



Exploring California's new law eliminating personal belief exemptions to childhood vaccines and vaccine decision-making among homeschooling mothers in California

Pamela McDonald^a, Rupali J. Limaye^{b,*}, Saad B. Omer^c, Alison M. Bittenheim^d, Salini Mohanty^d, Nicola P. Klein^e, Daniel A. Salmon^a

^a Johns Hopkins Bloomberg School of Public Health, Baltimore, MD USA

^b Johns Hopkins Bloomberg School of Public Health, Department of International Health, 615 N. Wolfe E6608, Baltimore, MD USA

^c Emory University Rollins School of Public Health, Hubert Department of Global Health, Atlanta, GA USA

^d University of Pennsylvania School of Nursing, Department of Family and Community Health, Philadelphia, PA USA

^e Kaiser Permanente Vaccine Study Center, Oakland, CA USA

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ABSTRACT

Background: California's Senate Bill 277 (SB-277) law eliminated the personal belief exemption to school immunization requirements. A potential consequence may be that parents choose homeschooling to avoid immunization. Vaccine attitudes and behaviors have not been well studied among the homeschooling population. This study explored the effect of SB-277 and vaccine decision-making among California home schoolers.

Methods: Purposive and snowball sampling were used recruit home-schooling parents through home-schooling Facebook groups based on home school type in high-exemption regions in California for in-depth interviews. Participants had to have a child in a legalized form of homeschooling in California in grades kindergarten-twelfth grade.

Results: Twenty-four mothers were interviewed. Participants were categorized based on self-reported vaccine attitudes and behavior into three groups: Confident and Accepting, Hesitant and Accepting, and Skeptical and Refusing. All reported the belief that SB-277 is an infringement on parental rights but was not currently impacting them. Confident and Accepting mothers (n = 10) generally believed vaccinations were safe, effective, and posed a lower risk than vaccine preventable disease (VPD). Hesitant and Accepting mothers (n = 5) expressed varying confidence levels in the belief that vaccinations were safe and effective, were not confident in the belief that vaccination posed lower risks than VPD risk, and risk perception affected vaccine decision-making. Skeptical and Refusing mothers (n = 9) generally believed that vaccinations were unsafe and ineffective, refused select vaccines, believed that vaccination posed a more serious risk than VPD risks, and belief of vaccine harm was a salient factor in vaccine decision-making.

Conclusion: Home-schooling mothers were concerned about SB-277 but did not report that it was directly impacting their children, their vaccine decisions, or reason to home school. Vaccine attitudes and beliefs among homeschooling mothers broadly fell into categories similar to parents of non-home-schooled children. Future quantitative studies should measure vaccine hesitancy and refusal prevalence and potential confounders.

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1. Introduction

Our society has gleaned the benefits of major public health interventions geared toward reducing childhood mortality.

Improvements in hygiene and incorporation of childhood vaccine programs have decreased childhood mortality by 90% since 1900 [1]. However, recent outbreaks of measles and the resurgence of pertussis highlight national vulnerability to vaccine preventable disease (VPD) outbreaks due to vaccine delay and refusal [2,3].

State laws requiring children to be vaccinated for school entrance has increased the success of vaccination programs [4,5].

* Corresponding author.

E-mail address: rlimaye@jhu.edu (R.J. Limaye).

Exemptions (medical, personal belief, and religious) can be filed for those refusing vaccination [6]. Most recently, California passed SB-277 eliminating the personal belief exemption (PBE) and proof of vaccination or medical exemption is now required for a child to attend daycare or begin kindergarten [7]. Effective July 1, 2016 parents could only file medical exemptions, signed by a board certified medical doctor or doctor of osteopathic medicine, to legally waive vaccination for children in classroom settings. SB-277 also stipulates that students receiving education without class-room based instruction are not required to provide proof of immunizations [7].

“Home school” is any parent-led, home-based education [8]. In California, “home school” can take four legal formats: PSA (Private School Affidavit), partial or full home-based charter programs, private PSP (Private Satellite Program) or public ISP (Independent Satellite Program) [9]. California has the highest number of students enrolled in charter programs of any state, representing 8.7% of all publicly enrolled K-12 students [10] with 20% of all charter schools accounting for home-based programs [11]. The number of students enrolled in the PSA and PSP format are more difficult to enumerate. However, by applying the national home-school rate of 3.3%, an estimate of about 200,000 California students in K-12 were in some form of home-based education for the 2015–2016 school year [12].

