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ORIGINAL PAPER

Indiana Parental Perceptions of the Acceptability of General and HPV-Specific State Vaccine Requirements

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Abstract

State vaccine requirements are a tool for improving child and adolescent vaccination immunization coverage, but to be effective, parental buy-in is needed. The objective of this study was to assess the demographic, healthcare characteristics, and health beliefs associated with parental acceptance of general and HPV-specific state vaccine requirements. Indiana parents (N = 601) with children ages 11–17 years old completed a survey during March 2020.

Results showed that 47.2% and 43.1% of parents believed there should always be general and HPV-specific state vaccine requirements, respectively. In multivariable analysis, higher odds of parental support for general state vaccine requirements were associated with being unsure whether HPV-associated cancer is a problem in the participant's county and having higher perceived benefits of HPV vaccines. Lower odds were associated with private insurance, having less than a bachelor's degree, and having less confidence in vaccines. In comparison, parents had higher odds of agreeing with HPV-specific state vaccine requirements if they reported higher interpersonal altruism and higher perceived benefits of HPV vaccines; they had lower odds if they were non-Hispanic White. Findings indicate that while similar percentages of parents agreed with general and HPV-specific state vaccine requirements, there were different characteristics associated with acceptance of each. Results can inform the development of tailored interventions for improving parental support for general and HPV-specific state vaccine requirements.

Keywords HPV vaccination · State vaccine requirements · Parents · Adolescent vaccines

Parental Perceptions of the Acceptability of General and HPV-Specific State Vaccine Requirements

Vaccines are effective tools that are responsible for preventing between 2 and 3 million deaths from infectious diseases each year worldwide [1]. To protect from infectious outbreaks, states have the authority to implement school-entry vaccine requirements [2]. All states require at least some childhood vaccines as a condition of school entry for public and most private schools, yet all states also allow for medical exemptions. Further, most states also offer exemptions based on differently defined religious and/or personal beliefs [3]. When school-entry vaccine requirements are implemented consistently and without vague exceptions, they are effective at increasing vaccine uptake uniformly across all groups [4]. However, evidence indicates that increasing numbers of parents are opting out of school-entry vaccine requirements by obtaining non-medical exemptions [5], which reflects the increasing number of concerns and misperceptions parents have about childhood vaccinations [6], even among communities with high vaccination rates [7].

Not surprisingly, higher vaccine uptake is generally achieved for vaccines that are routinely required for school entry in most or all states (e.g., Tetanus-Diphtheria- Pertussis

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and Meningococcal ACWY for entry into middle school), with lower coverage rates for non-required vaccines [8]. HPV vaccine, which can be given at age 9 years but is not required for school entry in the majority of US states, lags far behind the national Healthy People 2030 goal of 80% series completion, with only 61.7% of US adolescents being up-to-date with HPV vaccination in 2021[9, 10]. While recent studies indicate there is some support for general school-entry required vaccines [11, 12], parental support for HPV requirements in school tends to be mixed [13–15]. Reasons for lack of support include belief that the vaccine does not work well [4, 11], is not safe [4, 11], and infringes upon parental rights [11, 12]. Importantly, recent studies indicate that the degree of support is related to the inclusion of opt-out provisions [4, 13, 16]; when opt-out provisions are included, parental support for HPV vaccine requirements increase [17]. Overall, these studies indicate that the inclusion of opt-out provisions is essential to the support of school-entry requirements, as are perceptions that a given vaccine is safe and effective [14]. However, stronger support for easily accessible opt-out provisions is problematic because they are associated with higher non-vaccination and infection rates [18].

The study objective was to assess parental support for state-implemented general vaccine requirements for children and for making HPV vaccination a requirement for entry into middle school. Further, we examined demographic, healthcare characteristics, and health belief factors that may be associated with support for general and HPV-vaccine-specific requirements. This study focused on parents residing in Indiana, a state whose HPV vaccination rates have consistently been lower than the national average. Currently, Indiana's HPV vaccination rate for adolescents aged 13–17 years old is 72.1% for initiation and 55.2% for series completion [10]. Understanding parental support for general vaccine requirements, and HPV requirements specifically, may inform policy makers of salient variables associated with support for each to create tailored interventions to improve overall immunization coverage.

Methods

The authors conducted an online survey of a convenience sample of 601 parents of children ages 11–17 years old residing in Indiana in March 2020, when COVID-19 was in the national news but prior to community spread or lockdown measures. The data for this investigation is part of a National Cancer Institute-funded study of an environmental scan of Indiana to assess the motivators and barriers associated with HPV vaccination.

Eligible participants were recruited through Dynata, which is a survey research company that maintains panels of volunteer respondents who receive monetary incentives for participation. Eligibility criteria were: (1) being a parent of a child ages 11–17 years, (2) living in Indiana, and (3) being able to read English. The study received exempt status from the first author's Institutional Review Board.

Outcome Measures

The two main study outcomes were parents' support for general state vaccine requirements and agreement with HPV-specific vaccine requirements for entry into middle school. Support for general vaccine requirements was measured with a single question: "Are there certain circumstances in which it is acceptable for state law to mandate vaccines for children?" Respondents chose from four categorical responses of (1) "Yes, the state should always mandate vaccines for children", (2) "Yes, but vaccines should only be required for children attending public school", (3) "Yes, but in very limited circumstances when there is a severe outbreak (e.g. a measles outbreak)", and (4) "No, there is no circumstance in which it would be appropriate for state law to mandate vaccines for children." For the purposes of these analyses, the middle two categories were collapsed to reflect acceptability of mandates in limited situations, so that the outcome variable had three levels: never, in limited situations, and always. Agreement with HPV vaccine requirements for middle school was measured with a single item: "HPV vaccination should be required for a child to attend middle school in Indiana." Responses were measured on a Likert scale ranging from (1) strongly disagree to (5) strongly agree. Responses were collapsed into three categories: strongly disagree/disagree, neither disagree nor agree, and agree/strongly agree.

Independent Variables

Independent variables included socio-demographics, healthcare characteristics, and health beliefs.

