Published in final edited form as:

J Rural Health. 2018 June ; 34(3): 283–292. doi:10.1111/jrh.12285.

Belief About Mandatory School Vaccinations and Vaccination Refusal Among Ohio Appalachian Parents: Do Demographic and Religious Factors, General Health, and Political Affiliation Play a Role?

Jessica L. Krok-Schoen, PhD^{1,2}, Brittany M. Bernardo, MPH², Rory C. Weier, PhD³, Juan Peng, MAS⁴, Mira L. Katz, PhD^{2,5,6}, Paul L. Reiter, PhD^{2,5}, Morgan S. Richardson, MPH⁷, Michael L. Pennell, PhD⁸, Cathy M. Tatum, MA², Electra D. Paskett, PhD^{2,5,9}

¹Division of Medical Dietetics and Health Sciences, School of Health and Rehabilitation Sciences, College of Medicine, The Ohio State University, Columbus, Ohio

²Comprehensive Cancer Center, The Ohio State University, Columbus, Ohio

³Aver Inc., Columbus, Ohio

⁴Center for Biostatistics, Department of Biomedical Informatics, College of Medicine, The Ohio State University, Columbus, Ohio

⁵Division of Cancer Prevention and Control, Department of Internal Medicine, College of Medicine, The Ohio State University, Columbus, Ohio

⁶Division of Health Behavior and Health Promotion, College of Public Health, The Ohio State University, Columbus, Ohio

⁷Department of Neurology, College of Medicine, The Ohio State University, Columbus, Ohio

⁸Division of Biostatistics, College of Public Health, The Ohio State University, Columbus, Ohio

⁹Division of Epidemiology, College of Public Health, The Ohio State University, Columbus, Ohio

Abstract

Purpose: To examine how demographic, general health, religious, and political characteristics influenced beliefs about mandatory school vaccinations and history of vaccination refusal for children among Ohio Appalachian parents.

Methods: In 2013 and 2014, baseline data were obtained from parents (n = 337) of girls aged 9–17 from 12 counties in rural Ohio Appalachia enrolled in the Community Awareness, Resources and Education (CARE II) Project. Multivariate logistic regression models were used to identify correlates of parental beliefs about mandatory school vaccinations and history of refusing a doctor-recommended vaccine for their child(ren).

For further information, contact: Jessica Krok-Schoen, PhD, 306 Atwell Hall, 453 W. 10th Ave., Columbus, OH 43210; Jessica.krok@osumc.edu.

Disclosures: All of the authors report no actual, potential, or perceived conflicts of interest.

Results: About 47% of parents agreed that parents should have the right to refuse mandatory school vaccinations for their child(ren). Participants who reported their political affiliation as Republican (OR = 2.45, 95% CI: 1.28–4.66) or Independent (OR = 3.31, 95% CI: 1.70–6.44) were more likely to agree that parents should have the right to refuse school-mandated vaccinations than parents who reported their political affiliation as Democrat. Approximately 39% of parents reported ever refusing a vaccine for their child(ren). Participants who were female (OR = 3.90, 95% CI: 1.04–14.58) and believed that parents should have the right to refuse mandatory school vaccinations (OR = 3.27, 95% CI: 1.90–5.62) were more likely to report ever refusing a vaccine for their child(ren).

Conclusion: The study findings provide information to better understand factors related to vaccination refusal among parents in Appalachia Ohio that can be used to design interventions to improve vaccination uptake.

Keywords

adolescent immunization; Ohio Appalachia; parents; social determinants of health; vaccines

According to current recommendations by the Advisory Committee on Immunization Practices, adolescents should receive the tetanus–diphtheria toxoid–acellular pertussis vaccine (Tdap), meningococcal vaccine (Men-ACWY), and human papillomavirus (HPV) vaccine at 11–12 years old, and an influenza vaccine every year.¹ Despite their importance, immunization rates for adolescent vaccines lag behind those of childhood vaccines.² While Healthy People 2020 vaccination targets are at 80% for 1 Tdap dose and 1 MenACWY dose for adolescents aged 13–17 years, overall, vaccination coverage in the United States in 2014 was 87.6% for 1 Tdap dose and 79.3% for 1 MenACWY dose for adolescents aged 13–17 years. The lowest coverage was observed for HPV vaccination, where 39.7% of females and 21.6% of males aged 13–17 years completed the 3-dose series of the HPV vaccine.²

There are limited reports of the prevalence of vaccination refusal for a child among parents of adolescents. A 2013 study by Gilkey et al³ found 8% of parents from North Carolina refused or delayed a vaccine for their adolescent child(ren). Among those with a history of refusal, parents most commonly reported refusing influenza (26%) and HPV (16%) vaccines for their adolescent child(ren). In a 2016 study, Gilkey et al⁴ found that 24% of a national sample of parents refused any vaccine for their child(ren), with the prevalence of vaccine-specific refusal being 21% for the HPV vaccine (girls only), 5% for the meningococcal vaccine, and 2% for the Tdap vaccine.