It is important to understand the vaccine behaviors and beliefs among the home school population considering the popularity of home-based programs and the community and individual risks associated with geographic clustering of unvaccinated individuals [2,13–18]. A stereotype is that home-schooling parents reject vaccination. However, there are insufficient data to accept or reject such claims. A 2005 cross sectional survey of public ($n = 765$), private ($n = 144$) and home-schooling ($n = 27$) parents revealed that home-schooling parents reported the lowest confidence in vaccine safety and necessity of vaccination ($p < 0.05$) compared to parents whose children attended public and private schools [19]. In a study relying on a convenience sample of 137 homeschool and public/private school parents in Washington state, 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 [20]. Home-schooling parents are often missed through school attitudinal surveys, and population-based surveys often have inadequate sampling techniques to capture home-schooling parents. Studies examining the clustering of vaccine refusal rely upon school vaccine exemptions and thus do not include home-schooled children.

Vaccine decision making is a complex process and many models exist to explain and categorize parent beliefs and behaviors, but there is not a widely-accepted standard to define the hesitancy continuum. The World Health Organization’s Strategic Advisory Group of Experts (SAGE) on Immunization has developed a broad and comprehensive definition of hesitancy: “Vaccine hesitancy refers to delay in acceptance or refusal of vaccination despite availability of vaccination services. Vaccine hesitancy is complex and context specific, varying across time, place and vaccines. It is influenced by factors such as complacency, convenience and confidence” [23]. Vaccine hesitant parents are more likely to be white, upper-class, well-educated suburbanites with distrust in pharmaceutical companies, healthcare workers, government agencies, often believe that VPD are not severe or their child is not susceptible, and lower belief in vaccine safety and effectiveness compared to parents who are confident in vaccines [22–27].

This study sought to understand: (1) the impact of SB277 on home-schooling parents; and (2) how home-schooling parents perceive vaccine safety and effectiveness and factors underlying vaccine decision making.

2. Methods

2.1. Participants and data collection

Participants were eligible if they had at least one child in transitional kindergarten through 12th grade for the 2016–2017 or 2017–2018 school year using any of the four forms of legalized home-based education recognized by the state of California. Purposive and snowball sampling were used. Recruitment was initially conducted via Facebook. Administrators of five private California home-schooling Facebook groups were contacted, and, if approved to post a message, the study team posted a recruitment message on the group’s page. These groups were chosen as they included members that resided in high exemption regions such as Sonoma and Marin counties. Both Sonoma and Marin counties have some of the higher rates of underimmunized children in the state; for example, children living within clusters within those counties were 1.69 times more likely to be underimmunized for MMR compared to children living outside of those counties [36]. Fifteen participants responded to these Facebook posts. Snowball sampling was then used as we asked these fifteen participants to provide names of other homeschooling parents. Recruitment ended when saturation of responses for reasons to home-school and a range vaccine attitudes were obtained. The recruitment announcements sought caregivers generally for study inclusion; however, only mothers contacted the team for an interview.

Interviews were conducted from August 2017 through September 2017. Nineteen interviews were conducted in-person in the San Francisco and San Diego areas of California. Participants selected a public location that offered semi-privacy, such as cafes, parks, and libraries. Five interviews were conducted by phone when an in-person meeting was not possible. All interviews were digitally recorded and transcribed to text, and transcripts were checked for accuracy. All participants were verbally consented and compensated with a \$25 Amazon gift card. This study was approved by the Emory University Institutional Review Board.

2.2. Data analysis

Codebook development was guided by an iterative process in which codes were generated from the interview transcripts and applied to subsequent transcripts. First, the first two authors (PM, RJL) independently coded eight transcripts (33%) with emerging codes, using a grounded theory approach as outlined by Strauss and Corbin [34]. The coded transcripts were then compared for discrepancies and adjustments were made to the preliminary code list. As additional transcripts were coded constant comparative methods [34] were used to refine the code list. The lead investigator (PM) then re-coded the initial two transcripts to ensure accuracy of the revised code list. Then, two additional transcripts were randomly chosen and coded by the two investigators and compared for emerging themes and code list adjustments. The lead investigator then re-coded the previous four transcripts. This process of independent coding and comparison was repeated for two more cycles to include all eight initial transcripts. The lead investigator then coded the remaining fifteen transcripts and the second author reviewed selected sections of the transcripts to ensure reliability and accuracy. To determine inter-rater reliability, measured through Cohen’s kappa coefficient [35], eight randomly selected transcripts were independently coded by the two authors. Six randomly selected constructs were compared using Dedoose software. Accuracy was determined using the industry standard of $K = 0.80$ and a maximum of 36% disagreement. Cohen’s kappa coefficient was 0.91 (range: 0.79–1.0).

The following themes were explored: perceived impact of SB-277, SB-277 as a reason to home-school, perceptions concerning risk of VPD and vaccine effectiveness, beliefs concerning vaccine safety, and salient factors in vaccine decision-making. These themes were compared and contrasted by belief-behavior category, to ascertain if there were differences between belief-behavior type.

Table 1
Demographic characteristics of participants (mothers).

