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An exploratory study of expectant mothers' knowledge, attitudes and beliefs about infant vaccination

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ABSTRACT

Background: Childhood vaccination decision making occurs during pregnancy. However, more insight is needed to determine how expectant mothers in the United States decide whether to vaccinate their children — particularly as the first vaccine, Hepatitis B, is recommended within 24 hours of birth. **Aim:** This qualitative study used the foundational lens of the Theory of Reasoned Action to 1) explore how expectant mothers formulate knowledge, attitudes, and beliefs about infant vaccination, and 2) discern if differences exist regarding how first-time expectant mothers approach vaccine decision making. **Methods:** Eleven focus groups were conducted with pregnant participants from an obstetrics practice in the southeastern United States. Thematic analysis was undertaken, utilizing the constant comparative method. **Results:** Four overarching themes emerged: the need for evidence-based childhood vaccine information during pregnancy; perceptions of source trustworthiness and the social media paradox; concerns about the "one-size-fits-all" vaccine schedule; and the process of vaccine risk-benefit analysis of first-time mothers. **Discussion:** Practical implications highlight a need for standardized vaccine-related education during the prenatal care period. Theoretical implications reveal that the decision of whether to vaccinate one's infant remains complex, involving a variety of factors. **Conclusion:** Compared to expectant mothers who had children previously, first-time expectant mothers especially reported feeling ill-informed to make infant vaccine decisions.

KEYWORDS

Expectant mothers**,** hepatitis B vaccine**,** infant vaccine uptake**,** prenatal vaccination education**,** theory of reasoned action**,** vaccine hesitancy, vaccine literacy

BIOGRAPHIES

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Introduction

Immunizations have been cited as paramount for improving health and reducing incidences of disease and disability worldwide, an effort which contributes to economic growth due to decreased mortality and morbidity. Previous research calculated an annual return on investment in vaccination between 12% and 18% (Andre et al., 2008). Per birth cohort, nine routinely recommended vaccines are estimated to prevent 42,000 deaths and 20 million incidences of disease in the United States (Centers for Disease Control and Prevention [CDC], 2011). Prior to the COVID-19 pandemic, vaccine hesitancy, defined as the reluctance or refusal to vaccinate despite the availability of vaccines, was cited by the World Health Organization as one of the top 10 global health threats in early 2019 (WHO, 2019). Notably, vaccine concerns vary by geography and are often country or region-specific (Edelstein et al., 2020; Hausman, 2019).

Parental decisions regarding vaccine acceptance are usually made before conception or during the prenatal period (Corben & Leask, 2018; Danchin et al., 2017), often with guidance from health care providers. The importance of providing expectant parents with accurate vaccine information is critical for informed decision making. This importance highlights the need for providing standardized vaccine education during routine obstetric care and prenatal visits in the United States (Návar et al., 2007). However, limited research exists regarding how pregnant women in the United States formulate knowledge, attitudes, and beliefs about infant and childhood vaccines. Research indicates that one in 12 expectant mothers in the United States (Houston, TX) are classified as vaccine-hesitant, (Cunningham et al., 2018), and a need exists to better understand and address vaccine hesitancy among expectant parents before the birth of a child as opposed to focusing infant vaccine education efforts on parents with children. While findings are mixed, first-time expectant mothers are believed to be more vaccine-hesitant (Cunningham et al., 2018; Danchin et al., 2017).

Within the first 24 hours after birth, the American Academy of Pediatrics (AAP) recommends infants receive an initial dose of the Hepatitis B vaccine, and a Vitamin K injection to staunch bleeding and prevent “hemorrhagic disease of the newborn,” a rare, but life-threatening bleeding disorder (CDC, 2018; Dan, 2017). In the absence of scientifically based information from a medical provider while the baby is in utero, new mothers may often be faced with making a spontaneous decision after delivery relying on gut instinct or advice from one’s social network. With increased use of social network sites such as Facebook at the transition to parenthood, (Bartholomew et al., 2012), parents may readily encounter conflicting views and misinformation about childhood vaccines, leading to increased vaccine hesitancy, delays, and deviations from the recommended vaccination schedule (Weiner et al., 2015; Hoffman, et al., 2019). A study conducted in Colorado over four years revealed that parents who declined or delayed childhood vaccines were two times more likely to have begun thinking about vaccines before the birth of the baby, and eight times more likely to reevaluate their decision over time (Glanz et al., 2013) – highlighting a clear need for accurate, credible information about vaccines during pregnancy from a healthcare provider.

To prevent future vaccination delay and rejection, the perinatal period has been identified as an opportune time to implement optimized vaccination interventions through a better understanding of expectant mothers' decision-making process, particularly for women experiencing their first pregnancy (Corben & Leask, 2018). Further study is needed to better

understand how and why expectant mothers form their attitudes toward vaccination (Fadel et al., 2017) to facilitate shared decision making between patient and provider during pregnancy. Therefore, the purpose of this study was to understand how expectant mothers – especially first-time expectant mothers – gather and use information to inform their infant vaccine related knowledge, attitudes, and beliefs, and how, once developed, their knowledge, attitudes, and beliefs can translate into behavioral intent of vaccination uptake.