Parents do not vaccinate their adolescent children for several reasons including religious beliefs, poor knowledge about the vaccine, and concerns about vaccine safety, necessity, and effectiveness.^{5–8} Parental beliefs about vaccinations, including trust in government and opposition to vaccination mandates, have been found to influence parental vaccination decisions for their children (eg, seeking nonmedical exemptions, vaccination refusals).^{6,9,10}

To help counter these beliefs and improve risk communication about vaccines, there is a need for additional research on the demographic and social determinants of parental

vaccination refusal.^{11,12} Previous research has found that demographic factors were associated with vaccination refusal but with mixed results.^{6,13} Some studies have reported that parents who refused vaccines for their children tended to be white, college-educated, and had higher incomes.^{9,14,15} In contrast, living in health professional shortage areas and low socioeconomic areas, a lack of health insurance, problems accessing an immunization clinic, and inadequate support from an immunization clinic are also predictors of parental vaccination refusal for their children.^{16,17} Previous studies have also found that other social factors (eg, religious and political affiliation) have been found to influence beliefs about mandatory school vaccinations and vaccination refusal.^{6,9,18–20}

While there is some conflict over school mandates for vaccination, these mandates may help increase adolescent vaccine coverage, as well as decrease parental refusal to vaccinate their child(ren). Bugenske et al²¹ found that compared to states with no requirements, states that had school vaccination requirements had higher adolescent vaccination rates. Previous studies have found that parents who are non-white, of lower socioeconomic status, and have a larger household size are more likely to oppose mandatory school vaccinations for their child(ren).^{6,22} Given the multiple factors that influence vaccination uptake, more research is needed to better understand the social and demographic factors that play a role in opposition to mandatory school vaccinations and refusal to vaccinate a child among parents.

Additional research in vaccination beliefs and refusal is needed among underserved areas of the United States. One area, Ohio Appalachia, a 32-county area, is characterized by lower income, higher prevalence of unemployment, lower level of educational attainment, and numerous health disparities than the United States as a whole.^{23–25} Research on vaccination beliefs, refusal, and uptake among the Ohio Appalachian population has primarily focused on HPV vaccination due to the higher cervical cancer incidence within that area compared to non-Appalachian regions of the United States.^{25–27} HPV vaccine uptake is low in the United States, compared to other adolescent vaccinations, and this is no exception within Ohio Appalachia.²⁶

Previous research has found lower rates of adolescent vaccinations in rural areas compared to other populations. Vielot et al²⁸ found that rural adolescents were less likely to receive each of the recommended adolescent vaccinations than their urban counterparts in all geographical regions including Appalachia. Reasons for lower vaccination rates in Appalachia and rural areas of the United States are varied and may include socioeconomic status of the area, geographic isolation, fewer medical providers, and a physical environment (eg, unpaved roads) that may make it difficult to adhere to a vaccination schedule.^{29–32} Another reason for lower vaccination rates may be the perceptions and attitudes toward vaccinations within this population. For example, Katz et al³⁵ found that Appalachian parents reported government intrusion (vaccine mandates), religiosity, and conservative communities as factors influencing their attitudes and beliefs on HPV vaccines. Another study by Cohen and Head³¹ found rural Appalachian parents' distrust in the government and lack of knowledge about vaccines as issues regarding adolescent vaccinations (particularly voluntary ones). Furthermore, rural parental beliefs and attitudes regarding adolescent vaccinations were found to be associated with the timely completion of vaccinations.³² However, these limited studies did not take a comprehensive approach to explore the

multiple parental factors associated with their vaccine beliefs and refusal for their adolescent child(ren). Thus, this study sought to examine how demographic, general health, religious, and political affiliation are associated with beliefs about mandatory school vaccination and history of vaccination refusal for children among rural Ohio Appalachian parents.

Methods

Study Design

This study used data collected as part of a project of the Ohio State University Center for Population Health and Health Disparities (CPHHD), Community Awareness, Resources and Education (CARE II). This project, also known as the Parents in Appalachia Receive Education Needed for Teens (PARENT) Project, was designed to develop and evaluate a multilevel intervention to increase HPV vaccination rates among young girls and adolescent females (ages 9–17) living in rural Ohio Appalachia. Results of the intervention are reported elsewhere,²⁶ and this paper reports baseline survey data that were collected prior to participants receiving the intervention.

Recruitment

Names of residents in each of the 12 participating counties were randomly selected using a commercial survey company. A master list was first created consisting of all households from the 12 rural counties that had at least 1 female resident aged 9 to 17 years old. A random sample of households was drawn for each county and the names and addresses were given to project staff, who then mailed a recruitment letter and informational sheet introducing the study to the selected households. Rurality was determined by county and ZIP code information of the selected households, operationalized by the rural-urban classifications designated by the Office of Rural Health Policy and the Rural-Urban Commuting Area codes of 4 and above.

At least 5 business days after the letters were mailed, trained interviewers began to contact potential participants by phone. Once a household was reached, the interviewer explained the study and asked to speak to the parent who was the most involved in making health decisions for their daughter. Parents were eligible if they: (1) were 18 years of age and older; (2) were able to speak, read, and write English; (3) were a resident of one of the participating 12 rural Ohio Appalachian counties; (4) were a parent or a legal guardian of a young girl (aged 9 to 17 years; if a parent had more than one daughter, they were asked questions about their eldest daughter); and (5) did not have a child who had received the HPV vaccine. During the initial phone call, the study was described, questions were answered, informed consent was obtained, and the baseline survey was administered.