Demographic	N (%)
<i>Age</i>	
20–25	0 (0)
26–30	11 (46)
31–35	2 (8)
36–40	9 (38)
>40	2 (8)
Total	24
<i>Education</i>	
High school	4 (17)
Associate/technical	3 (12)
College graduate	11 (46)
Graduate	5 (21)
Doctorate	1 (4)
Total	24
<i>Home school program</i>	
Private School Affidavit	3 (13)
Private Satellite Program	4 (16)
Independent Study Program	1 (4)
Charter- full time home	13 (54)
Charter- part time home	3 (13)
Total	24
<i>Vaccination status*</i>	
Up to date	10 (42)
Not up to date	14 (58)
total	24
<i>Possess medical exemption</i>	
Yes	1 (4)
No	21 (88)
Would pursue	2 (8)
Total	24

* Parent reports the child has received all the vaccines currently required for school attendance.

3. Results

Twenty-three interviews were conducted with twenty-four mothers (one interview was conducted with two mothers) lasting a mean of forty-six minutes (range: 20–150 min). All participants were mothers of home-schooled children from the San Francisco area (n = 12) or the San Diego area (n = 12). Demographics, type of home school program, child's immunization exemption status, and vaccine status of participants children are in Table 1.

While all respondents were aware of SB277 and perceived the law to be an infringement on parental autonomy, none reported that the law impacted their decision to vaccinate or reason to home school. "Religion" was not explicitly stated as a motivation to home school, yet many subjects (n = 20) used terms such as "world view", "values" and "influence" in a religious context. Participants were grouped into three categories based on self-reported vaccine uptake behaviors and beliefs. Behaviors included: accept all vaccinations, Refuse all vaccinations, and Delay and/or selectively refuse some vaccinations. Belief dimensions pertained to safety: Confident that vaccines are safe, Hesitant to believe in safety, and Skeptical in the belief that vaccines are safe. These belief-behavior categories included (1) Confident and Accepting; (2) Hesitant and Accepting; and (3) Skeptical and Refusing. These belief-behavior classifications are summarized in Table 2.

Participants' beliefs concerning probability of experiencing a vaccine-related severe adverse event (SAE) as well as perception of relative harm of vaccines vs. VPD are shown in Table 3. Those classified as Confident and Accepting believed risks associated with VPD to be greater than risks associated with vaccination. Those in the Hesitant and Accepting group were unsure how the risks of VPD compare to risks of vaccination, but many believed the vaccination may pose a greater risk. Those in the Skeptical and Refusing group believed VPD did not carry a serious risk and risks of vaccination were greater. Beliefs in safety shifted over time as a result of personal experiences, affecting vaccine decision making for those in the Skeptical and Refusing category, leading to the creation of sub-categories of Regressive Refusal and Progressive Acceptance (Table 2).

Most participants reported concerns about vaccine components/ingredients, belief in online testimonies claiming injury, concerns regarding the safety of the recommended schedule in both timing and dose, and historical considerations such as the belief

Table 2
Summary of participant responses for broad safety assessment, uptake behavior, and self-reported personal experiences that influenced beliefs and behaviors.

Parent Category	Uptake Behavior	Attitude	Experience
Confident and Accepting (n = 10)	Accepts all according to recommended schedule	Vaccines are, generally, safe	- Family influence - Academic influence
Hesitant and Accepting (n = 5)	- Delay all - Selectively refuse some - Delay and selectively refuse	Unsure if vaccines are safe	- Suspects, with varying amounts of confidence, child experienced harm/injury from vaccination - Family influence
Skeptical and Refusing (n = 2)	Completely refuse all; no change over time	Vaccines are, generally, unsafe	- Family influence - Self-directed research
<i>Sub-category</i>			
Regressive Refusal (n = 6)	- Accepted all or some vaccinations with oldest child(ren); gradually refused most or all vaccinations with younger children - Younger children are completely unvaccinated	Confident that vaccines are unsafe	- Suspects, with high confidence, child experienced vaccine harm/injury - Social/peer influence - Self-directed research
Progressive Acceptance (n = 1)	- Initially refused all with oldest child; gradually accepted - Younger children vaccinated per recommended schedule	Vaccines are, generally, safe	- Change in risk perception (susceptibility) - Trust in provider

*Belief in vaccine safety as reported at the time of interview.

Table 3

Participant perceptions concerning risk perception: severity of vaccine preventable illness and susceptibility to contracting vaccine preventable illness, by Parent Category.