Socio-Demographics

Socio-demographic factors included parent race and ethnicity, biological sex, education, rural/urban residence, political ideology, and child's biological sex and race and ethnicity. Race/ethnicity was measured by including all United States Census categories for race and ethnicity. A small number of participant responses in most categories resulted in combining responses into two categories: Non-Hispanic White and Other Race/Ethnicity. Biological sex was measured with the categories of male, female, and other/prefer not to

Table 1 Sample Description, Support for General Vaccine Requirements, and Bivariate Associations with Support for General Vaccine Requirements

	Total	Support for General Vaccine Requirements, n (%)			Bivariate Association, OR [95% CI]	
	N (%) or Mean (SD)	Always (n = 265, 47.2)	Some Circumstances (n = 212, 37.8)	Never (n = 84 15.0)	Always vs. Never	Limited Circumstances vs. Never
Child Race/Ethnicity						
Minority	130 (23.7)	63 (48.5)	51 (39.2)	16 (12.3)	Ref	Ref
Non-Hispanic White	419 (76.3)	196 (46.8)	156 (37.2)	67 (16.0)	0.74 (0.40, 1.37)	0.73 (0.39, 1.37)
Child Sex						
Female	278 (49.6)	126 (45.3)	106 (38.1)	46 (16.6)	Ref	Ref
Male	282 (50.4)	139 (49.3)	105 (37.2)	38 (13.5)	0.86 (0.50, 1.50)	0.88 (0.50, 1.57)
Parent Race/Ethnicity						
Minority	109 (19.7)	49 (44.6)	44 (40.4)	16 (15.0)	Ref	Ref
White	445 (80.3)	211 (47.4)	166 (37.3)	68 (15.3)	1.01 [0.54, 1.90]	0.89 [0.47, 1.68]
Parent Biological Sex						
Female	420 (74.9)	200 (47.6)	159 (37.9)	61 (14.5)	Ref	Ref
Male	141 (25.1)	65 (46.1)	53 (37.6)	23 (16.3)	0.86 [0.50, 1.50]	0.88 [0.50, 1.57]
Parent Education						
Bachelors or higher	200 (36.30)	103 (51.5)	76 (38.0)	21 (10.5)	Ref	Ref
Some college of less	351 (63.70)	154 (43.9)	134 (38.2)	63 (17.9)	**0.50*[0.29, 0.87]**	0.59 [0.33, 1.04]
Geography						
Urban	211 (38.37)	101 (47.9)	87 (41.2)	23 (10.9)	Ref	Ref
Rural	339 (61.63)	158 (46.6)	120 (35.4)	61 (18.0)	0.59 [0.34, 1.01]	**0.52*[0.30, 0.90]**
Political Ideology						
Conservative	166 (35.0)	62 (37.3)	75 (45.2)	29 (17.5)	Ref	Ref
Liberal	193 (40.7)	99 (51.3)	62 (32.1)	32 (16.6)	2.03 [0.85, 4.84]	0.75 [0.41, 1.37]
Moderate	115 (24.3)	65 (56.5)	42 (36.5)	8 (7.0)	**3.80**[1.61, 8.95]**	1.45 [0.80, 2.62]
Healthcare Characteristics						
Child HPV Shots						
1+	306 (54.7)	162 (52.9)	111 (36.3)	33 (10.8)	Ref	Ref
0	253 (45.3)	102 (40.3)	100 (39.5)	51(20.2)	**0.34***[0.20, 0.57]**	**0.56*[0.33, 0.96]**
Vaccination site						
Other	146 (26.0)	64 (43.8)	66 (45.2)	16 (11.0)	Ref	Ref
Private clinic	415 (74.0)	201 (48.4)	146 (35.2)	68 (16.4)	0.74 [0.40, 1.36]	**0.52* [0.28, 0.97]**
Insurance type						
Other	230 (41.6)	112 (48.7)	93 (40.4)	25 (10.9)	Ref	Ref
Private	323 (58.4)	153 (46.6)	117 (35.7)	58 (17.7)	**0.59*[0.35, 0.99]**	**0.54*[0.32, 0.93]**
Regular healthcare provider						
No	53 (09.5)	22 (41.5)	23 (43.4)	8 (15.1)	Ref	Ref
Yes	508 (90.5)	243 (47.8)	189 (37.2)	76 (15.0)	1.16 [0.50, 2.72]	0.87 [0.37, 2.02]
Ability to take time off work						
No	132 (23.6)	60 (45.4)	50 (37.9)	22 (16.7)	Ref	Ref
Yes	428 (76.4)	205 (47.9)	161 (37.6)	62 (14.5)	1.21 [0.69, 2.13]	1.14 [0.64, 2.04]
Health Beliefs						
Cancer from HPV infection problem						
No	154 (27.5)	54 (35.0)	62 (40.3)	38 (24.7)	Ref	Ref
Yes	135 (24.1)	78 (57.8)	47 (34.8)	10 (7.4)	**5.49***[2.51, 11.95]**	**2.88**[1.30, 6.37]**
Unsure	271(48.4)	133 (49.1)	102 (37.6)	36 (13.3)	**2.60***[1.49, 4.53]**	1.74 [0.99, 3.02]
Perceived collective benefits of vaccines	4.16 + (0.96)	4.38 ±(0.91)	4.08 ± (0.92)	3.67 ± (1.01)	**2.10**[1.63, 2.67]**	**1.41**[1.12, 1.78]**
Lack of confidence in vaccines	1.68 + (0.72)	1.49 ± (0.67)	1.71 ± (0.59)	2.18 ± (0.88)	**0.28***[0.19, 0.40]**	**0.49 [0.35, 0.67]**

Table 1 (continued)

	Total	Support for General Vaccine Requirements, n (%)			Bivariate Association, OR [95% CI]	
	N (%) or Mean (SD)	Always (n = 265, 47.2)	Some Circumstances (n = 212, 37.8)	Never (n = 84 15.0)	Always vs. Never	Limited Circumstances vs. Never
Perceived risks of vaccination	3.00 ± (0.96)	2.72 ± (0.94)	3.25 ± (0.88)	3.30 ± (0.90)	**0.50*** [0.38, 0.67]**	0.93 [0.70, 1.24]
Perceived vaccine importance	4.21 +(0.78)	4.42 ± (0.74)	4.17 ±(0.66)	3.65 ± (0.89)	**3.46*** [2.47, 4.86]**	**1.97*** [1.46, 2.66]**
Perceived benefits of HPV vaccines	3.80 ± (0.90)	4.17 ± (0.73)	3.63 ± (0.80)	3.07 ± (1.06)	**4.69*** [3.36, 6.55]**	**1.89*** [1.43, 2.50]**
Interpersonal altruism	2.66 +(0.80)	2.70 ± (0.81)	2.63 ± (0.73)	2.59 ± (0.63)	1.19 [0.86, 1.65]	1.07 [0.76, 1.50]

[1]Bolded values are significant at $p < 0.05^{*}$, $p < 0.01^{**}$, $p < 0.001^{***}$

say. Due to minimal participant response in the "other" category (n = 1), this category was dropped, leaving a two-item category of male and female. Education was categorized as either: 1) bachelor's degree and higher; or (2) some college or less. Rural/urban residency was measured as living in a predominantly rural (< 1,000 people per square mile) or urban (at least 1,000 people per square mile) location, which was determined using each participant's reported ZIP code [19]. Political ideology was measured with a single item, which asked: "In general, how would you describe your political views," with the answer choices being very liberal, liberal, moderate, conservative, very conservative, and prefer not to answer. Due to the distribution of small and unequal responses in categories, a three-level variable was created: liberal, moderate, and conservative.