Interviews were conducted between February 2013 and March 2014. Out of the 4,798 recruitment letters sent to households, 2,168 households were unable to be contacted, 9 parents were deceased, 1,599 were ineligible, 685 refused, and 337 were eligible, consented, and completed the baseline survey.²⁶ The overall cooperate rate was 33.0% (337 of 1,022 eligible parents). Participants received a \$10 Wal-Mart gift card after completing the survey. The study was approved by the Institutional Review Board of The Ohio State University.

Measures

Beliefs about the Right to Refuse Mandatory School Vaccinations—To assess beliefs about mandatory school vaccinations, participants were asked to respond to the statement, “Parents should have the right to refuse vaccines that are required for school for any reason.” Responses for this item were measured on a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree). Responses were dichotomized into yes (strongly agree, agree, slightly agree) and no (strongly disagree, disagree, slightly disagree, not sure).

History of Vaccine Refusal—Participants were asked (yes/no), “Have you ever refused a vaccine for your child(ren) that a doctor recommended?”

Religious Identity, Religiosity, Religious Attendance, and Place of Worship—Participants were asked, “With what religious family, if any, do you most closely identify?” Responses included all Christian denominational families, nondenominational Christian, no religion, and other. Participants were also asked about their religiosity: “How religious do you consider yourself to be?” Response options included “not at all religious,” “not too religious,” “somewhat religious,” and “very religious.” Participants were asked about their frequency of attendance in religious services: “How often do you attend religious services at a church, mosque, synagogue, or other place of worship?” Response options included “never,” “less than once a year,” “once or twice a year,” “several times a year,” “once a month,” “2–3 times a month,” “about weekly,” “weekly,” and “several times a week.” Last, participants were asked: “By your best guess, how would your current place of worship feel about vaccines?” Response options included “forbids,” “strongly discourages,” “somewhat discourages,” “encourages,” “isn’t concerned,” and “don’t know.” Responses were divided into “forbids/strongly discourages/somewhat discourages” and “encourages/isn’t concerned.” The response, “don’t know,” for this item was excluded from analyses.

Political Affiliation—Participants were asked: “Do you think of yourself as Republican, Democrat, or Independent?” Response options were: “strong Republican,” “moderate Republican,” “leaning Republican,” “Independent,” “leaning Democrat,” “moderate Democrat,” “strong Democrat,” and “other.” Responses were divided into Republican (“strong Republican,” “moderate Republican,” “leaning Republican”), Independent, and Democrat (“leaning Democrat,” “moderate Democrat,” “strong Democrat”). The response “other” for this item was excluded from analyses.

Demographic and Health Characteristics—Participants provided information about their age, gender, race, ethnicity, marital status, education, annual household income, employment status, current health insurance, and smoking status. Annual household income was obtained in ranges of \$5,000 for incomes below \$20,000 and in ranges of \$10,000 for incomes between \$20,000 and \$100,000 and included a final income category of \$100,000 or more. In statistical analyses, we dichotomized income as below \$50,000 versus \$50,000 or above, or at or below the middle income category versus above the middle income category. General health status (36-item Short Form Health Survey, SF-36³³) was also measured (0 = worst to 100 = best).

Analyses

Univariate logistic regression models were used to examine associations with each potential correlate for 2 outcomes: parental beliefs about mandatory school vaccinations and history of refusing vaccination for their children. Backward elimination was then performed starting with all variables significant at the 0.25 level in the univariate analyses; elimination proceeded until all remaining variables were significant at the 0.1 level. Two-way interactions were explored between variables remaining in the final model and all analyses were conducted using SAS v9.3 (SAS Institute, Cary, North Carolina).

Results

Sample Characteristics

Baseline characteristics of the 337 parents are shown in Table 1. The mean age of the sample was 43.5 years, and the majority of the participants were non-Hispanic white ($n = 329$, 97.6%) and female ($n = 311$, 92.3%). Most participants reported being married or living as married ($n = 301$, 89.3%), having more than a high school education ($n = 240$, 71.2%), being employed less than full-time ($n = 188$, 56.0%), having a household income $> \$50,000/\text{year}$ ($n = 141$, 58.8%), and having current health insurance ($n = 306$, 91.1%).

Correlates of Parental Beliefs About Refusal of Mandatory School Vaccinations

Of the 336 participants (one participant had missing data for this outcome), 158 (47.0%) agreed with the statement that parents should have the right to refuse vaccines that are required for schools for any reason. In univariate analyses, those who were employed full-time were significantly less likely to agree that a parent had the right to refuse mandatory school vaccinations for their child(ren) than participants who did not work full-time (OR = 0.63, 95% CI: 0.41–0.98). Also, participants who identified themselves as an Independent (OR = 3.31, 95% CI: 1.70–6.44) or Republican (OR = 2.45, 95% CI: 1.28–4.66) were significantly more likely to agree that a parent had the right to refuse mandatory school vaccinations for their child(ren) than participants who identified themselves as Democrats (Table 2). At the conclusion of backward elimination, only political affiliation was associated with a parent's belief in the right to refuse mandatory school vaccinations.