Parent category	Themes	Illustrative quotes
Confident and Accepting and Progressive	• Risk of VPD complication greater than risk of vaccine VPD poses serious health risk	"I feel like the disease is riskier because just from what I've read and seen, I feel like the risks for the vaccine are so much less than the risk of the disease."
Hesitant and Accepting	• Risk of vaccine SAE may be greater than risk of contracting VPD • SAE may be greater than VPD symptoms • SAE risk is uncertain and varies by individual	"... Immunizations, autism, mercury poisoning... If it was something that wasn't so reputable it would have fizzled out a long time ago... there's enough other people being vaccinated that if I didn't vaccinate him, it would probably be safe enough for him... there wouldn't be those diseases... because there's enough children that have been vaccinated... there would probably be a very low risk of him getting those diseases... I think right now... probably the vaccination is a little more (risky) than the actual disease..." "If you read the insert of the vaccine, there's information that people can be injured. It's not 100% safe. Just because your kids had them and nothing happened to them, doesn't mean it's not going to happen to somebody else" "My kids are more likely to get sick than yours and I'm okay with that... their argument is herd mentality... I bring it back to what about the kids that can't be vaccinated because it makes them sick? They get vaccine injured. I'm not willing to put my kids at risk" "We were already a little skeptical about it before, my husband... was reading the insert, he goes, 'Well, the risk of actually acquiring this disease is actually less than the risk of a side effect happening.' The more I read about it... I realized (low susceptibility to VPD) ... That was the last vaccine we've given our children"
Skeptical and Refusing and Regressive	• VPD do not carry a serious risk • Vaccine carries a greater risk • Risk of contracting a VPD is lesser than the risk of SAE	

that safety is supported by the amount of time a vaccine has been commercially available. Participant vaccine safety perceptions also varied among parent categories and subcategories (Table 4). Those categorized as Confident and Accepting were not concerned with vaccine ingredients, met online testimonials with skepticism, believed the recommended schedule was safe in terms of timing and dose although some expressed concerns over the child's comfort, stated improved child health is evident with the elimination of certain VPD, and reported their child had not experienced serious side effects or described reactions as minor and temporary. Those in the Hesitant and Accepting group were uncertain about vaccine safety. Most believed vaccine ingredients to be unsafe, and most had concerns regarding the recommended vaccination schedule and overall number of vaccines. Responses concerning historical perceptions and belief that their child experienced a severe reaction had a wide range of variability in this group. Skeptical and Refusing mothers expressed concerns that vaccinations, the recommended schedule and dosing, and ingredients were unsafe. Most accepted the Hygiene Hypothesis and reported that vaccination has not contributed to improved childhood survival and stated increases in other morbidities as proof vaccines are unsafe. Most reported strongly believing online testimonials.

Participants described salient factors that influenced the decision to accept, delay, or refuse vaccinations for their child(ren). These salient factors included: importance of conducting one's own research, trusting advice of medical professionals, weighing the risks and benefits of individual vaccinations and subjective statements of safety. Salient factors varied by parent category and there was wide variability in how parents make decisions concerning vaccination (Table 5). Confident and Accepting and Progressive Acceptance mothers (Table 2) trusted advice and feedback from providers when making vaccination decisions. Hesitant and Accepting mothers relied on self-directed research, risk perception of vaccination, and safety of vaccines for decision making. Skeptical and Refusing mothers (Table 2) relied on self-directed research, perceptions of vaccine safety and risk of VPDs when making decisions. Regressive mothers relied on perceptions that the child (or a child they know personally) was harmed by vaccination and that event led to increasing skepticism, changes in risk perception, and eventual refusal of vaccines.

There was variability in perceived effectiveness of vaccines by parent category, including observable decreases in disease incidence and prevalence in this country, presence of VPD in countries

without vaccination programs, and beliefs that diseases incidence have been reduced by improved hygiene rather than vaccination (Table 6). Confident and Accepting mothers believed vaccinations to be effective and responsible for increases in childhood survival. Hesitant and Accepting mothers were unsure of vaccine effectiveness and most stated being unsure if vaccine effectiveness outweighed occurrence of side effects. Skeptical and Refusing mothers did not believe as strongly in vaccine effectiveness compared with the other groups and tended to attribute decreases of disease incidence and prevalence to other factors, such as the hygiene hypothesis.

Vaccination was not a factor in the decision to home-school although policies concerning vaccination was often viewed as important within home school communities.

4. Discussion

This study provides valuable insight into the vaccine decision making process in addition to vaccine perceptions held by California home-schooling parents including how confidence in vaccination may change with personal experiences. Vaccine attitudes and beliefs among homeschooling mothers fell into categories similar to parents whose children attended schools [3,5,13,22–27]. There were distinct differences in how members of each of the three main belief-behavior categories perceived risk, vaccine safety and effectiveness, and held a variety of salient factors in decision making.

Our study is the first among homeschooling mothers pertaining to SB277 and one of the few pilot studies of vaccine attitudes and beliefs among homeschooling parents. As previously mentioned, homeschooling parents are typically missed in school-based surveys, and population-based surveys. Thus, our study findings provide a critical step in laying the foundation to better understanding vaccine attitudes among homeschooling parents.

The qualitative nature of this study facilitated the richness of data in a population that has not been well studied. However, our study has limitations. We used a purposive sample and attempted to capture a broad range of perceptions by ensuring we included participants from each of the four forms of legalized home-based education recognized by the state of California. While we cannot characterize the frequency of vaccine attitudes and behaviors among homeschooling parents, a general trend among

Table 4

Participant perceptions of vaccine safety defined by ingredients, historical context, recommended vaccination schedule, perceptions of own child's harm/injury and perception of harm/injury on the web.