Healthcare Characteristics

Healthcare characteristics were based on self-report and included binary responses to questions about their child's HPV vaccination status (zero vs. one or more doses), location of vaccination site (private clinic/other), regular healthcare provider for child (yes/no), and ability to take time off work to get child to medical appointments (yes/no). Type of insurance was measured with three categories of private, public/Medicare, and uninsured. Due to a low percentage of uninsured, a two-level variable of private and other/or none was created.

Health Beliefs

To assess the perceived local severity of HPV cancers, participants were asked: "Do you think that cancer resulting from HPV infection is a major problem in your county?" Participants responded with a 5-point Likert-type scale ranging from Definitely Yes to Definitely Not. Responses were collapsed across the two "Yes" groups and across the two "Not" groups, resulting in a 3-level variable: Yes, Unsure, and Not.

Perceived collective benefits of vaccines, vaccine hesitancy, perceived vaccine importance, perceived benefits of HPV vaccines, and interpersonal altruism were all measured on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree) and were adapted from prior research, where possible [20–27]. Perceived collective benefits of vaccines was measured with a 2-item scale that reflected the belief that personal vaccination benefits the larger community (Cronbach's alpha = 0.80) [20]. Vaccine hesitancy was measured using a modified version of the vaccine hesitancy scale (VHS) and was composed of two subscales: lack of confidence and risks [21, 22]. Lack of confidence in vaccines was measured with 6-items, which were reverse scored and summed (Cronbach's alpha = 0.90) so that higher scores indicate less confidence in vaccines. Perceived risks of vaccination was measured with two items that were summed (Cronbach's alpha = 0.69) so that higher scores indicate greater perceived risks.

Perceived vaccine importance was measured with a 5-item scale derived from the U.S. Department of Health & Human Services website of the "Five Important Reasons to Vaccinate your Child" (Cronbach's alpha = 0.89) [23]. Perceived benefits of HPV vaccines was measured with a 7-item scale that was constructed from previous studies (Cronbach's alpha = 0.70) [24–26]. Last, to measure interpersonal altruism we modified a previously published scale [27]. Interpersonal altruism consisted of six items (Cronbach's $\alpha = 0.74$) that measured behaviors that require a relatively high level of interpersonal involvement in helping others; e.g., "I have helped push a stranger's car out of the snow or mud." A mean score was calculated for the interpersonal altruism scale.

Statistical Analyses

Study variables were assessed using descriptive statistics, with means and standard deviations for continuous variables and frequencies and percentages for categorical variables. For analysis of the outcome variable, acceptability of general state vaccine requirements for childhood vaccines, the category "never" served as the reference group. For analyses with the outcome variable, belief in HPV-specific vaccine requirements in middle school, the category "strongly disagree/disagree" served as the reference group. Individual associations of each covariate with the outcome variable were examined using multinomial regression. Any variable that was significant at $p < 0.05$ in bivariate comparisons was entered into separate multivariable multinomial logistic regression models built for each outcome. Using a backward selection process, covariates with $p < 0.05$ were retained in the final multivariable models. Data were analyzed using SPSS Software v. 27 (IBM Corp., Armonk, N.Y., USA).

Results

Study Participants

Of the 601 participants, 10 answered the survey for children under age 11 years and were therefore omitted from the analyses. Of the remaining 591 participants, 29 did not respond to one or both outcome items and one additional participant did not answer the age and gender questions, leaving an analyzable sample size of 561 (94.9%). For the 561 respondents, 74.9% identified as female and 25.1% as male. Non-Hispanic Whites and other race/ethnicities represented 80.3% and 19.7% of the sample, respectively. Parent participants' mean age was 41.1 years (SD = 8.7), and their children's mean age was 13.9 years (SD = 1.9). Participants' political views indicated that 24.5% were liberal, 39.9% moderate, and 35.6% conservative, though a relatively large number of respondents (15.5%) either skipped this question (n = 8) or preferred not to answer (n = 79). Participants were primarily from rural locations (61.7%), with 63.7% having some college or less and 36.3% having a college degree or higher.

Beliefs About General School-Entry Required Vaccines

Out of 561 responses, 47.2% (n = 265) of parents believed there should always be general childhood vaccine requirements; 37.8% (n = 212) believed there should be so in limited circumstances, and 15.0% (n = 84) believed there should never be state vaccine requirements.

Always Accepting vs. Never Accepting General Vaccine Requirements

In bivariate analyses, the participants had greater odds of being in the group who reported there should always be vaccine requirements (vs. never accepting vaccine requirements) if they were politically moderate compared to conservative (OR = 3.80; 95% CI = 1.61–8.95), agreed or were unsure that cancer from HPV is a problem in the county (OR = 5.49; 95% CI = 2.51–11.95; OR = 2.60; 95% CI = 1.49–4.53, respectively), endorsed higher collective benefits of vaccines (OR = 2.10; 95% CI = 1.63–2.67), higher perceived vaccine importance (OR = 3.46; 95% CI = 2.47–4.86), and had higher perceived benefits of HPV vaccines (OR = 4.69; 95% CI = 3.36, 6.55). Odds were lower if participants had less than a bachelor's degree (OR = 0.50; 95% CI = 0.29-0.87), their child had not received any HPV vaccinations (OR = 0.34; 95% CI = 0.20-0.57), they had private insurance (OR = 0.59; 95% CI = 0.35-0.99), had less confidence in vaccines (e.g., greater lack of confidence in vaccines) (OR = 0.28; 95% CI = 0.19-0.40), and perceived greater risks associated with vaccination (OR = 0.50; 95% CI = 0.38-0.67). These variables were all included in the final model.

