

Homeschoolers' Vaccination Perception and Rate: A Comparison with a Public/Private School Population

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Abstract

Background and Purpose: School vaccination laws have played a critical role in ensuring the success of the United States' immunization policy. Recent outbreaks of vaccine-preventable diseases (VPDs) in homeschool populations have raised concerns that homeschoolers are under-vaccinated. Little vaccination-related research has been conducted within the homeschool population. To fill the void in the literature, this study explored homeschooling parents' opinions regarding vaccination and examined the vaccination rates of their children in comparison to public/private school population. **Methods:** A convenience sample of 137 homeschool and public/private school parents in Washington state participated in a 36-question cross-sectional online survey. **Results:** The homeschooling parents reported significantly lower vaccination rates of their children, lower perceived benefits of vaccination, lower perceived susceptibility to VPDs if unvaccinated, and higher perceived barriers in comparison to the public/private school parents. Overall the participants expressed a preference for less governmental regulation of vaccinations, though homeschooling parents express an even stronger preference for same. **Conclusions:** Homeschool and public/private school population differed in the vaccination rate and vaccination related opinions. Further research among homeschool population and examination of immunization policy is needed.

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Introduction

Vaccination is an important public health intervention in controlling communicable diseases and establishing a healthy nation. Governmental policies requiring vaccination for enrollment in school play an important role in achieving the vaccination goal set by Healthy People 2020. Considering the fact that homeschooling is a growing trend in the United States (National Center for Education Statistics, 2017) and that homeschooled children are less likely to be subject to and influenced by school vaccination requirements (Khalili & Caplan, 2007; Thorpe, Zimmerman, Steinhart, Lewis, & Michaels, 2012), the vaccination status among homeschooled students must be examined, as there is a concern that these populations have not sustained vaccination rates high enough to

achieve herd immunity (Parker et al., 2006; Johnson et al., 2013). To address this need, the current study compared vaccination rate and vaccination opinions between homeschoolers and the public/private school population in Washington State through an online cross-sectional survey.

Vaccination and School Enrollment

Healthy People 2020 set a goal of 90% coverage for most vaccines in order to reduce morbidity and mortality rates of VPDs (U. S. Department of Health and Human Services, 2014). However, some parents delay or refuse childhood immunizations out of vaccine-safety concern (such as the concern over the use of mercury as an ingredient) and low perceived

susceptibility (Smith, et al., 2011), which compromises the achievement of the Healthy People 2020 goal and leaves children unprotected. Phadke and colleagues (2016) conducted a literature review to understand the association between vaccine delay, refusal, or exemption and the epidemiology of measles and pertussis. Their study found out that the vaccine refusal was associated with an increased risk for measles and pertussis. Specifically, unimmunized children from 3-10 years old experience a 60-fold increase risk of contracting measles and a 16-fold increase risk of contracting pertussis compared to children who were immunized (Feikin et al., 2000). In addition to their own risk for disease development, an unvaccinated individual poses a risk to the public by negatively affecting herd immunity, which is important, as it protects those who cannot get vaccinated for medical reasons (i.e., those allergic to ingredients in the vaccine, those who are severely immunocompromised, or those too young to be vaccinated), those who choose for philosophical reasons not to be vaccinated, and those who received a vaccine but in whom immunity was not acquired (Diekema, 2014).

Herd immunity, also known as community immunity, refers to a situation in which a sufficient proportion of a population is immune to an infectious disease, making its spread from person to person unlikely. In this way, even individuals not vaccinated are protected because the disease has little opportunity to spread within the community (Centers for Disease Control and Prevention, 2016). Herd immunity is largely established within a community through schools, which require children to be immunized in order to enroll (Orenstein, & Hinman, 1999; Khalili, & Caplan, 2007). Studies have found that enforcing school vaccination laws have played a critical role in ensuring the success of the United States' immunization policy (Orenstein, & Hinman, 1999). For example, within two years of states mandating measles vaccinations for school entry, those states that strictly enforced the laws experienced less than one tenth the incidence rates of measles seen in states that did not strictly enforce the laws (Orenstein, & Hinman, 1999).

