE 2018;13:e0191728.

[46] Zellner A. An efficient method of estimating seemingly unrelated regressions and tests for aggregation bias. J Am Stat Assoc 1962;57:348–68.

[47] Kaiser Family Foundation, Women, Work, and Family Health: Key Findings from the 2017 Kaiser Women’s Health Survey. Menlo Park, CA: Kaiser Family Foundation; 2018.

[48] Chen C, Gabrielson R, Sanders T. Vaccinating Black Americans Is Essential. Key States Aren’t Doing the Work to Combat Hesitancy. ProPublica 2020.

[49] Effler PV, Chu C, He H, Gaynor K, Sakamoto S, Nagao M, et al. Statewide school-located influenza vaccination program for children 5–13 years of age, Hawaii, USA. Emerg Infect Dis 2010;16:244.

[50] Gold R, Naleway AL, Jenkins LL, Riedlinger KK, Kurosky SK, Nystrom RJ, et al. Completion and timing of the three-dose human papillomavirus vaccine series among adolescents attending school-based health centers in Oregon. Prev Med 2011;52:456–8.

[51] Delamater PL, Pingali SC, Buttenheim AM, Salmon DA, Klein NP, Omer SB. Elimination of nonmedical immunization exemptions in California and school-entry vaccine status. Pediatrics 2019;143.

[52] O’Leary ST, Narwaney KJ, Wagner NM, Kraus CR, Omer SB, Glanz JM. Efficacy of a web-based intervention to increase uptake of maternal vaccines: an RCT. Am J Prev Med 2019;57:e125–33.