For the final model (Table 2), respondents had higher odds of being in the always agree with school-entry vaccine requirements group if they were unsure that cancer from HPV is a major problem in their community compared to those who believed it is not a problem (aOR = 3.13; 95% CI = 1.39–7.17) and had higher perceived benefits of HPV vaccines (aOR = 2.67; 95% CI = 1.49–4.78). Respondents had lower odds of being in the always agree group if they had private insurance (aOR = 0.25; 95% CI = 0.11-0.59), less than a bachelor's degree (aOR = 0.45; 95% CI = 0.21-0.95), and had greater perceived risks of vaccination (aOR = 0.66; 95% CI = 0.44-0.98).

Accepting in Limited Circumstances vs. Never Accepting Requirements

In bivariate analyses, odds of being in the limited circumstances group (vs. never accepting) was higher for those who agreed that cancer from HPV is a problem in their county in comparison to those who did not (OR = 2.88; 95% CI = 1.30–6.37), endorsed higher collective benefits of vaccines (OR = 1.41; 95% CI = 1.12–1.78), had higher perceived vaccine importance (OR = 1.97; 95% CI = 1.46–2.66), and higher perceived benefits of HPV vaccines (OR = 1.89; 95% CI = 1.43–2.50). Participants had lower odds if they lived in a rural area (OR = 0.52; 95% CI = 0.30-0.90), had their child vaccinated at a private clinic (OR = 0.52; 95% CI = 0.28-0.97), had private insurance (OR = 0.54; 95%

Table 2 Multivariable Multinomial Logistic Regression, Support for General Vaccine Requirements

Variable	Always vs. Never	Limited Circumstances vs. Never
Education		
Bachelors or higher	Ref	Ref
Some college	**0.45*[0.21, 0.95]**	0.50 [0.24, 1.04]
Geography		
Urban	Ref	Ref
Rural	0.46 [0.21, 1.01]	**0.33**[0.16, 0.71]**
Political Ideology		
Conservative	Ref	Ref
Liberal	1.64 [0.57, 4.74]	1.30 [0.47, 3.61]
Moderate	0.67 [0.30, 1.47]	**0.39**[0.18, 0.83]**
Healthcare Characteristics		
Child HPV shots		
1+	Ref	Ref
0	0.90 [0.40, 2.03]	0.96[0.43, 2.15]
Vaccination site		
Other	Ref	Ref
Private clinic	0.62 [0.23, 1.65]	0.44 [0.17, 1.15]
Insurance type		
Other	Ref	Ref
Private	**0.25**[0.11, 0.59]**	**0.33**[0.14, 0.74]**
Health Beliefs		
Cancer from HPV infection problem		
No	Ref	Ref
Yes	2.31 [0.78, 6.85]	1.67 [0.58, 4.79]
Unsure	**3.13**[1.39, 7.17]**	1.75 [0.81, 3.77]
Perceived collective benefits of vaccines	1.11 [0.70, 1.77]	0.95 [0.61, 1.47]
Lack of confidence in vaccines	0.53 [0.26, 1.09]	**.48*[0.24, 0.95]**
Perceived risks of vaccination	**0.66*[0.44, 0.98]**	1.12 [0.77, 1.65]
Perceived vaccine importance	1.46 [0.75, 2.85]	1.61 [0.86, 3.02]
Perceived benefits of HPV vaccines	**2.67***[1.49, 4.78]**	1.07 [0.64, 1.81]

[1]Bolded values are significant at $p < 0.05^{*}$, $p < 0.01^{**}$, $p < 0.001^{***}$

[2]Table shows constructs with bivariate values significant at 0.05 used in final multivariable model

CI = 0.32-0.93), had not given their child any HPV vaccinations (OR = 0.56; 95% CI = 0.33-0.96), and reported less confidence in vaccines (OR = 0.49; 95% CI = 0.35-0.67). These variables were all included in the final model.

For the final model shown in Table 2, moderate political ideology as compared to conservative (aOR = 0.39; 95% CI = 0.18-0.83) was associated with higher odds of being in the limited circumstances group compared to the never agreeing group. Lower odds included: private insurance (aOR = 0.33; 95% CI = 0.14-0.74), rural location (aOR = 0.33; 95% CI = 0.16-0.71), and less confidence in vaccines (aOR = 0.48; 95% CI = 0.24-0.95).

Beliefs About HPV Vaccine-Specific Requirements in Middle School

Out of 561 responses, 43.1% (n = 242) of participants strongly agreed or agreed that there should be school-entry requirements for HPV in middle school; 27.8% (n = 156) were unsure, and 29.1% (n = 163) strongly disagreed or disagreed.

Agreeing vs. Disagreeing with HPV Vaccine Requirements for Middle School

In bivariate analyses, the participants had greater odds of being in the group who agreed there should always be HPV vaccine requirements in middle school (vs. never agreeing) if they were politically moderate compared to conservative (OR = 1.99; 95% CI = 1.11–3.56), agreed or were unsure that cancer from HPV infection is a problem in the county (OR = 4.66; 95% CI = 2.63–8.25; OR = 1.89; 95% CI = 1.18–3.03), endorsed higher collective benefits of vaccines (OR = 1.40; 95% CI = 1.13–1.74), reported higher perceived vaccine importance (OR = 2.05; 95% CI = 1.56–2.72), higher perceived benefits of HPV vaccines (OR = 9.34; 95% CI = 6.36–13.72), and higher interpersonal altruism (OR = 1.45; 95% CI = 1.11–1.89). Participants had lower odds of agreeing there should be HPV vaccine requirements in middle school if their child did not have at least one HPV shot (OR = 0.20; 95% CI = 0.13-0.31), were non-Hispanic White (OR = 0.53; 95% CI = 0.31-0.91), had their child vaccinated at a private clinic (OR = 0.61; 95% CI = 0.38-0.98), had less confidence in vaccines (OR = 0.46; 95% CI = 0.34-0.63), and had greater perceived risks of vaccination (OR = 0.70; 95% CI = 0.56-0.87) (See Table 3). These variables were all included in the final adjusted model.

For the final model, shown in Table 4, participants had higher odds of being in the group that agreed with HPV-specific vaccine mandates (versus not agreeing) if they had higher interpersonal altruism (aOR = 1.55; 95% CI = 1.02–2.35) and higher perceived benefits of HPV vaccines (aOR = 16.50; 95% CI = 8.30-32.19). Participants had lower odds of agreeing there should be HPV vaccine requirements in middle school if they were non-Hispanic White (aOR = 0.34; 95% CI = 0.15-0.81).