Vaccination and Immunization Exemption

Although all states have immunization requirements for children to enter school, states vary in their strictness of vaccination requirements and exemption laws. All states allow exemptions for medical reasons, such as an allergy to the ingredients of the vaccines. Most states also allow exemptions for nonmedical reasons (i.e., religious or philosophical reasons). Exemptions for religious reasons are available in 47 states, and 20 states have philosophical exemptions based on personal, moral, or other beliefs ("States with religious and philosophical...", 2016). For example, parents in Washington State may obtain a medical, religious, or philosophical exemption while California State only allows medical exemption (California State, 2015; Revised Code of Washington 28A.210).

The extent to which a state makes nonmedical immunization exemptions available for school entry has an effect on the overall vaccination rate. Blank, Caplan, and Constable (2013) found that states with more rigorous exemption policies (i.e., states that allow only medical exemptions) had exemption rates that were half those in states with exemptions that were easier to obtain. Similarly, states with policies that allowed a philosophical exemption experienced exemption rates that were more than 2.5 times greater than states that only permitted religious and medical exemptions (Omer, Richards, Ward, & Bednarczyk, 2012). These findings suggested that when exemptions are easily obtained, exemption rates increase, which is significant, as schools that had VPD outbreaks had higher exemption rates (Feikin et al. 2000).

Vaccinations and Homeschooling

States vary in their immunization requirements for homeschooled children. Homeschooled children do not fall under the same immunization requirements as children who attend public or private schools. According to the Coalition for Responsible Home Education (2015), only four states (Minnesota, North Dakota, Pennsylvania, and Tennessee) require proof of immunization for homeschooled children. Other states require immunizations but do not require proof of those immunizations, and

a total of 25 states do not require homeschoolers to be immunized (Coalition for Responsible Home Education, 2015). For example, homeschooling parents in Washington State are required to keep a record of their children's immunization status, while California State has eliminated vaccine requirements for homeschooled children altogether (California State, 2015; Revised Code of Washington 28A.210).

A growing concern is that the lack of vaccination requirements for homeschoolers has contributed to recent outbreaks of VPDs in the homeschool population. A study by Parker and colleagues (2006) of a 2005 measles outbreak in Indiana found that of the 34 confirmed cases, 94% were unvaccinated and 71% were homeschooled. Similarly, in Oklahoma there were only two reported cases of tetanus in 2012, and both cases were homeschooled children who had no record of vaccination (Johnson et al., 2013). Further, researchers, in a pilot study using email surveys of homeschooling parents in Western Pennsylvania, found that only 38% of homeschool families were fully vaccinated (Thorpe, Zimmerman, Steinhart, Lewis & Michaels., 2012), which is well below the herd immunity threshold for most childhood VPDs, which ranges from 75-94% (Willingham & Helft, 2014).

Compounding the issue is the fact that limited vaccination-related research has been conducted within the homeschooling population. To fill the void in the literature, this study was designed to explore homeschooling parents' opinions regarding vaccination and to examine the vaccination rates of their children.

Methods

Study Design and Procedure

A cross-sectional Qualtrics online survey was distributed to homeschool and public/private-school parents in Washington State. The survey link was sent to parents through contacts on 193 homeschool cooperative websites, as well as homeschool groups on Facebook from April to August 2016. Similarly, 28 public and private schools were contacted through Facebook parent

groups (e.g., parent-teacher associations) and were asked to send the survey link to their parent peers. No incentives were provided for participation. The survey results from participants who had both homeschooled and public/private schooled kids were excluded from the analysis. A total of 137 surveys with complete information for the questions were used for the study. Due to this form of dissemination method, a response rate cannot be calculated. Human Subject approval from the Institutional Review Board and informed consent by participants were obtained prior to data collection.

Instruments

The self-designed instrument contains eight sections with 36 questions covering demographic information, vaccination perception, opinions regarding the government's role in vaccination, and vaccination status. Related literature and the Health Belief Model provided the guide for the creation of the items regarding the participants' perceived susceptibility to VPDs if unvaccinated, perceived severity of VPDs, perceived benefits of vaccination, and perceived barriers to vaccination (see items in Table 2-5). For each construct, participants were asked to rate their agreement with the statements using a 6-point Likert scale. Their responses were given a value between 1 and 6, with the higher scores indicating higher perceived risk, benefits, barriers, susceptibility, and severity. For opinions regarding the government's role in vaccination, participants were asked to rate their agreement with a 6-point Likert scale for the following statements: a) "Individual states should grant vaccine exemptions for religious beliefs"; b) "Individual states should grant vaccine exemptions for personal beliefs"; c) "It is the government's right to mandate vaccinations"; and d) "It is the government's responsibility to mandate vaccinations." Internal reliability was calculated with Cronbach's alpha of .949 (perceived barrier), .918 (benefits), .891 (severity), .613 (susceptibility), and .927 (governmental role).