Parent category	Themes of safety	Illustrative quotes
Confident and Accepting	<i>General Assessment</i> • Vaccines are, generally, safe • Most do not believe ingredients are unsafe <i>Historical Perceptions</i> • History of disease elimination and improved health <i>Schedule concerns</i> • Most accept recommended schedule • Few considered "spacing" for the child's comfort; not safety related <i>Belief child experienced vaccine harm</i> • Vaccine related SE perceived as minimal and/or temporary <i>Belief in reliability of online testimonies of vaccine injury</i> • Met with skepticism	"I think for the majority, I feel like they are safe" "And kids who had autism—other people could see it in their kids before they could... He (doctor) took the time to talk to me about it and tell me about the study... and I thought it was safe... my husband's a pharmacist... he said they haven't used Mercury for... many years. It's not even a thing" "...I do think these illnesses are legitimate threats. But because people have been vaccinating they aren't as real as threats. But now that people have not been vaccinating... there is a wider spectrum of people that will be getting it in a worst-case scenario... when you get a vaccine you can still get it (VPD), but maybe it's a little knocked down... or you might not get it at all... there's more and more people who aren't vaccinating and... if you look at the barrier... it's getting weaker and weaker... to welcoming in diseases that were eradicated in the 50's and 60's" "...I understand the science behind herd immunity and... I still really believe in the individual's rights to make those choices for their family. So, we vaccinate (according to the recommended schedule)" "There's more vaccines they give all at once, more than they used to... there's been a few times... they (children) would get four pokes and they swallowed one... I've gone back and forth. I have some friends who say, 'I'll just space them out differently so it's not so many at once' and I've friends who are nurses say, 'What's the difference? You're going to get poked. Just do it all at once'... since I live 30 min outside of the city, it's just easier for me to do it all at once" "[NAME] had a really strong reaction Tdap. He was kind of out for a couple days almost like he had the flu... he's usually really active and he was in a lot of pain. I didn't really like that, but I feel like it's worth it because we camp and hike a lot... we're out and situations where he could step on a rusty nail... and they've (older siblings) had fevers before after vaccinations" "...people's experiences is hard because it's their experience. If it really happened to them then I'm not necessarily going to doubt their experience. I feel you have to be careful... on the internet in terms of where is this coming from or what's the person's agenda... I feel a little skeptical but that's more with individual blogs or links to some article somebody posts..."
Hesitant and Accepting	<i>General Assessment</i> • Uncertain about safety • Most believe ingredients are unsafe • Variability and subjective interpretation of "unsafe" <i>Historical Perceptions</i> • Range of beliefs on the true success of vaccines in history • Some believe historical context highlights dangers and the need for improvement <i>Schedule concerns</i> • Most had serious concerns with both schedule and dose • Many expressed concerns (safety and necessity) about infants receiving vaccinations "so young" <i>Belief child experienced vaccine harm</i> • Range of subjective perception of severity of SE • SE are diagnosed by parent • Many suspect vaccines caused injury, but state they "aren't certain" <i>Belief in reliability of online testimonies of vaccine injury</i> • Wide range of perceptions • Some met with skepticism • Most reported as reliable and believable	"It's just interesting to me (because)... I'm not inherently against vaccines. I think it's a great idea. I just think they could be safer, we could be paying more attention to how patients are reacting" "I do not think that all of the ingredients within the vaccines are safe. For us... the reason we vaccinate with some... is that the disease itself... seems (scarier) and more dangerous than the actual vaccine ingredients..." "I look at a lot of the preservatives because... albumin is one that I've reacted to... a lot of them contain aluminum as preservatives too and it doesn't break down in your body" "...the vaccines I've given my children have been around for years... Does that mean they're super healthy? That could be why we have all the cancers we have. I don't know. But there's a time issue" "...There's no money in a new adjuvant... there's money in finding new vaccines... but... if they had to prove that aluminum was safe... today, it would never have been proven... If you read studies about the safety, when they check a shot... the placebo has aluminum in it... we're leveling the playing field by giving everybody aluminum... you can't really see if there's a significant difference [in safety]" "Too many, just like a total abundance of them. Some that are not necessary for babies and even children, that they really should be waiting until later" "My husband and I felt like having between four and seven vaccines at one time was just too much on a child's immune system... when we started doing research we... discovered that it was just so much that their little bodies were having to fight... we started doing research on how to get the vaccines that we thought were important... but not bombard their system... doing a once a month system was what we were able to find by... people who walk the line like we do... we're not no vaccine, but we're not all vaccine" "We do not do the MMR... we gave my six-year-old it when he was one, and for three months, he did not act like his normal self. It really scared me... coinciding right with the vaccine. Based on the research... I know there's not anything cohesive that says that it causes autism... we noticed a difference in his personality... that scared us to the point where we said, 'Never again, we're not doing it'" "...because my son had a seizure when he was four and a half... It's never been diagnosed. It's sort of unspecified, it's sort of rare, they don't really know" "He's (child) the one that challenges me the most... I wonder if the vaccines have affected him, his brain... I'm thinking a three and a half year old, should not be talking the way he is or behaving that way" "I've read the things... and it's terrifying. But you never know what scare media and what's fact... I feel like the whole conversation is still muddled to know where true information is coming from... what thing paid by this drug dealer to release this information and what's an angry mom who just wants to pin it something on somebody" "I don't like... to dismiss an anecdotal... (it) is important because I think that's how we even notice... How would we notice that there was some anomaly if there wasn't somebody saying, 'Hey, this weird thing happened to me,' right? So, you have to pay attention to them"