Table 3 Sample Description, Support for HPV Vaccine Requirements in Middle School, and Bivariate Associations with Support for HPV Vaccine Requirements in Middle School

		Support for HPV Vaccine Requirements, n (%)			Bivariate Association, OR [95% CI]	
	Total	Agree (n = 242 43.1)	Unsure (n = 156 27.8)	Disagree (n = 163 29.1)	Agree vs. Disagree	Unsure vs. Disagree
Child Race/Ethnicity						
Minority	130 (23.2)	60 (46.2)	41(31.5)	29 (22.3)	Ref	Ref
Non-Hispanic White	419 (74.5)	175 (41.8)	114 (27.2)	130 (31.0)	0.65 (0.40, 1.07)	0.62 (0.36, 1.06)
Child Sex						
Female	278 (50.5)	118 (42.5)	79 (28.4)	81 (29.1)	Ref	Ref
Male	272 (49.5)	113 (41.5)	77 (28.3)	82 (30.2)	1.28 (0.71, 2.33)	1.04 (0.47, 2.31)
Parent Race/Ethnicity						
Minority	109 (19.7)	55 (50.4)	32 (29.4)	22 (20.2)	Ref	Ref
White	445 (80.3)	183 (41.1)	123 (27.7)	139 (31.2)	**0.53* [0.31, 0.91]**	0.61 [0.34, 1.10]
Parent Biological Sex						
Female	420 (74.9)	179 (42.6)	109 (26.0)	132 (31.4)	Ref	Ref
Male	141 (25.1)	63 (44.7)	47 (33.3)	31 (22.0)	1.5 [0.92, 2.44]	**1.84*[1.09, 3.09]**
Parent Education						
Bachelors or higher	200 (36.3)	91 (45.5)	60 (30.0)	49 (24.5)	Ref	Ref
Some college of less	351 (63.7)	146 (41.6)	94 (26.8)	111 (31.6)	0.71 [0.46, 1.08]	0.69 [0.43, 1.10]
Geography						
Urban	211 (38.4)	98 (46.5)	56 (26.5)	57 (27.0)	Ref	Ref
Rural	339 (61.6)	139 (41.0)	98 (28.9)	102 (30.1)	0.79 [0.52, 1.19]	0.99 [0.62, 1.57]
Political Ideology						
Conservative	166 (35.0)	64 (38.6)	46 (27.7)	56 (33.7)	Ref	Ref
Liberal	193 (40.7)	84 (43.5)	56 (29.0)	53 (27.5)	1.41 [0.73, 2.7]	1.29 [0.75, 2.21]
Moderate	115 (24.3)	59 (51.3)	30 (26.1)	26 (22.6)	**1.99*[1.11, 3.56]**	1.39 [0.84, 2.28]
Healthcare Characteristics						
Child HPV Shots						
1+	306 (54.7)	162 (52.9)	84 (27.5)	60 (19.6)	Ref	Ref
0	253 (45.3)	78 (30.8)	72 (28.5)	103 (40.7)	**0.20***[0.13, 0.31]**	**0.39***[0.24, 0.62]**
Vaccination site						
Other	146 (26.0)	71 (48.6)	42 (28.8)	33 (22.6)	Ref	Ref
Private clinic	415 (74.0)	171 (41.2)	114 (27.5)	130 (31.3)	**0.61*[0.38, 0.98]**	0.69 [0.41, 1.16]
Insurance type						
Other	230 (41.2)	108 (46.9)	57 (24.8)	65 (28.3)	Ref	Ref
Private	328 (58.8)	132 (40.2)	99 (30.2)	97 (29.6)	0.82 [0.55, 1.23]	1.16 [0.74, 1.83]
Regular healthcare provider						
No	53 (9.4)	20 (37.7)	16 (30.2)	17 (32.1)	Ref	Ref
Yes	508 (90.6)	222 (43.7)	140 (27.6)	146 (28.7)	1.29 [0.66, 2.55]	1.02 [0.50, 2.10]
Ability to take time off work						
No	132 (23.6)	54 (40.9)	44 (33.3)	34 (25.8)	Ref	Ref
Yes	428 (76.4)	188 (43.9)	111 (25.9)	129 (30.2)	0.92 [0.57, 1.49]	0.67 [0.40, 1.11]
Health Beliefs						
Cancer from HPV infection problem						
No	154 (27.5)	52 (33.7)	34 (22.1)	68 (44.2)	Ref	Ref
Yes	135 (24.1)	89 (65.9)	21(15.6)	25 (18.5)	**4.66***[2.63, 8.25]**	1.68 [0.83, 3.42)
Unsure	271 (48.4)	101 (37.3)	100 (36.9)	70 (25.8)	**1.89**[1.18, 3.03]**	**2.86**[1.71, 4.77]**
Perceived collective benefits of vaccines	4.16 ± (0.96)	4.32 ± (0.89)	4.06 ± (0.96)	4.02 ± (1.02)	**1.40**[1.13, 1.74]**	1.03 [0.83, 1.28]
Lack of confidence in vaccines	1.68 ± (0.72)	1.51 ± (0.61)	1.72 ± (0.69)	1.88 ± (0.83)	**0.46***[0.34, 0.63]**	0.77 [0.58, 1.03]

Table 3 (continued)

		Support for HPV Vaccine Requirements, n (%)			Bivariate Association, OR [95% CI]	
	Total	Agree (n = 242 43.1)	Unsure (n = 156 27.8)	Disagree (n = 163 29.1)	Agree vs. Disagree	Unsure vs. Disagree
Perceived risks of vaccination	3.00 ± (0.96)	2.88 ± (1.00)	3.00 ± (0.83)	3.21 ± (0.99)	**0.70*** [0.56 0.87]**	**0.79* [0.63, 1.00]**
Perceived vaccine importance	4.21 + (0.78)	4.40 ± (0.67)	4.16 ± (0.69)	3.98 ± (0.94)	**2.05*** [1.56, 2.72]**	1.29 [0.99, 1.69]
Perceived benefits of HPV vaccines	3.80 ± (0.90)	4.32 ± (0.60)	3.75 ± (0.64)	3.09 ± (0.99)	**9.34*** [6.36, 13.72]**	**2.63*** [1.90, 3.58]**
Interpersonal altruism	2.66 ± (0.80)	2.78 ± (0.81)	2.55 ± (0.67)	2.57 ± (0.73)	**1.45** [1.11, 1.89]**	0.97 [0.72, 1.3]