In addition, demographic items (such as school enrollment type, education level, etc.) and

vaccination status of each school-age child in the household were included. Homeschooling parents were also asked if vaccine mandates played a role in their decision to homeschool and their opinion regarding vaccine exemption.

Data Analysis

Raw data were imported from Qualtrics into the IBM SPSS Statistics Version 23 software for analysis. An Analysis of Variance between groups was used to explore any differences between homeschool and public/private-school parents in their perceptions of vaccination, opinions regarding vaccine exemption, and government roles in vaccination. Chi-squares were used to further analyze the association between the different parent groups and opinions for a specific statement.

Results

Participant Characteristics

Of the 137 responses, about two thirds of the participants had a bachelor's degree or higher and more than two thirds had an income higher

than \$50,000. Demographic data showed that 55 of the participants were in the 31–40- and 41–50-year-old age range. Participants came from 14 counties in Washington State with the highest number from Whatcom county (n=51) followed by Benton (n=28), Snohomish (n=24), and King (n=22) counties.

Vaccination Rates

Participants were provided a vaccine schedule for all required vaccines, then were asked to provide vaccination status for each child with one of the following responses: (1) up to date, (2) some but not all, (3) none, or (4) don't know. The overall vaccination status for all the children of each participant was calculated by summing up the vaccination status of each child and then dividing by the number of children in each participant's family. The lower the score, the closer the to "up to date" the status was. The ANOVA test indicated a statistically significant difference between homeschool (M=1.823, SD=.737) and public/private school students (M=1.255, SD=.595) in terms of vaccination status (p=.000) (Table 1).

Table 1.

Comparisons between Homeschooling Parents and Public/private School Parents on Perceptions toward Vaccination					
	Group	M	SD	ANOVA	p
Perceived Barriers	H ^a	4.20	1.27	F _(1,131) =29.77	.000
	P ^b	3.00	1.10		
Perceived benefits	H	3.69	1.26	F _(1,129) =19.36	.000
	P	4.67	1.13		
Perceived Susceptibility	H	2.93	0.99	F _(1,131) =9.47	.003
	P	3.47	0.95		
	H	4.77	0.93		
Perceived Severity	P	4.67	1.08	F _(1,129) =.28	.595
	H	1.82	0.74		
Vaccination rate	P	1.26	0.60	F _(1,125) =20.38	.000
	H	2.06	1.30		
Government Role	H	2.06	1.30	F _(1,131) =31.96	.000
	P	3.48	1.56		

a: H= Homeschooling parents

b: P= Public/private school parents

Perceptions Regarding Vaccination

Perceived barriers to and benefits of vaccines, as well as perceived susceptibility to and severity of VPDs were measured by dividing the sum of the item scores in each specific domain by the number of items. The perception score ranged from 1 to 6; the higher the score, the stronger the perception of that specific aspect.

Perceived Barriers. The mean perceived barriers score for all participants was 3.764 out of 6 with a statistically significant difference between homeschool (M=4.196, SD=1.274) and public/private-school families (M=3.000, SD=1.097, $p = .000$) (Table 1). Further examination of each statement within this domain revealed a significant association

between parents of different schooling type and their perceptions (Table 2). For the convenience of reporting, the opinions of “strongly agree,” “agree,” and “somewhat agree” were combined and viewed as “in support of the statement,” and the opinions of “strongly disagree,” “disagree,” and “somewhat disagree” were combined and viewed as “against the statement.” The top three items with the highest percentage difference between homeschool and public/private-school parents were: “certain vaccines might cause learning disabilities” (57.5% vs 14.2% in support of the statement, $p = .000$); “certain vaccines might cause autism” (53.4% vs 16.7% in support of the statement, $p = .000$); and “childhood vaccines are safe” (41.0% vs 73.7% in support of the statement, $p = .000$) (Table 2).

Table 2.