Table 4 (continued)

Parent category	Themes of safety	Illustrative quotes
Skeptical and Refusing	<i>General Assessment</i> • Certainty that vaccines are unsafe • Confidence in belief vaccines ingredients are unsafe • Desire for “natural” ingredients	“Personally, until they have safer vaccinations, I don’t feel comfortable giving it to my children” “I think vaccinations used to be good to a point and now they are putting aborted fetuses, monkey brains...I mean when you look at what... (is) in them I just don’t trust that they are even good for us”
	<i>Historical Perceptions</i> • Lack of safety evidenced through increases in other morbidities <i>Schedule concerns</i> • Concerns about “overloading” • Similar to Hesitancy in concerns with number per visit and total number <i>Belief child experienced vaccine harm</i> • Confidence in perception that vaccine caused harm to child • Claims injury is common and shares family members stories <i>Belief in reliability of online testimonies of vaccine injury</i> • Perceptions of truth, believability, and reliability	“I wouldn’t mind them if they would separate them and take out the junk. I wouldn’t mind them if they would introduce them in a natural way...if they did more comprehensive research” “And if you look up the history of vaccines there was no childhood cancer until we had a vaccine schedule. That’s when the childhood cancer came in...maybe leukemia...but never did we have kids with cancer like we do now...and people weren’t allergic to peanuts” “We’re both vaccinated, but not the same schedules that they get vaccinated nowadays. I looked at my own vaccination card and it’s very little I got MMR...a few other shots, but it wasn’t the crazy schedule that they get now...kids get, I don’t know even know, is it 21? 27? Shots?” “I think it’s too much, too quick...I think they fail in terms of doing generational studies. I just don’t think we have all the answers for them to be recommending these things. It’s not safe for everybody. You can’t take a whole pool of people and say...what’s right for person A...is going to work for person D. You might need to change the cocktail. Maybe you can make it safe...but according to how people are vaccine injured I don’t see the proof” “...When she was a baby...she had just had her Hep B shots, and then one night I discovered she wasn’t breathing...my husband and I observed her...we noticed that at one stage she wasn’t breathing for 30 s...But, this child is the one that has speech issues and we think there are other issues but...we don’t have any testing on that right now...so, we kept vaccinating...I didn’t draw this conclusion of SIDS and vaccines until I was pregnant with my third and that’s when I did the research” “And it’s from the MMR, I know it is, because she has a huge egg allergy and after the MMR...her eczema flared...If you look back at pediatric journals when vaccines were really rolling, it says ‘do not give children with eczema the vaccine, don’t do it at any cost’. She was given, for the greater good, because we’re treated like cattle...she spent a whole year of her life bloody. It was awful...I was like, “You’ve got to detox her. There’s something in that vaccine that made this worse” “We have family in [city], and they had the highest rate of autism...maybe a bad batch or something...we have two cousins both their kids’ have autism and learning disabilities based on the vaccinations. The moms have determined it” “I have several friends with kids who are vaccine injured and I think I listen to them in the personal testimony more than anybody or anything”

our sample emerged consistent with current literature suggesting home-schooling parents may make vaccination decisions in similar ways as parents who do not home school. Further investigation is warranted. Our study was limited to California, as we were particularly interested in the impact of SB277. An additional limitation is that we are not able to provide a response rate as some of the

Facebook groups had hundreds of members and we are not able to determine who in each group viewed the recruitment message.

Future studies should include homeschooling parents from other states. Themes such as distrust in pharmaceutical companies, healthcare workers, government agencies, statements of compression bias and risk aversion, [18,21,22,26,27] are constructs

Table 5

Salient factors influencing vaccine decision making by Parent Category among California home school mothers.