[1]Bolded values are significant at $p < 0.05^{*}$, $p < 0.01^{**}$, $p < 0.001^{***}$

Table 4 Multivariable Multinomial Logistic Regression, Support for HPV Mandates in Middle School

Variable	Agree vs. Disagree	Unsure vs. Disagree
Parent Race/Ethnicity		
Minority	Ref	Ref
Non-Hispanic White	**0.34** [0.15, 0.81]**	0.58 [0.25, 1.34]
Parent Biological Sex		
Female	Ref	Ref
Male	1.49 [0.80, 2.89]	1.51 [0.71, 3.20]
Political Ideology		
Conservative	Ref	Ref
Liberal	0.62 [0.26, 1.45]	0.81 [0.35, 1.87]
Moderate	0.67 [0.32, 1.40]	0.84 [0.42, 1.68]
Healthcare Characteristics		
Child HPV shots		
1+	Ref	Ref
0	0.61 [0.31, 1.20]	0.70 [0.37, 1.34]
Vaccination site		
Other	Ref	Ref
Private clinic	0.62 [0.30, 1.30]	0.61 [0.30, 1.23]
Health Beliefs		
Cancer from HPV infection problem		
No	Ref	Ref
Yes	0.92 [0.38, 2.20]	0.60 [0.23, 1.55]
Unsure	1.20 [0.58, 2.49]	**2.24* [1.12, 4.45]**
Perceived collective benefits of vaccines	0.99 [0.64, 1.53]	0.82 [0.54, 1.24]
Lack of confidence in vaccines	1.80 [0.89, 3.66]	1.12 [0.57, 2.20]
Perceived risks of vaccination	0.86 [0.61, 1.22]	0.94 [0.67, 1.31]
Perceived vaccine importance	0.80 [0.43, 1.48]	0.97 [0.54, 1.74]
Perceived benefits of HPV vaccines	**16.50*** [8.30, 32.19]**	**3.93*** [2.20, 7.02]**
Interpersonal altruism	**1.55* [1.02, 2.35]**	1.07 [0.71, 1.60]

[1]Bolded values are significant at $p < 0.05^{*}$, $p < 0.01^{**}$, $p < 0.001^{***}$

[2]Table shows constructs with bivariate values significant at 0.05 used in final multivariable model

Unsure vs. Disagreeing with HPV Vaccine Requirements for Middle School

In bivariate analyses, the participants had greater odds of being in the group who were unsure of whether there should be HPV vaccine requirements in middle school (vs. not agreeing) if they were male (OR = 1.84; 95%CI = 1.09, 3.09), unsure that cancer from HPV is a problem in the county compared to those who believed it is not a problem (OR = 2.86; 95% CI = 1.71–4.77) and had higher perceived benefits of HPV vaccines (OR = 2.63; 95% CI = 1.90–3.58). Participants had lower odds if their child had not received at least one HPV shot (OR = 0.39; 95% CI = 0.24-0.62), and if they had greater perceived risk of vaccines (OR = 0.79; 95% CI = 0.63 – 1.00). These variables were all included in the final adjusted model.

For the final model, respondents had higher odds of being in the group who were unsure of whether there should be HPV-specific vaccine requirements in middle school if they were unsure whether cancer from HPV is a problem in their county in comparison to those who did not believe so (aOR = 2.24; 95% CI = 1.12–4.45) and if they had higher perceived benefits of HPV vaccines (aOR = 3.93; 95% CI = 2.20–7.02). (See Table 4).

Discussion

This study assessed and compared Indiana parental support for general state vaccine requirements for children and HPV-specific vaccine requirements in middle school. Our study found that the variables that drive parental support for general versus HPV vaccine requirements can differ, and it identified common and unique characteristics of groups accepting of each. Similarly, results showed that perceived benefits of HPV vaccination were significantly associated with support for both general and HPV-specific vaccine

requirements. Indeed, 66% of respondents in our study who believed the state should always mandate general vaccine requirements also agreed with HPV vaccine requirements for middle school. This is encouraging because the number of states proposing school-entry requirements for HPV vaccination has increased over the last decade [17], yet studies have consistently found lower parental acceptance of HPV vaccine requirements [17] in comparison to other vaccines typically required for school entry (e.g., Measles-Mumps-Rubella, Diphtheria-Tetanus-Pertussis, Hepatitis B) [28].

In terms of differences, the adjusted model showed that education, insurance type, perceived risks of vaccination, and perception of cancer from HPV as a problem in the community significantly impacted parental support for general state vaccine requirements, while race and interpersonal altruism impacted support of HPV requirements in middle school. The construct of altruism has received considerable theoretical consideration in research on vaccination decisions [29–32]. Research has shown that vaccine messages targeting altruism can increase vaccination intentions by invoking messages that prompt greater concern for others' welfare [30]. When incorporated into epidemiological models, it can shift vaccination decisions away from individual self-interest toward community interest [31]. However, individual studies lack a cohesive definition of altruism that clarifies the dynamics between the self and others as it relates to vaccination decisions [33]. Our analysis refined the altruism construct by operationalizing it as interpersonal altruism, which is behavioral involvement in substantial acts of giving to others (e.g., pushing another person's car out of the mud/snow) and demonstrated that it can be impactful in parental views about HPV requirements in middle school.

Our study also described the characteristics of parents who were either unsure about or supportive of vaccine requirements in limited circumstances. This analysis is important because it is often the unsure and moderately tempered groups that are most persuaded by messaging, as individuals tend to resist or avoid persuasion messages that contradict one's deeply held beliefs (See Festinger's 1957 cognitive dissonancy theory) [34]. Our results from the overall model can provide direction for future public health interventions. Specifically, results indicate that interventions and messages aimed at persuading those who are more moderately accepting of general vaccine requirements should improve confidence in vaccines, especially targeting information among parents in rural Indiana locations who have private insurance. To address parents unsure about accepting HPV vaccine requirements in middle school, messages addressing the benefits of HPV vaccination and education about the incidence of HPV-related cancers in the parent's county may be useful persuasion tactics.