Comparisons of Homeschooling and Public/private School Parents on Perceived Barriers

	Group	Strongly Agree n (%)	Agree n (%)	Somewhat Agree n (%)
Childhood vaccines are safe	H	9 (10.2)	21(23.9)	14(15.9)
	P	21(42.9)	17(34.7)	3(6.1)
Certain vaccines might cause learning disabilities	H	18(20.7)	12(13.8)	20(23.0)
	P	0(0)	6(12.2)	1(2.0)
Certain vaccines might cause autism	H	17(19.3)	8 (9.1)	22(25.0)
	P	2 (4.2)	6(12.5)	0(0)
Vaccines can cause uncomfortable side-effects	H	39(44.3)	29(33.0)	16(18.2)
	P	5(10.2)	26(53.1)	12(24.5)
Vaccines can cause dangerous side effects	H	35(40.2)	22(25.3)	15(17.2)
	P	4(8.2)	10(20.4)	17(34.7)
Too many vaccines at one time can overwhelm a child's immune system	H	38(43.2)	15(17.0)	22(25)
	P	7(14.3)	11(22.4)	13(26.5)
It is better for children to develop immunity by getting sick rather than getting the vaccines	H	17(19.5)	12(13.8)	23(26.4)
	P	2(4.1)	3(6.1)	5(10.2)

Note: * indicates more than 25% of cells with less than 5 expected count

Perceived Benefits. The overall mean score for perceived benefits was 4.09 out of 6 with a statistically significant difference between homeschool (M=3.751, SD=1.265) and public/private-school parents (M=4.722, SD=1.140, $p = .000$) (Table 1). Chi-square tests indicated an association between parents of

different schooling types and their perceptions in 4 out of 5 items in this section (Table 3). The item without group association stated that “Most of the diseases that vaccines are intended to prevent are rare.” Though nearly two thirds (64%) of homeschooling parents support that “Vaccines are important for keeping children

healthy” (versus 85.6% among public/private school parents), 41.3% of homeschooling parents support the statement “Healthy children do not need vaccines” (compared to 14.6% of public/private school parents). At the same time,

the majority (59.8%) of homeschooling parents believe that “The body can naturally protect itself from diseases that vaccines are intended to prevent” versus less than one third (27.2%) of the public/private-school parents (Table 3).

Table 3.

Comparisons of Homeschooling and Public/private School Parents on Perceived Benefits									
	Group	Strongly Agree n (%)	Agree n (%)	Somewhat Agree n (%)	Somewhat Disagree n (%)	Disagree n (%)	Strongly Disagree n (%)	χ^2 df=5	p
Vaccines are important for keeping children healthy	H	22(25.6)	16(18.6)	17(19.8)	4(4.7)	17(19.8)	10(11.6)	23.828	.000
	P	30 (61.2)	11(22.4)	1(2.0)	2(4.1)	3(6.1)	2(4.1)		
Vaccines do a good job of preventing disease	H	22(25.3)	21(24.1)	19(21.8)	11(12.6)	10(11.5)	4(4.6)	22.131	.000
	P	32(65.3)	8 (16.3)	3(6.1)	3(6.1)	2 (4.1)	1 (2.0)		
The body can naturally protect itself from diseases that vaccines are intended to prevent	H	6(6.9)	16(18.4)	30(34.5)	17(19.5)	12(13.8)	6(6.9)	20.338	.001
	P	3 (6.3)	2(4.2)	8(16.7)	8(16.7)	16(33.3)	11(22.9)		
Most of the diseases that vaccines are intended to prevent are rare	H	5(5.7)	16(18.4)	25(28.7)	20(23.0)	15(17.2)	6(6.9)	6.803	.236
	P	0(0)	9(18.8)	9(18.8)	11(22.9)	15(31.3)	4(8.3)		
Healthy children do not need vaccinations	H	9(10.3)	12(13.8)	15(17.2)	16(18.4)	17(19.5)	18(20.7)	24.641	.000
	P	1(2.1)	5(10.4)	1 (2.1)	2(4.2)	14(29.2)	25(52.1)		
A vaccination might cause the disease it intended to prevent	H	16(18.6)	14(16.3)	21(24.4)	8(9.3)	18(20.9)	9(10.5)	17.096	.004

Perceived Severity. Overall, the average score was 4.732 out of 6, indicating relatively high perceived severity of not vaccinating against VPDs among all respondents. Nearly all respondents agreed with the statement “VPDs could make my child very sick” (93.2%); 87.2% believed that “having VPDs would be stressful”;

83.6% believed that “VPDs could be expensive and leave my child physically disabled”; 81.3% believe that “VPDs could be deadly (81.3%)”; and 71.4% believed that “VPDs could cause my child mental disability.” No group association was found for any items in this domain (Table 4).

Table 4.