Literature review

Formulation of vaccination knowledge, attitudes, and beliefs during pregnancy

Mothers in the United States have expressed a clear preference for information about infant and childhood vaccinations, with a study conducted in Tennessee and California revealing greater receipt of information linked to increased positive maternal attitudes and beliefs about vaccine safety (Vannice et al., 2011). A study conducted in Australia affirmed that the majority of expectant mothers make decisions about vaccinations before or during their pregnancies, but a "vaccine confidence gap" currently exists (Corben & Leask, 2018). This is problematic as any level of expressed vaccine hesitancy has been linked to a 9-fold greater likelihood of voluntarily delaying or declining childhood vaccines and an 80% reduction in the likelihood of having pro-vaccine social contacts (Corben & Leask, 2018). Another study in Australia revealed that approximately one third of mothers reported receiving insufficient infant and childhood vaccine information during pregnancy (Danchin et al., 2017). Along these lines, Danchin et al. (2017) reported that opportunities exist for healthcare providers in Australia to improve education and communication on childhood vaccines during the antenatal period, which could decrease vaccine hesitancy and increase infant and childhood vaccine uptake.

According to the CDC, infants are particularly at risk to contract contagious diseases, making timely vaccination critical. Vaccine education during pregnancy is important for increasing infant vaccination uptake within communities and creating subsequent community immunity, or "a situation in which a sufficient proportion of a population is immune to an infectious disease (through vaccination and/or prior illness) to make its spread from person to person unlikely" (CDC, 2020).

Scientifically based, accurate information about the safety and efficacy of vaccinations from healthcare providers during pregnancy, including the timeline of the recommended Hepatitis B and Vitamin K injections within the first 24 hours of birth, would ensure new mothers have the full resources and knowledge to make an informed decision in the hospital. A survey of obstetrician-gynecologists (OBGYNs) in the United States to understand their attitudes, beliefs, and current practices toward providing information about routine childhood immunizations during standard prenatal care appointments revealed that while 84% reported that information provision was important, only 47% believed that they could influence mothers' childhood vaccination decisions (Link-Gelles et al., 2012). Similarly, in China, Hu et al. (2017) identified the need for vaccination education for pregnant women in conjunction

with a strong partnership with obstetricians, which can improve mothers' knowledge and increase the coverage, completeness, and timeliness of childhood vaccination.

Although information on vaccine safety issues has increased exponentially in the past 50 years from ≤ 10 publications per year in the 1960s to > 10,000 per year in the past decade (Asturias et al., 2016), previous research describes high or moderate levels of concern among expectant mothers in Australia regarding vaccine side effects (25.4%), safety (23.6%), and efficacy (23.1%) (Corben & Leask, 2018). In 2012, the SAGE Working Group formally defined vaccine hesitancy as "attitudes toward vaccination on a continuum from total acceptance to complete refusal." The report highlighted the mid-range group's ambivalence to vaccine acceptance by stating the group may "refuse some vaccines, but agree to others; delay vaccines or accept vaccines, but are unsure in doing so" (WHO, 2012). Vaccine hesitancy has been associated with lack of confidence in the recommended childhood vaccination schedule ($p < 0.001$) (Corben & Leask, 2018), and past research suggests the need to identify and address vaccine hesitancy among expectant parents during the period of family planning or pregnancy, but before the infant's birth (Cunningham et al., 2018; Danchin et al., 2017). While the majority of expectant mothers in the second trimester of pregnancy in the United States reported holding positive beliefs toward vaccination overall, 70 percent indicated the need for more information about the recommended childhood vaccination schedule; those who were most undecided reported a primary reliance on socially available sources of vaccine information rather than scientifically-based information issued by a healthcare professional (Weiner et al., 2015). False information spreads more rapidly than truth on social media, and even five to 10 minutes of viewing vaccine-critical information online can decrease intention to vaccinate (Hoffman et al., 2019; Betsch et al., 2010; Chou et al., 2018).

Childhood vaccination decision making is a complex process often ridden with decisional conflict, particularly for first-time expectant mothers. Psychosocial and other factors impact pregnant women's attitudes, intentions, and behaviors in terms of vaccinating their child (Corben & Leask, 2018). Notably, in the intensive parenting style touted as superior, new mothers, especially, may feel social pressure to become experts on vaccination prior to consenting to any injections since they are typically the primary caregivers responsible for protecting their children from any harm (Damnjanović, et al., 2018). Prior beliefs about vaccinations have also been found to influence vaccine hesitancy (Dubé et al., 2014; Damnjanović, et al., 2018). For example, a mother choosing to decline or delay Hepatitis B for her infant at birth for any reason, including the perception of inadequate information, could impact her subsequent vaccination decisions for that child.