Last, results of this study found that there was still a considerable percentage of parents who did not accept any type of vaccine requirement (15% and 29% for general and HPV, respectively), suggesting a need for ongoing policies and interventions aimed at improving acceptance. Gaining parental support for HPV-specific school requirements for middle school is important because the vaccine is most effective if it is given before HPV infection is acquired [35], and, by age 16 years, an estimated 34% of US girls and boys have already initiated sexual intercourse [35]. Additionally, general vaccine requirements are associated with reducing socioeconomic and racial-ethnic inequalities in health provider recommendation and vaccine uptake [36]. While public health officials have suggested that states can use strategies such as the elimination or tightening of exemptions (e.g., strengthening the application process, frequency of submission, and enforcement) to improve vaccination rates, interpersonal communication consisting of in-depth discussions with hesitant parents are still influential and necessary [37]. Having these important discussions may be more effective when knowing both the direction of support as well as the health beliefs and healthcare characteristics that influence parental stances toward requirements as defined in this study.

Limitations

These results should be interpreted in the context of several limitations. The study used a convenience sample of individuals who are part of a survey panel and consented to the study, and thus the results may not be representative of the broader population of Indiana parents or generalizable to other states. The data are also cross-sectional, and causal relationships cannot be determined. Furthermore, the self-report nature of the data is also subject to recall and social desirability biases; however, the survey was anonymous to reduce chances of social desirability bias. Also, this study was conducted just prior to the COVID-19 pandemic. Given the increased emphasis on vaccine mandates during the pandemic, parental responses may now differ. Despite limitations, our (bring up sentence from below to this line)

study demonstrated the parental attitudes and characteristics associated with both general and HPV-specific vaccine requirements to inform policy makers of salient predictor variables for improving vaccination support.

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Declarations

Competing Interest *GDZ* has served as a consultant to Merck (regarding HPV vaccination) and external advisory board member for Mod-

erna (regarding COVID-19 vaccination) and Pfizer (regarding meningococcal vaccination). He has also received investigator-initiated research funding from Merck, administered through Indiana University. *MLK* has received investigator-initiated research funding from Merck, administered through Purdue University. *KJH* has received investigator-initiated research funding from Merck, administered through Indiana University, and serves as an unpaid advisory member to the Indiana Immunization Coalition.

References

1. Gualano, M. R., Olivero, E., Voglino, G., et al. (2019). Knowledge, attitudes and beliefs towards compulsory vaccination: a systematic review. *Human Vaccines & Immunotherapeutics*, *15*(4), 918–931. https://doi.org/10.1080/21645515.2018.1564437.
2. Shachar, C., & Rubinstein Reiss, D. (2020). When are vaccine mandates appropriate? *AMA Journal of Ethics*, 22*(a)*, e36-42. https://doi.org/10.1001/amajethics.2020.36.
3. Immunize.org (2022). Exemptions permitted to school and child care immunization requirements. Retrieved May 30, 2021 from https://www.immunize.org/laws/exemptions.pdf.
4. Robitz, R., Gottlieb, S. L., De Rosa, C. J., et al. (2011). Parent attitudes about school requirements for human papillomavirus vaccine in high-risk communities of Los Angeles, California. *Cancer Epidemiology Biomarkers & Prevention*, *20*(7)), 1421–1429. https://doi.org/10.1158/1055-9965.
5. Olive, J. K., Hotez, P. J., Damania, A., & Nolan, M. S. (2018). Correction: the state of the antivaccine movement in the United States: a focused examination of nonmedical exemptions in states and counties. *PLOS Medicine*, *15*(7), e1002616. https://doi.org/10.1371/journal.pmed.1002616.
6. Olson, O., Berry, C., & Kumar, N. (2020). Addressing parental vaccine hesitancy towards childhood vaccines in the United States: a systematic literature review of communication interventions and strategies. *Vaccines (Basel)*, *8*(4), 590. https://doi.org/10.3390/vaccines8040590.
7. Allan, N., & Harden, J. (2014). Parental decision-making in uptake of the MMR vaccination: a systematic review of qualitative literature. *Journal of Public Health (Bangkok)*, *37*(4), fdu075. https://doi.org/10.1093/pubmed/fdu075.
8. Facciola, A., Visalli, G., Orlando, A., et al. (2019). Vaccine hesitancy: an overview on parents' opinions about vaccination and possible reasons of vaccine refusal. *Journal of Public Health Research*, *8*(1), 1436. https://doi.org/10.4081/jphr.2019.1436.
9. U.S. Department of Health and Human Services Healthy People 2030 (2022). Increase the proportion of adolescents who get recommended doses of the HPV vaccine – IID-08. Retrieved September 15, 2022 from https://health.gov/healthypeople/objectives-and-data/browse-objectives/vaccination/increase-proportion-adolescents-who-get-recommended-doses-hpv-vaccine-iid-08.
10. Pingali, C., Yankey, D., Elam-Evans, L. D., et al. (2021). National vaccination coverage among adolescents aged 13–17 years – National Immunization Survey-Teen, United States. *MMWR Morbidity and Mortality Weekly Report*, *71*, 1101–1108. https://doi.org/10.15585/mmwr.mm7135a1.
11. Horn, L., Howard, C., Waller, J., & Ferris, D. G. (2010). Opinions of parents about school-entry mandates for the human papillomavirus vaccine. *Journal of Lower Genital Tract Disease*, *14*(1), 43–48. https://doi.org/10.1097/LGT.0b013e3181b0fad4.
12. Perkins, R. B., Pierre-Joseph, N., Marquez, C., Iloka, S., & Clark, J. A. (2010). Parents' opinions of mandatory human papillomavirus vaccination: does ethnicity matter? *Women's Health Issues*, *20*(6), 420–426. https://doi.org/10.1016/j.whi.2010.07.001.
13. Calo, W. A., & Brewer, N. T. (2020). HPV vaccine requirements, opt-outs and providers' support: key studies missing from a recent systematic review. *Human Vaccines & Immunotherapeutics*, *16*(1), 128–130. https://doi.org/10.1080/21645515.2019.1646580.
14. Colon-Lopez, V., Medin-Laabes, D. T., Abrew, R. S., et al. (2021). Understanding parents' views toward the newly enacted HPV vaccine school entry policy in Puerto Rico: a qualitative study. *Bmc Public Health*, *21*, 1938. https://doi.org/10.1186/s12889-021-11952-w.
15. Vercruysse, J., Chigurupati, N. L., Fung, L., et al. (2016). Parents' and providers' attitudes toward school located provision and school-entry requirements for HPV vaccines. *Human Vaccines & Immunotherapeutics*, *12*(6), 1606–1614. https://doi.org/10.1080/21645515.2016.1140289.
16. Smith, J. S., Brewer, N. T., Chang, Y. (2011). Acceptability of school requirements for human papillomavirus vaccine. *Human Vaccines*, 7*(9)*, 952–57. https://doi.org/10.4161/hv.7.9.15995.
17. Calo, W. A., Gilkey, M. B., Shah, P. D., et al. (2016). Support for school-entry requirements for HPV vaccination: a national study. *Cancer Epidemiology Biomarkers Prevention*, *25*(9), 1317–1325. https://doi.org/10.1158/1055-9965.
18. Calo, W. A., Gilkey, M. B., Shah, P. D., Moss, J. L., & Brewer, N. T. (2016). Parents' support for school-entry requirements for human papillomavirus vaccination: a national study. *Cancer Epidemiology Biomarkers & Prevention*, *25*(9), 1317–1325. https://doi.org/10.1158/1055-9965.EPI-15-1159.
19. Ratcliffe, M., Burd, C., Holder, K., & Fields, A. (2016). Defining rural at the U.S. Census Bureau. *American Community Survey and Geography Brief*. Retrieved January 20, 2020 from https://www2.census.gov/geo/pdfs/reference/ua/Defining_Rural.pdf.
20. Betsch, C., Schmid, P., Heinemeier, D., Korn, L., Holtmann, C., & Bohm, R. (2018). Beyond confidence: development of a measure assessing the 5 C psychological antecedents of vaccination. *Plos One*, *13*(12), e0208601. https://doi.org/10.1371/journal.pone.0208601.
21. Shapiro, G. K., Tatar, O., Dube, E., et al. (2018). The vaccine hesitancy scale: psychometric properties and validation. *Vaccine*, *36*(5), 660–667. https://doi.org/10.1016/j.vaccine.2017.12.043.
22. Helmkamp, L. J., Szilagyi, P. G., Zimet, G., et al. (2021). A validated modification of the vaccine hesitancy scale for childhood, influenza and HPV vaccines. *Vaccine*, *39*(13), 1831–1839. https://doi.org/10.1016/j.vaccine.2021.02.039.
23. U.S. Department of Health & Human Services (2023). Five important reasons to vaccinate your child. Retrieved January 15, 2020 from https://www.hhs.gov/immunization/get-vaccinated/for-parents/five-reasons/index.html.
24. Cox, D. S., Cox, A. D., Sturm, L., & Zimet, G. (2010). Behavioral intention to increase HPV vaccination among mothers of young girls. *Health Psychology*, *29*, 29–39. https://doi.org/10.1037/a0016942.
25. Dempsey, A. F., Zimet, G. D., & Davis, R. L.,Koutsky. L (2006). Factors that are associated with parental acceptance of human papillomavirus vaccines: a randomized intervention study of written information about HPV. *Pediatrics*, *117*, 1486–1493. https://doi.org/10.1542/peds.2005-1381.
26. Rickert, V. I., Auslander, B. A., Cox, D. S., et al. (2014). School-based vaccination of young US males: impact of health beliefs on intent and first dose acceptance. *Vaccine*, *32*(17), 1982–1987. https://doi.org/10.1016/j.vaccine.2014.01.049.
27. Rushton, J. P., Chrisjohn, R. D., & Fekken, G. C. (1981). The altruistic personality and the self-report altruism scale. *Personality and Individual Differences*, *2*(4), 293–302. https://doi.org/10.1016/0191-8869(81)90084-2.