Comparisons of Homeschooling and Public/private School Parents on Perceived Severity									
If my child got a disease that vaccines are intended to prevent	Group	Strongly Agree n (%)	Agree n (%)	Some-what Agree n (%)	Some-what Disagree n (%)	Disagree n (%)	Strong-ly Dis-agree n (%)	χ^2 df=5	p
It could be deadly	H	26 (30.6)	27 (31.8)	15 (17.6)	11 (12.9)	4 (4.7)	2 (2.4)	2.270	.811
	P	14 (28.6)	17 (34.7)	10 (20.4)	3 (6.1)	4 (8.2)	1 (2.0)		
It could make my child very sick	H	34 (40.0)	36 (42.4)	11 (12.9)	4 (4.7)	0 (0.0)	0 (0.0)	6.053	.301
	P	20 (41.7)	16 (33.3)	7 (14.6)	2(4.2)	2 (4.2)	1 (2.1)		
My child could become mentally disabled	H	20 (23.8)	22 (26.2)	21 (25.0)	9(10.7)	10 (11.9)	2 (2.4)	3.109	.683
	P	11 (22.4)	10 (20.4)	11 (22.4)	9(18.4)	5 (10.2)	3 (6.1)		
My child could become physically disabled	H	23 (27.1)	27 (31.8)	22 (25.9)	2(2.3)	1 (1.1)	1 (1.1)	6.932	.226
	P	17 (34.7)	10 (20.4)	13 (26.5)	3(6.1)	2 (4.1)	4 (8.2)		
It would be expensive	H	25 (29.4)	28 (32.9)	17 (20.0)	8(9.4)	5 (5.9)	2 (2.4)	3.570	.612
	P	19 (38.8)	10 (20.4)	13 (26.5)	3(6.1)	3 (6.1)	1 (2.0)		
It would be stressful	H	38 (44.7)	38 (44.7)	7 (8.2)	0(0)	2 (2.4)	0(0.0)	6.668	.154*
	P	28 (58.3)	12 (25.0)	6 (12.5)	1(2.1)	1 (2.1)	0(0.0)		

Note: * indicates more than 25% of cells with less than 5 expected count

Perceived Susceptibility. The average perceived susceptibility score was 3.128 out of 6. There was a statistically significant difference between homeschool (M=2.929, SD=.991) and public/private-school parents (M=3.469, SD=.954, $p=.003$) (see Table 1). About two fifths (40.8%) of public/private school parents (versus 58.3% of

homeschooling parents) believed that the risk of having the illness is low if not vaccinated. Conversely, 32.7% of public/private school parents (versus 16.6% of homeschooling parents) believed that their children would catch the illness if not vaccinated. However, the chi-square tests fail to find the group association for both items in this domain (Table 5).

Table 5.

Comparisons of Homeschooling and Public/private School Parents on Perceived Susceptibility									
If my child is not vaccinated for a disease	Group	Strongly Agree n (%)	Agree n (%)	Somewhat Agree n (%)	Somewhat Disagree n (%)	Disagree n (%)	Strongly Disagree n (%)	χ^2 df=5	p
..the child will get the disease	H	2 (2.4)	2 (2.4)	10 (11.8)	25 (29.4)	33 (38.8)	13 (15.3)	7.10	.213
	P	2 (4.1)	2 (4.1)	12 (24.5)	17 (34.7)	11 (22.4)	5 (10.2)		
..the child is at low risk of getting the disease	H	4 (4.8)	18 (21.4)	27 (32.1)	19 (22.6)	13 (15.5)	3 (3.6)	10.88	.054
	P	1 (2.0)	2 (4.1)	18 (36.7)	10 (20.4)	15 (30.6)	3 (6.1)		

Government's Role

Attitudes about the government's role in vaccination mandates were measured by summing the Likert-scale responses and dividing by the number of questions in the construct. The higher the score (maximum possible score = 6), the stronger the belief in strict governmental regulation of vaccinations. Overall, the average score was 2.581 out of 6, indicating a low belief in strict governmental regulations. In comparison, homeschooling parents ($M=2.057$, $SD=1.301$) believed in less strict governmental regulation than the public/private-school parents ($M=3.479$, $SD=1.558$, $p=.000$) (Table 1). Though chi-square tests indicated the significant associations between parents of different schooling types and opinions in all statements in this domain, the support among public/private-school parents for the statements of "It is government's right/responsibility to mandate vaccination" was not strong either, as only 53.1% and 49.2% supported each statement (Table 6). A total of 81% of homeschooling parents agreed with the statement "Individual states should grant personal immunization exemptions" while only 38.8% of public/private school parents shared this opinion. For the religious exemptions, the group difference was not as high (83.6% for homeschooling parents versus 59.6% for public/private parents). At the same time, 16.1% ($n=22$) of homeschooling parents reported that vaccine mandates in public

and private schools had played a role in their decision to homeschool their children, and 40.1% ($n=54$) of them would seek vaccination exemptions if vaccinations were mandatory for homeschoolers.