Parent Category	Themes	Illustrative quotes
Confident and Accepting	• Concerns are addressed and resolved by provider • Most report intentionally not seeking information outside of provider	“It’s kind of strange, I usually do a ton of research into things before I do them and vaccines...I just decided when the kids were born...I’m just going to do it. I’m not going to freak out about it. I’m not going to get the altered schedule...I only have so much room in my head to deal with so many things and this is just one I’m going to be like I think it’s okay” “I try not to look at the ingredients at all. I know I would just talk myself out of it. But I would say...How long is it been around? And how serious is the disease it’s trying to prevent? Yeah, those are...the two or three things I would look at”
Progressive Acceptance ^{***}	• Trust in provider • Change in risk perception	“...I’m from [town]...a lot of homeschoolers and...people that are very anti-vax...my friends are there...they’re like, “Have you thought about this?”...I just assumed, “Vaccinate. Everyone vaccinates.” Then...you hear stories...you jump online and see all this stuff and it’s overwhelming...I just remember crying...thinking, “What are we (going to) do?”...So we didn’t vaccinate. He wasn’t vaccinated at all...then we were going...to Russia...to orphanages...it literally would not be safe for him not to be vaccinated...it was distressing to hear...Then the measles thing came up...(other) things would come up...in California. He’s completely un-vaccinated. That was a scary thing for me too...so we started the whole vaccine process...We just kept doing it...At that point it was too stressful thinking about it...we were already wanting to, because we travel a lot...so we’re (going to) go forward...right on schedule...Completely the opposite of our firstborn...some of my friends were like, “I thought you were preaching it: Don’t vaccinate.”...I’m like... ‘Things change’...that was our journey. I don’t regret it”

(continued on next page)

Table 5 (continued)

Parent Category [*]	Themes	Illustrative quotes
Hesitant and Accepting	• Complex set of constructs • Most report in depth reading/research • Few report unreliable sources such as Facebook articles or documentaries • Vaccine ingredients • Risk perception	What it really came down to was did my husband and I get the vaccine...have we been okay? The MMR we did get, but all the other ones...like chicken pox wasn't around when we were children...I guess the <i>longitude</i> of the vaccine (because) there's more research...more people who have gone through the vaccine...some history behind them...some information would come out that they were good or not. We did look at <i>ingredients</i> ...at <i>side effects</i> and what the <i>side effects</i> could be, versus the <i>danger of the actual disease</i> ...my stepmom had Measles and she's fine...didn't have any adverse reaction. My husband and I both had Chicken Pox, we were fine...Prevnam...it's a common cold vaccine...there's...13 or 15 strains that it covers out of 96 strains of the cold...if it only covers 15 of those, then why are we only covering 15 when you have way more that you're not covering? That didn't seem logical...and it was a newer vaccine...it didn't have a lot of research done...and time to see the long-term effects on people...a lot of different things went into our decision"
Regressive Refusal ^{***}	• Peers and various web sources • Vaccine ingredients • Risk perception	"I think a combination, definitely trying to find the insert that comes with the vaccine and looking over the ingredients. Then, I think a lot of the issues that we're vaccinating for...aren't that common...if they are...they're not common for a child whose straight from a mother's uterus"
Skeptical and Refusing	• Complex set of constructs that vary by individual • "Fact check" scientific information encountered through anti-vaccine resources • Vaccine Ingredients • Risk perception	"Additives. What's carrying the vaccine? What else is in there? How bad is the thing they're trying to vaccinate against? Can I tolerate that?...What's the likelihood of them getting it? But I know that statistics are just the statistics and things can happen at any time...I also might look at what is the incidence of problems coming from that particular thing"

^{*} Parent categories described in Table 2.

^{**} Subcategory of Confident and Accepting; initially refused vaccination with oldest child and progressively accepted vaccinations for younger children with confidence.

^{***} Subcategory of Skeptical and Refusing; initially accepted vaccination with oldest child and regressively delayed or completely refused with younger children marked by increasing skepticism.

Table 6

Perceptions of vaccine effectiveness and illustrative quotes by parent category among California home school mothers.

Parent category	Themes	Illustrative quotes
Confident and accepting	• All believe that vaccines are effective and have reduced prevalence of VPD • Many were skeptical of newer vaccines such as Gardasil	"...I do think that they do (prevent disease)...because we talk about eradicating polio and there used to be lots of polio cases and now there aren't. So yeah, they do work. The old established ones, so newer things like the Gardasil- I don't know? Do they?...We don't have that same history to prove it...when I was working as a nurse a lot of (older) people (would) ask for the shingles vaccine...if I was in that situation and that age group I probably would get it for myself. Just to have that assurance because shingles is associated with a lot of pain and is really uncomfortable. Yeah! I do think that they do work"
Hesitant and accepting	• Variances in responses • Most recognize effectiveness, although concerns remain focused on risk of vaccine; not risks of VPD • Few state uncertainty in effectiveness	"Yeah (they are efficacious). But I think for the most part...the execution or the damage that can happen to some people. If there was something, a plague going around and people were passing out, I'd be the first in line, like, "Give me one!" I do feel like they work" "...I've never heard any other explanation as to why those (diseases) wouldn't be around anymore. Immunizations are great. They did takeaway Polio and Measles and the stuff our parents grew up having to go through...there is a good aspect but I think there's also a bad aspect to them...I'm not totally against them but I'm not totally for them"
Skeptical and refusing	• Little to no belief in effectiveness • Most focus on "Hygiene Hypothesis"	"Most diseases, I just believe naturally died off on their own. I don't if there's any proof that they vaccines have (reduced prevalence)" "They bring up certain vaccinations that we give...but it's only because back in the day...people didn't have as good of hygiene. The water wasn't really clean...I remember they (information source) were talking about how people didn't have as good of a system...with clean water...things were lurking around...people were more likely to catch things. Now, we may not be as exposed" "Everybody that got sick, were fully vaccinated people...clearly, there's a flaw in what we're putting inside of our bodies"