Correlates of Ever Refusing a Vaccine

Of the 337 participants, 130 (38.6%) reported ever refusing a vaccine for their child(ren) that a doctor had recommended. In univariate analyses, participants who were female (OR = 2.82, 95% CI: 1.04–7.68), very religious (OR = 1.79, 95% CI: 1.11–2.87), attended religious services at least weekly or more (OR = 1.65, 95% CI: 1.02–2.67), or agreed that a parent had the right to refuse vaccines for their child(ren) that are required for schools for any reason (OR = 2.49, 95% CI: 1.59–3.91) were significantly more likely to have ever refused vaccination for their child(ren) (Table 3). In the multivariable model built using backward elimination, participants who were female (OR = 3.90, 95% CI: 1.04–14.58) and agreed that a parent had the right to refuse vaccines for their child(ren) that are required for schools for any reason (OR = 3.27, 95% CI: 1.90–5.62) were significantly more likely to have ever refused a vaccine for their child(ren).

Discussion

This study assessed the demographic, general health, religious, and political affiliation correlates related to beliefs about the right to refuse mandatory school vaccinations for a child and history of vaccination refusal for a child among Ohio Appalachian parents. Previous studies examining social and demographic factors associated with parental beliefs about mandatory school vaccinations and vaccination refusal for a child have found mixed results.^{6,13} Therefore, this study sought to provide additional insight into the social and demographic correlates related to beliefs about mandatory school vaccinations and vaccination refusal for a child from the parent perspective.

Approximately 47% of participants agreed with the statement that parents should have the right to refuse vaccines that are required for school for any reason. This percentage is higher than that reported by Kennedy and associates where among over 1,500 parents who participated in a national survey, only 12% stated that they were opposed to mandatory school vaccinations.⁶ Our high percentage of agreement with the parental right to refuse mandatory school vaccinations for a child compared to the Kennedy and associates study may be due to the political and media climate concerning proposed state-mandated HPV vaccinations (eg, Ohio House Bill 81)³⁴ prior to and during the data collection period. Another reason for the high percentage of agreement regarding the parental right to refuse mandatory school vaccinations for a child may be factors associated with HPV vaccine acceptability identified by Ohio Appalachian parents including lack of trust in the medical community and “outsiders,” government intrusion in parental affairs, cultural attitudes, and perceived barriers to vaccination.³⁵

Our analyses found that parents who reported political affiliations of Independent or Republican were more likely to agree with the belief that parents should have the right to refuse mandatory school vaccinations for their child(ren) compared to the political affiliation of Democrat. Our findings are similar to previous research^{18,36} which found that certain political affiliations were associated with different vaccination outcomes, with Republicans and Independents less willing than Democrats to receive the H1N1 vaccine for themselves and their children^{18,36} as well as HPV vaccine for their adolescent daughters.^{19,36} Our findings support the argument that vaccination mandates and refusal have become a political issue.^{37–40} Last, agreement with the statement that parents should have the right to refuse mandatory school vaccinations for their child(ren) was associated with vaccination refusal for their child(ren). This finding is consistently supported in the literature^{4,5,7,9,10,18,41} in which individual perceptions (eg, opposition to mandatory vaccinations) influence the likelihood of actions (eg, vaccination refusal).

In this study, 38.6% of participants reported refusing a vaccination for their child(ren) that a doctor recommended. This percentage is higher than that reported by Gilkey et al,⁴ which found 24% of parents had ever refused a vaccine for their child. Another study by Gilkey and associates examined the child’s age at the time of parent vaccination refusal and reported forgone vaccination was more common for young children than for teenagers (16% vs 8%).³ This study and previous studies^{3,4} demonstrate that a considerable percentage of parents may be unwilling to vaccinate their child(ren), putting their children and

communities at risk of disease outbreaks. Because health care providers are the most common source of information about vaccinations,⁴² physicians are in a position to convey to parents the importance of vaccines to the health of child(ren) and reduce parental vaccination refusal for their child(ren).

Multivariate analyses found that parents who were female were more likely to have refused a vaccine for their child(ren). Previous research found similar results, identifying mothers as more likely to refuse a vaccine for their child(ren) than fathers.³ Also, Rickert et al⁸ reported that mothers were more likely to have negative attitudes regarding vaccination than fathers. The majority of the participants in this study were women, who at recruitment reported that they were the most involved in making health decisions for their daughter. Future research should consider the potential influence of gender on parental immunization beliefs and behavior.

Analyses found that the univariate associations between religiosity and history of vaccination refusal for a child were attenuated once beliefs about school mandates were included in the multivariate model. A possible explanation for this finding is that religious beliefs may affect a parent's beliefs on whether or not someone has the right to refuse school-mandated vaccinations which, in turn, results in vaccination refusal for their children. Longitudinal research is needed to more fully characterize the associations of parental religious beliefs, beliefs about school-mandated vaccinations, and vaccination refusal for a child from infancy through adolescence.

Parental beliefs about mandatory school vaccinations and refusal of vaccination for a child may be associated with several parental social and demographic factors.^{6,8,9,18–20} To maintain the public health benefit of childhood and adolescent immunizations, continued efforts must be made to educate the public about the need for childhood and adolescent immunizations. There is increasing rhetoric around “patient choice,” and public health agendas have gradually shifted to accommodate the right to refuse vaccination, focusing on making an individual, informed choice.⁴³ Since physicians have an influence on parental health care decisions,⁴⁴ it is important they educate parents and anticipate concerns that parents may have about vaccination in order to minimize refusal and increase vaccination rates.