Discussion

The results of this study indicated a lower vaccination rate among homeschool children in comparison to public/private-school children. However, this result was not surprising, considering the low vaccination rates for homeschooling population evident in the literature (Johnson et al., 2013; Parker, et al, 2006; Thorpe, Zimmerman, Steinhart, Lewis & Michaels, 2011). Specifically, Thorpe and colleagues (2012) reported 38% of homeschool families had fully vaccinated children while the CDC reported such rate of 71.6% at the national level (National Center for Health Statistics, 2015). Safety concerns regarding vaccines and distrust of the government are the common reasons for refusal of childhood vaccines (Diekema, 2014; Smith et al., 2011). According to Kennedy and Gust (2005), homeschooling parents tended to have the most concerns about vaccine safety and the least belief in the value of vaccination, compared to public/private-school parents, which explained the lower vaccination rate among homeschooled children.

Table 6.

Comparisons of Homeschooling and Public/private School Parents on Attitudes Regarding Vaccination Regulation									
	Group	Strongly Agree n (%)	Agree n (%)	Some- what Agree n (%)	Some- what Disagree n (%)	Disagree n (%)	Strongly Disagree n (%)	χ^2 df=5	p
Individual states should grant vaccine exemptions for religious beliefs	H	44 (51.8)	17 (20.0)	10 (11.8)	5 (5.9)	6 (7.1)	3 (3.5)	18.69	.002
	P	9 (18.4)	10 (20.4)	10 (20.4)	4 (8.2)	11 (22.4)	5 (10.2)		
Individual states should grant vaccine exemptions for personal beliefs	H	45 (53.6)	14 (16.7)	9 (10.7)	7 (8.3)	5 (6.0)	4 (4.8)	27.03	.000
	P	11 (22.4)	4 (8.2)	4 (8.2)	7 (14.3)	11 (22.4)	12 (24.5)		
It is the government's right to mandate vaccinations	H	3 (3.5)	6 (7.1)	1 (1.2)	10 (11.8)	19 (22.4)	46 (54.1)	31.13	.000*
	P	4 (8.2)	10 (20.4)	12 (24.5)	4 (8.2)	4 (8.2)	15 (30.6)		
It is the government's responsibility to mandate vaccinations	H	39 (44.3)	29 (33.0)	16 (18.2)	2 (2.3)	1 (1.1)	1 (1.1)	28.34	.000
	P	6 (12.2)	14 (28.6)	9 (18.4)	6 (12.2)	5 (10.2)	9 (18.4)		

Note: * indicates more than 25% of cells with less than 5 expected count.

Consistent with the literature regarding parents' concern over vaccine safety (Diekema, 2014; Smith et al., 2011), more than 80% of homeschool and 60% of public/private-school parents believed that vaccines can cause dangerous side effects, which suggested a need for a conversation between parents and health professionals in addressing their concerns. In addition, more than half of homeschooling parents believed that certain vaccines might cause learning disabilities and autism, versus less than 20% of public/private-school parents. As Ragan and Diane (2012) pointed out, the perception of the association between thimerosal (a mercury-containing preservative) and autism was one of the common vaccine safety concerns, though numerous studies have proven no such link. These results indicated a direction for future vaccine education for the public. Specifically, the public must be effectively informed that 1) there is no evidence of a link between thimerosal in vaccines and autism and 2) all vaccines routinely recommended for

young children (6 years of age and under) are available in formulations that do not contain thimerosal (FDA, 2017). At the same time, it also warrants a further exploration of the possible reasons behind the high proportion difference between the homeschool and public/private-school parents in believing in the association between vaccines and learning disabilities & autism.