28. Walker, K. K., Head, K. J., Owens, H., & Zimet, G. D. (2021). A qualitative study exploring the relationship between mothers' vaccine hesitancy and perceptions of COVID-19 prevention during the early pandemic months. *Human Vaccines & Immunotherapeutics*, *17*(10), 3355–3364. https://doi.org/10.1080/21645515.2021.1942713.
29. Cato, S., Iida, T., Ishida, K., et al. (2022). Vaccination and altruism under the COVID-19 pandemic. *Public Health in Practice (Oxf)*, *3*, 100225. https://doi.org/10.1016/j.puhip.2022.100225.
30. Cucciniello, M., Pin, P., Imre, B., Porumbescu, G. A., & Melegaro, A. (2022). Altruism and vaccination intentions: evidence from behavioral experiments. *Social Science & Medicine*, *292*, 114195. https://doi.org/10.1016/j.socscimed.2021.114195.
31. Shim, E., Chapman, G. B., Townsend, J. P., & Galvani, A. P. (2012). The influence of altruism on influenza vaccination decisions. *Journal of the Royal Society Interface*, *9*(74), 2234–2243. https://doi.org/10.1098/rsif.2012.0115.
32. Zhu, P., Tatar, O., Griffin-Mathieu, G., et al. (2022). The efficacy of a brief, altruism-eliciting video intervention in enhancing COVID-19 vaccination intentions among a population-based sample of younger adults: Randomized controlled trial. *JMIR Public Health and Surveillance*, *8*(5), e37328. https://preprints.jmir.org/preprint/37328.
33. Kraaijeveld, S. R. (2020). Vaccinating for whom? Distinguishing between self-protective, paternalistic, altruistic and indirect vaccination. *Public Health Ethics*, *13*(2), 190–200. https://doi.org/10.1093/phe/phaa005.
34. Festinger, L. (1957). *A theory of cognitive dissonance*. Stanford University Press.
35. Polonijo, A. N. (2020). The impact of school-entry mandates on social inequalities in human papillomavirus vaccination. *SSM Population Health*, *12*, 100647. https://doi.org/10.1016/j.ssmph.2020.100647.
36. Lindberg, L. D., Firestein, L., & Beavin, C. (2021). Trends in U.S. adolescent sexual behavior and contraceptive use, 2006–2019. *Contraception X*, *3*, 100064. https://doi.org/10.1016/j.conx.2021.100064.
37. Yang, Y. T., & Silverman, R. D. (2015). Legislative prescriptions for controlling nonmedical vaccine exemptions. *JAMA Viewpoint*, *313*, 247–248. https://doi.org/10.1001/jama.2014.16286.
38. Mello, M. M., Opel, D. J., Benjamin, R. M., et al. (2022). Effectiveness of vaccination mandates in improving uptake of COVID-19 vaccines in the USA. *The Lancet*, *400*(10351), 535–538. https://doi.org/10.1016/S0140-6736(22)00875-3.