Strengths/Limitations

Our study has several important strengths including the sample of parents who were from 12 Appalachian Ohio counties, as determined in collaboration with community cancer coalition members, increasing generalizability of the results to many areas of Ohio Appalachia. The study also examined possible correlates of parental beliefs about mandatory school vaccinations and history of vaccination refusal for their child(ren), an area that is not well studied, especially in an Appalachian population. In addition to the cross-sectional nature of the study, there were some limitations. First, the data are based on self-report, and we do not know the specific vaccine(s) the parents had refused for their child(ren). However, given our focus of examining vaccination refusal in general, the data are sufficient. Second, participants were not asked the reason why they had refused a vaccine for their child(ren). Last, most participants were female, white, and living in Ohio Appalachia, and they may not

represent the totality of the residents living in these counties. The findings of this study are based on a white, largely rural, North Central Appalachian population and transferability to other groups in the Appalachian region (ie, Northern, Southern, Southern Central, Central) is likely limited. Furthermore, the education and income levels of participants may not reflect the socioeconomic status of the Ohio Appalachian region as a whole. Due to this limited generalizability, more research is warranted to examine the multiple factors associated with parental beliefs about mandatory school vaccinations and history of vaccination refusal for their child(ren) within an Appalachian population.

Conclusions

This study examined demographic, health, religious, and political affiliation factors associated with beliefs about mandatory school vaccinations and history of vaccination refusal for children among parents residing in Ohio Appalachia. Political affiliation was a significant correlate of parental beliefs about the right to refuse mandatory school vaccinations for their child(ren). Also, parental beliefs about the right to refuse mandatory school vaccinations and gender were significant correlates of vaccination refusal for their child(ren). The study findings provide information to better understand factors related to vaccination refusal among parents in Appalachia Ohio that can be used to design interventions to improve vaccination uptake.

Funding:

This parent study was supported by a grant from the National Cancer Institute (P50 CA105632) and the Behavioral Measurement Shared Resource at The Ohio State University Comprehensive Cancer Center (P30CA016058). Two coauthors, PLR and EDP, have received research grants from Merck Sharp & Dohme Corp. One author, PLR, has also received a research grant from Cervical Cancer-Free America, via an unrestricted educational grant from GlaxoSmithKline. These funds were not used to support this research study.

References

- Centers for Disease Control and Prevention. Recommended immunization schedule for persons aged 7–18 years–United States. 2008. *S D Med*. 2008;61:1–4.
- Reagan-Steiner S, Yankey D, Jeyarajah J, et al. National, regional, state, and selected local area vaccination coverage among adolescents aged 13–17 years–United States, 2014. *MMWR Morb Mortal Wkly Rep*. 2015;64(29):784–792. [PubMed: 26225476]
- Gilkey MB, McRee AL, Brewer NT. Forgone vaccination during childhood and adolescence: findings of a statewide survey of parents. *Prev Med*. 2013;56:202–206. [PubMed: 23295175]
- Gilkey MB, Reiter PL, Magnus BE, McRee AL, Dempsey AF, Brewer NT. Validation of the Vaccination Confidence Scale: a brief measure to identify parents at risk for refusing adolescent vaccines. *Acad Pediatr*. 2016;16:42–49. [PubMed: 26300368]
- Luthy KE, Beckstrand RL, Meyers CJ. Common perceptions of parents requesting personal exemption from vaccination. *J Sch Nurs*. 2013;29:95–103. [PubMed: 22835889]
- Kennedy AM, Brown CJ, Gust DA. Vaccine beliefs of parents who oppose compulsory vaccination. *Public Health Rep*. 2005;120:252–258. [PubMed: 16134564]
- Gargano LM, Herbert NL, Painter JE, et al. Impact of a physician recommendation and parental immunization attitudes on receipt or intention to receive adolescent vaccines. *Hum Vaccin Immunother*. 2013;9:2627–2633. [PubMed: 23883781]
- Rickert VI, Rehm SJ, Aalsma MC, Zimet GD. The role of parental attitudes and provider discussions in uptake of adolescent vaccines. *Vaccine*. 2015;33:642–647. [PubMed: 25529293]