The big proportion difference between homeschool (59.7%) and public/private school parents (20.4%) in supporting the statement "It is better for children to develop immunity by getting sick rather than getting the vaccines" is worthy of further examination. The declining incidence of VPDs may lead all parents to underestimate the severity of the diseases (Ragan & Duffy, 2012). However, this phenomenon alone cannot explain the group difference mentioned above, especially because the results of the current study indicated no statistical differences between homeschool and

public/private-school parents in perceived severity of not vaccinating against VPDs. Examining the perceived benefits for vaccination from the participants helped shed some light on understanding this difference. Specifically, about two thirds (59.8%) of homeschooling parents supported the statement “The body can naturally protect itself from diseases that vaccines are intended to prevent,” compared to 27.2% of public/private-school parents supporting the same statements. It is possible that homeschoolers’ belief in human bodies’ natural mechanism in fighting disease lead them to value less the importance of vaccination. In other words, the significant differences in the perception regarding the importance and value of vaccination in battling VPDs may contribute to the group difference in supporting the statement “It is better for children to develop immunity by getting sick rather than getting the vaccines.”

Taken together, the results of the current study suggested that, while parents in both groups were aware of the dangers of VPDs, homeschooling parents tended to have more negative views regarding vaccines in general, both higher perceived barriers to vaccination and lower perceived benefits of vaccination and susceptibility to VPDs, which may lead to lower vaccination rates among homeschooled children compared to public/private-school children. For future research, it may be meaningful to examine how those perceptions interact with each other in predicting the vaccination rate. In addition, qualitative research may offer deeper understanding of the group differences in those aspects, which may be helpful in working with the homeschool population to increase vaccination acceptance and compliance.

Given the very negative view of vaccination and governmental mandates of vaccination among homeschooling parents, it was surprising that only 16.1% of homeschooling parents reported that vaccine mandates in public and private schools played a role in their decision to homeschool. Combining the fact that many people choose homeschooling because of disappointment with public schooling (Cooper & Sureau, 2007; McMullen, 2002), this may

indicate that homeschool families distrust governmental programs in general, not just vaccines, which should be taken into consideration for future vaccination promotion and education programs.

Although vaccine mandates played little role in the overall decision to homeschool, 40.1% of all homeschool participants expressed the desire to seek an exemption if vaccinations were mandatory for homeschoolers, which is much higher than the national public and private schools’ exemption rate of 1.7% (CDC, 2015). Hence, the idea of simply mandating vaccines for homeschoolers to protect the herd immunity may be insufficient to achieve similar vaccination rates of public and private school children. The suggestion of increasing the difficulty of obtaining exemption may offer another layer of success insurance (Diekema, 2014).

Limitations

There were several limitations to this study. First, the sample obtained was a convenience sample. However, a random sample was impossible because no registry exists for homeschoolers. Second, all information was self-reported and was therefore subject to social desirability response bias. However, the emphasis on anonymity at the beginning of the survey encouraged honest answers. Third, participants may be influenced by recall bias in reporting the vaccination status of their children. Fourth, the results of this study lack generalizability as states have different regulations regarding immunization and homeschooling. However, this study may provide meaningful information for policy comparison and help identify best practices.

Application and Implication

This study validates the concern that the low vaccination rate among homeschooling children may be a threat to the herd immunity. In addition, the results of the study also provide insights regarding the reasons behind the low vaccination rate. To increase the vaccination compliance rate, the following suggestions may be helpful:

- 1) The concerns/myths regarding vaccine safety must be addressed. With the rise of anti-vaccine movements, such as the highly visible “Vaxxed” movement (vaxxed.com), with an anti-vaccine documentary and bus tours promoting the alleged dangers of vaccines, public health professionals need to be more creative in addressing the concerns of the vaccine-wary population.
- 2) Qualitative research is needed to better understand the perception difference between homeschool and public/private-school parents, in order to be constructive in designing audience-specific messages to increase vaccination rates.
- 3) The vaccination policy—including exemption rules—should be reexamined for homeschoolers. Considering the subtle balance between individual freedom and community welfare, the policy must be carefully formulated, as a stricter policy

would likely face a significant push-back from the homeschooling community (Diekema, 20014). Alternative solutions may be to require reporting on vaccination status in order to increase surveillance on potentially under-vaccinated communities.

The vaccination challenges among homeschooling families and communities are unique and complex. It requires the collaborative efforts of various professionals, including health educators, school administrators, and researchers, in order to promote vaccination compliance. State legislators should also be part of the discussion to facilitate the development of supportive, feasible, and effective vaccination policies that specifically target homeschoolers. With collective efforts, herd immunity can sustain and continue to protect vulnerable populations.

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