reported by hesitant and refusing participants in this study and are also associated with vaccine hesitancy among non-home-schooling parents.

Vaccine hesitancy has been described in terms of attitudes, behavior, and decision-making models [29–33]. This study underscores information in current literature that vaccine hesitancy is not the result of one factor, but a complex fusion of multiple factors and is largely dependent upon context of the individual's experiences. Consistent with the work of Kennedy and Gust [19] this study also showed similarity in the type of concerns among

home-schooling parents. A general process of uncertainty, socio-cultural influence, perception of injury, and validation of injury beliefs can be conceptualized to understand how parents move along the hesitancy continuum. For example, only two (out of nine) categorized as "Skeptical and Refusing" rejected all vaccinations from the time their children were born. The other seven reported regression in their general confidence concerning vaccine safety and eventually reached a point in which all vaccinations were refused for their younger children. While complete refusal was reported at the time of interview all seven reported underlying

hesitancy and began a delayed schedule during the oldest child's infancy and all reported never being completely confident in the decision to vaccinate. The perception of injury was the climactic turning point in the decision to cease vaccination and introduction of information that validated experiences contributed to regressive attitudes and behaviors. The prominent themes for participants categorized as "Regressive Refusal" and "Skeptical and Refusing" were most alarming, from a vaccine safety perspective. Participants from these categories were the most likely to conduct their own research related to vaccines and conclude that vaccines were generally unsafe; they also expressed a desire for more 'natural' ingredients to be included in vaccines. Understanding which persuasion approaches and tactics may affect their vaccine decision-making process is an area ripe for additional study.

The religious context discussed by most subjects has important implications because "religion" is a contributing force of one's value system and may impact moral constructs of purity and liberty which may be closely associated to vaccine hesitancy [28]. Additionally, many participants stated displeasure with the larger "public" system as reasons to home-school. Perhaps moral values, such as purity and justice, are similar among home schoolers and those who refuse vaccines. The relationship between moral foundations, vaccine attitude, and decision to home-school is unclear, but a common set of moral foundations may act as a confounder. Additional research is needed to test this theory. Fourteen mothers reported that their children were not up to date on school required vaccinations. Among our sample, 8 mothers with 31 children were not up to date. Home-schooling families interact through various co-ops, field trips, and private educational groups that are not state certified. For those not up to date there may be an increased risk of VPD outbreaks occurring within these social clusters. Future studies should examine vaccine attitudes, beliefs and vaccine compliance among the home school population, regardless of home school program.

Our study provides evidence that home-schoolers may make decisions concerning vaccination in a way similar to non-home-schooling parents and the stereotype that the majority of home-school parents reject vaccination, or home-school to avoid vaccination, was not expressed by most participants. The observed continuum of vaccine acceptance and perceptions among the participants is like continuums constructed from data of non-home-schooling parents. Future investigations such as surveys from a random sample of the home school population, studies designed to stratify and compare by home school type (ISP verse PSA) and school type (home school versus public school) and measuring the moral foundations among the home school population would be valuable in adding another layer of understanding in the quest to explain, predict, and intervene among parents with hesitant and refusal tendencies. In addition, our study occurred within the first year of SB277's implementation. The impact of SB277 should be explored after the law has been implemented for several years, to better understand how the law may affect home-schooling decisions in the future.

5. Conclusions

Vaccination was not a factor in the decision to home-school among our participants; however, the impact of SB-277 should be explored among homeschooling parents after the law has been in effect for several years to see if parental decision-making process changes. Our study results also suggest that the attitude formation of homeschooling parents' toward vaccination align with non-home-schooling parents in many aspects. Future research should seek to include homeschooling parents in understanding vaccine exemption clustering specifically and

vaccine attitudes generally, as this population is generally not included in larger population-based surveys measuring vaccine attitudes and behaviors.

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Conflict of interest

D. Salmon has received grant funding or consultancy funds from Merck, Pfizer and Walgreens. N. Klein has received previous research support from the Centers for Disease Control, Merck, Glaxo-Smith Kline, Pfizer, Sanofi Pasteur, MedImmune, Protein Science (now Sanofi Pasteur) and Dynavax.

Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.vaccine.2018.12.018>.

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