9. Salmon DA, Moulton LH, Omer SB, DeHart MP, Stokley S, Halsey NA. Factors associated with refusal of childhood vaccines among parents of school-aged children: a casecontrol study. *Arch Pediatr Adolesc Med.* 2005;159:470–476. [PubMed: 15867122]
10. Kessels SJ, Marshall HS, Watson M, Braunack-Mayer AJ, Reuzel R, Tooher RL. Factors associated with HPV vaccine uptake in teenage girls: a systematic review. *Vaccine.* 2012;30:3546–3556. [PubMed: 22480928]
11. Poland GA, Jacobson RM. Vaccine safety: injecting a dose of common sense. *Mayo Clin Proc.* 2000;75:135–139. [PubMed: 10683650]
12. Keane MT, Walter MV, Patel BI, et al. Confidence in vaccination: a parent model. *Vaccine.* 2005;23:2486–2493. [PubMed: 15752835]
13. Jeudin P, Liveright E, del Carmen MG, Perkins RB. Race, ethnicity, and income factors impacting human papillomavirus vaccination rates. *Clin Ther.* 2014;36:24–37. [PubMed: 24417783]
14. Perkins RB, Lin M, Silliman RA, Clark JA, Hanchate A. Why are us girls getting meningococcal but not human papilloma virus vaccines? Comparison of factors associated with human papilloma virus and meningococcal vaccination among adolescent girls 2008 to 2012. *Womens Health Issues.* 2015;25:97–104. [PubMed: 25747517]
15. Dorell C, Yankey D, Jeyarajah J, et al. Delay and refusal of human papillomavirus vaccine for girls, National Immunization Survey—Teen, 2010. *Clin Pediatr.* 2014;53:261–269.
16. Wilson TR, Fishbein DB, Ellis PA, Edlavitch SA. The impact of a school entry law on adolescent immunization rates. *J Adolesc Health.* 2005;37:511–516. [PubMed: 16310129]
17. Gore P, Madhavan S, Curry D, et al. Predictors of childhood immunization completion in a rural population. *Soc Sci Med.* 1999;48:1011–1027. [PubMed: 10390041]
18. Mesch GS, Schwirian KP. Confidence in government and vaccination willingness in the USA. *Health Promot Int.* 2015;30:213–221. [PubMed: 25369794]
19. Dubé E, Vivion M, MacDonald NE. Vaccine hesitancy, vaccine refusal and the anti-vaccine movement: influence, impact and implications. *Expert Rev Vaccines.* 2015;14:99–117. [PubMed: 25373435]
20. Marlow LA, Waller J, Wardle J. Parental attitudes to pre-pubertal HPV vaccination. *Vaccine.* 2007;25:1945–1952. [PubMed: 17284337]
21. Bugenske E, Stokley S, Kennedy A, Dorell C. Middle school vaccination requirements and adolescent vaccination coverage. *Pediatrics.* 2012;129:1056–1063. [PubMed: 22566425]
22. Gaudino JA, Robison S. Risk factors associated with parents claiming personal-belief exemptions to school immunization requirements: community and other influences on more skeptical parents in Oregon 2006. *Vaccine.* 2012;30:1132–1142. [PubMed: 22178105]
23. Appalachian Regional Commission. County Economic Status Designations in the Appalachian Region-Fiscal Year 2006. Columbus, OH: Cancer Incidence Surveillance System, Ohio Department of Health, Ohio State University; 2006 Available at: <http://www.arc.gov/index.do?nodeId=2934>. Accessed July 25, 2017.
24. Ohio Department of Health Primary Care Office. Ohio Primary Care-Health Professional Shortage Areas. Columbus, OH: Ohio Department of Health; 2005.
25. Fisher JL, Engelhardt HL, Stephens JA, et al. Cancer-related disparities among residents of Appalachia Ohio. *J Health Dispar Res Pract.* 2012;2:61–74.
26. Paskett ED, Krok-Schoen JL, Pennell ML, et al. Results of a multilevel intervention trial to increase human papillomavirus (HPV) vaccine uptake among adolescent girls. *Cancer Epidemiol Biomarkers Prev.* 2016;25:593–602. [PubMed: 27196093]
27. Ohio Cancer Incidence Surveillance System, Ohio Department of Health, and The Ohio State University. Cancers Associated with Human Papillomavirus in Ohio. Columbus OH: Ohio Department of Health; 2015.
28. Vielot NA, Butler AM, Brookhart MA, Becker-Dreps S, Smith JS. Patterns of use of human papillomavirus and other adolescent vaccines in the United States. *J Adolesc Health.* 2017;61:281–287. [PubMed: 28739327]
29. Short VL, Oza-Frank R, Conrey EJ. Preconception health indicators: a comparison between non-Appalachian and Appalachian women. *Matern Child Health J.* 2012;16:238–249. [PubMed: 23054445]

30. Sohn MW, Kang H, Park JS, et al. Disparities in recommended preventive care usage among persons living with diabetes in the Appalachian region. *BMJ Open Diabetes Res Care*. 2016;4:e000284.
31. Cohen EL, Head KJ. Identifying knowledge–attitude–practice gaps in parental acceptance of adolescent vaccinations in Appalachian Kentucky: implications for communication interventions. *J Commun Healthcare*. 2014;7(4):295–302.
32. Gore P, Madhavan S, Curry D, et al. Predictors of childhood immunization completion in a rural population. *Social Sci Med*. 1999;48:1011–1027.
33. Ware JE, Kosinski M, Dewey JE, Gandek B. *SF-36 Health Survey: Manual and Interpretation Guide*. 2nd ed Lincoln, RI: QualityMetric; Boston, MA: Health Assessment Lab; 2000.
34. HPV Vaccination Required, Ohio House Bill 81; 2007.
35. Katz ML, Reiter PL, Heaner S, Ruffin MT, Post DM, Paskett ED. Acceptance of the HPV vaccine among women, parents, community leaders, and healthcare providers in Ohio Appalachia. *Vaccine*. 2009;27:3945–3952. [PubMed: 19389447]
36. Constantine NA, Jerman P. Acceptance of human papillomavirus vaccination among Californian parents of daughters: a representative statewide analysis. *J Adolesc Health*. 2007;40:108–115. [PubMed: 17259050]
37. Baum MA. Red state, blue state, flu state: media self-selection and partisan gaps in swine flu vaccinations. *J Health Polit Policy Law*. 2011;36:1021–1059. [PubMed: 21948819]
38. Salmon DA, Teret SP, MacIntyre CR, Salisbury D, Burgess MA, Halsey NA. Compulsory vaccination and conscientious or philosophical exemptions: past, present, and future. *Lancet*. 2006;367:436–442. [PubMed: 16458770]
39. Jansen VA, Stollenwerk N, Jensen HJ, Ramsay ME, Edmunds WJ, Rhodes CJ. Measles outbreaks in a population with declining vaccine uptake. *Science*. 2003;301:804. [PubMed: 12907792]
40. Gauchat G Politicization of science in the public sphere a study of public trust in the United States, 1974 to 2010. *Am Sociol Rev*. 2012;77:167–187.
41. Smith PJ, Humiston SG, Marcuse EK, et al. Parental delay or refusal of vaccine doses, childhood vaccination coverage at 24 months of age, and the Health Belief Model. *Public Health Rep*. 2011;126:135–146. [PubMed: 21812176]
42. Smith PJ, Kennedy AM, Wooten K, Gust DA, Pickering LK. Association between health care providers' influence on parents who have concerns about vaccine safety and vaccination coverage. *Pediatrics*. 2006;118:e1287–e1292. [PubMed: 17079529]
43. Yaqub O, Castle-Clarke S, Sevdalis N, Chataway J. Attitudes to vaccination: a critical review. *Soc Sci Med*. 2014;112:1–11. [PubMed: 24788111]
44. Diekema DS. Improving childhood vaccination rates. *N Engl J Med*. 2012; 366:391–393. [PubMed: 22296072]

Table 1Demographic and Health Characteristics of Parents (N = 337)^a

Variable	Total (N = 337) n (%)
Age (mean ± SD)	43.5 ± 6.7
Gender	
Male	26 (7.7)
Female	311 (92.3)
Race/ethnicity	
Non-Hispanic white	329 (97.6)
Other	8 (2.4)
Education	
High school	97 (28.8)
>High school	240(71.2)
Marital status	
Married/living as married	301 (89.3)
Divorced/separated/widowed/single	36 (10.7)
Annual household income	
>\$50,000	141 (58.8)
\$50,000	99 (41.2)
Employment	
Full-time	148 (44.0)
Part-time/disabled/unemployed/retired	188 (56.0)
Current health insurance	
Yes	306(91.1)
No	30 (8.9)
Smoking status	
Never	201 (66.3)
Former/current	102 (33.7)
General health score (mean ± SD)	65.6 ± 22.7

^aTotals may not sum to stated sample size due to missing data.

Table 2
Demographic, Health, Religious, and Political Affiliation Correlates of Parental Belief on Mandatory School Vaccinations

Variable	“Parents Should Have the Right to Refuse Vaccines that are Required for School for any Reason”		Univariate OR (95% CI) ^a
	Yes (n = 158) n (%)	No (n = 178) n (%)	
Age (mean ± SD)	43.5 ± 6.9	43.5 ± 6.5	1.00 (0.97–1.03) ^b
Gender			
Female	143 (46.1)	167 (53.9)	0.63 (0.28–1.41)
Male	15 (57.7)	11 (42.3)	1.00 (referent)
Race/ethnicity			
Non-Hispanic white	151 (46.0)	177 (54.0)	n/a
Other	7 (87.5)	1 (12.5)	
Education			
High school	50 (51.6)	47 (48.4)	1.29 (0.80–2.07)
>High school	108 (45.2)	131 (54.8)	1.00 (referent)
Marital status			
Married/living as married	142 (48.3)	152 (51.7)	1.52 (0.78–2.95)
Divorced/separated/widowed/single	16 (38.1)	26 (61.9)	1.00 (referent)
Annual household income			
>\$50,000	67 (47.5)	74 (52.5)	1.18 (0.70–1.98)
\$50,000	43 (43.4)	56 (56.6)	1.00 (referent)
Employment			
Full-time	60 (40.8)	87 (59.2)	0.63 (0.41–0.98) [*]
Part-time/disabled/unemployed/retired	98 (52.1)	90 (47.9)	1.00 (referent)
Current health insurance			
Yes	143 (46.9)	162 (53.1)	1.01 (0.48–2.14)
No	14 (46.7)	16 (53.3)	1.00 (referent)
General health score	67.8 ± 21.1	64.0 ± 23.7	1.01 (0.99–1.02) ^c
Smoking status			
Never	93 (46.5)	107 (53.5)	1.15(0.71–1.85)
Former/current	44 (43.1)	58 (56.9)	1.00 (referent)

Variable	“Parents Should Have the Right to Refuse Vaccines that are Required for School for any Reason”		Univariate OR (95% CI) ^a
	Yes (n = 158) n (%)	No (n = 178) n (%)	
Religious family			
No religion	15 (55.6)	12 (44.4)	1.58 (0.71–3.50)
Religion	121 (44.2)	153 (55.8)	1.00 (referent)
Religiosity			
Very religious	65 (46.8)	74 (53.2)	1.10(0.70–1.74)
Somewhat/not too/ not at all religious	71 (44.4)	89 (55.6)	1.00 (referent)
Religious attendance			
Weekly	72 (49.3)	74 (50.7)	1.58 (0.99–2.53)
<Weekly	53 (38.1)	86 (61.9)	1.00 (referent)
Place of worship’s opinion on vaccines			
Encourages/isn’t concerned	100 (43.5)	130 (56.5)	n/a
Forbids/strongly discourages/somewhat discourages	4 (80.0)	1 (20.0)	
Political affiliation			
Republican	49 (45.8)	58 (54.2)	2.45 (1.28–4.66) ***
Independent	48 (53.3)	42 (46.7)	3.31 (1.70–6.44) ***
Democrat	19 (25.7)	55 (74.3)	1.00 (referent)

^aOR and 95% CI not reported if there was an expected cell count less than 5.

^bOR corresponding to 1-year increase.

^cOR corresponding to 1-unit increase.

Totals may not sum to stated sample size due to missing data.

* $P < .05$;

*** $P < .001$.

Demographic, Health, Religious, and Political Affiliation Correlates of Parents' History of Vaccination Refusal for Their Child(ren)

Table 3

Variable	Ever Refused a Vaccine for Their Children			Univariate OR (95% CI) ^a	Multivariate OR (95% CI) ^a
	Yes (n = 130) n (%)	No (n = 207) n (%)			
Age (mean ± SD)	42.9 ± 6.5	43.9 ± 6.8		0.98 (0.95–1.01) ^b	
Gender					
Female	125 (40.2)	186 (59.8)		2.82 (1.04–7.68) [*]	3.90 (1.04–14.58) [*]
Male	5 (19.2)	21 (80.8)		1.00 (referent)	1.00 (referent)
Race/ethnicity					
Non-Hispanic white	125 (38.0)	204 (62.0)		n/a	
Other	5 (63.0)	3 (37.0)			
Education					
High school	39 (40.2)	58 (59.8)		1.10 (0.68–1.78)	
>High school	91 (37.9)	149 (62.1)		1.00 (referent)	
Marital status					
Married/living as married	114 (38.6)	181 (61.4)		1.02 (0.53–1.99)	
Divorced/separated/widowed/single	16 (38.1)	26 (61.9)		1.00 (referent)	
Annual household income					
\$50,000	52 (36.9)	89 (63.1)		0.98 (0.58–1.67)	
<\$50,000	37 (37.4)	62 (62.6)		1.00 (referent)	
Employment					
Full-time	51 (34.5)	97 (65.5)		0.38 (0.88–2.15)	
Part-time/disabled/unemployed/retired	79 (42.0)	109 (58.0)		1.00 (referent)	
Current health insurance					
Yes	120 (39.2)	186 (60.8)		1.51 (0.67–3.40)	
No	9 (30.0)	21 (70.0)		1.00 (referent)	
General health score	65.9 ± 23.1	65.4 ± 22.5		1.00 (0.99–1.01) ^c	
Smoking status					
Never	77 (38.3)	124 (61.7)		1.09 (0.67–1.79)	
Former/current	37 (36.3)	65 (63.7)		1.00 (referent)	

Variable	Ever Refused a Vaccine for Their Children		Univariate OR (95% CI) ^a	Multivariate OR (95% CI) ^a
	Yes (n = 130) n (%)	No (n = 207) n (%)		
Religious identity				
No religion	11 (40.7)	16 (59.3)	1.15 (0.51–2.57)	
Religion	103 (37.5)	172 (62.5)	1.00 (referent)	
Religiosity				
Very religious	62 (44.6)	77 (55.4)	1.79(1.11–2.87) [*]	
Somewhat/not too/not at all religious	50 (31.1)	111 (68.9)	1.00 (referent)	
Religious attendance				
Weekly	64 (43.8)	82 (56.2)	1.65 (1.02–2.67) [*]	
<Weekly	45 (32.1)	95 (67.9)	1.00 (referent)	
Place of worship's opinion on vaccines				
Encourages/isn't concerned	85 (37.0)	145 (63.0)	n/a	
Forbids/strongly discourages/somewhat discourages	2 (40.0)	3 (60.0)		
Political affiliation				
Republican	46 (43.0)	61 (57.0)	1.82 (0.97–3.40)	
Independent	34 (37.8)	56 (62.2)	1.46 (0.76–2.82)	
Democrat	22 (29.3)	53 (70.7)	1.00 (referent)	
Belief about the right to refuse mandatory school vaccinations				
Yes	79 (50.0)	79 (50.0)	2.49 (1.59–3.91) ^{***}	3.27 (1.90–5.62) ^{***}
No	51 (28.7)	127 (71.3)	1.00 (referent)	1.00 (referent)

^aOR and 95% CI not reported if there was an expected cell count less than 5.

^bOR corresponding to 1-year increase.

^cOR corresponding to 1-unit increase.

Totals may not sum to stated sample size due to missing data.

^{*} $P < .05$;

^{***} $P < .001$.