The book entitled "Guidelines for Perinatal Care," developed jointly by the American College of Obstetricians and Gynecologists and the American Academy of Pediatrics, recommends that pregnant women meet with a newborn provider during the third trimester to discuss the issues of infant and childhood vaccines. However, survey results from the AAP illustrated that only 5 to 39 percent of first-time expectant mothers attend prenatal visits with a pediatrician, and of those least likely to attend such an informational visit are pregnant women in rural areas with limited access and urban women of a lower socioeconomic status (Yogman et al., 2018). Therefore, exploratory qualitative research can help us to ascertain which sources expectant mothers currently find most trustworthy and educational in formulating their knowledge, attitudes, and beliefs about infant vaccination and which ones are most frequently accessed in addition to, or more often in absence of, direct recommendations from a healthcare provider.

Theoretical framework

In a comprehensive literature review on maternal vaccination (Myers, 2016), the theory of reasoned action/theory of planned behavior emerged as a predominant theoretical framework used to investigate this issue through the lens of the salient relationship between beliefs and behaviors. The theory of reasoned action (Fishbein & Ajzen, 1975) posits that the underlying behavioral and normative beliefs affect intentions and subsequent behavior through attitudes and/or subjective norms (Madden et al., 2010). Behavioral beliefs are often derived from perceived norms -- injunctive norms, or perceptions of what other people think we should do -- and descriptive norms -- perceptions of what others have done or are presently doing or are likely to do in the future (Fishbein & Ajzen, 2010; Perloff, 2017). Likewise, Perloff (2017) posits that the reasoned action model offers the most systematic explanation of the processes by which beliefs influence behavior.

Less-than-positive maternal attitudes toward childhood vaccination have been identified as the strongest predictor of eventual vaccination uptake or lack thereof (Fadel, et al., 2017). Notably, it is important to differentiate between vaccine uptake (administration) and vaccine acceptance, or the idea that an individual expresses an intention to receive the vaccine. As the knowledge, attitudes and beliefs of pregnant women related to vaccination acceptance are complex, and any receipt of information, regardless of accuracy, can influence the expressed intention to vaccinate or not vaccinate, (Myers, 2016) more study is needed to identify how pregnant women in the United States access and make sense of information directly pertaining to infant vaccination from myriad sources in accordance with their own pre-established beliefs and value systems.

The SAGE Working Group Model Determinants of Vaccine Hesitancy includes contextual, individual/social/group influences, and vaccination-specific issues (Larson, et al., 2014), many of which were examined in our study. The purpose of this study was to examine expectant mothers' knowledge, attitudes and beliefs about vaccination and how first-time expectant mothers might differ in their decision making in comparison to expectant mothers with children, as articulated in the following research questions:

> RQ1: How do expectant mothers in the United States formulate knowledge, attitudes, and beliefs about childhood vaccination?
>
> RQ2: Do first-time expectant mothers approach childhood vaccination decision making differently than expectant mothers with children?

Method

Qualitative research creates an interpretive bricolage of representations fitted to specific complex situations and is particularly appropriate in studying routine and controversial subjects and experiences in an effort to understand meaning (Denzin & Lincoln, 2000). In our study, the lead researcher conducted audio-recorded focus groups with expectant mothers in all stages of pregnancy. A seven-step process was implemented, which included: thematizing inquiry, designing the conceptual framework, conducting focus groups with participants, transcribing audio-recorded focus groups, data analysis, verifying, and reporting of the study

(Brinkmann & Kvale, 2015). As is typical of flexible qualitative research design, data collection, coding, and analysis occurred in a spiral process as opposed to a fixed linear model. In our study, data analysis began immediately after the first focus group and continued throughout the process, even as recruitment remained ongoing and additional focus groups were conducted.

Recruitment

Previous research has revealed that mothers, in comparison to fathers, typically have a greater imbalance in child-rearing, bearing more of the parenting load (Riina & Feinberg, 2012), striving to achieve lofty ideals for motherhood, and making approximately 80% of healthcare decisions for their families (Metoff-Stepp et al., 2014). Thus, our study focused on expectant mothers rather than expectant fathers or other caregivers.

Pregnant participants were recruited from the Faculty Group Practice's Women's Clinic associated with a large Southeastern university in the United States in the Summer of 2018. To recruit participants, the lead researcher posted flyers in the clinic's lobby, on bulletin boards in hallways, in examination rooms, and on a clipboard at the check-out counter. Additionally, the lead researcher spoke to women at the clinic during scheduled, prenatal centering groups to encourage them to participate in the study during a future visit, if possible. Snowball sampling was also implemented, with participants suggesting friends and acquaintances who would also qualify for the study.

Ultimately, eleven focus groups were conducted with 29 participants in various stages of pregnancy, ranging in size from two to five individuals. Most participants were from the United States (n = 26), predominantly Florida or the southeastern United States, but one participant was from China, another was from Puerto Rico, and a third was from Nigeria. Approximately 45% of participants (n = 13) were expecting their first child at the time of the focus groups, and 55% of participants (n = 16) were in their third trimester of pregnancy, many in the last month. Participants' ages ranged from 18-40 years old. Focus groups lasted an average of 43 minutes. In total, 516 minutes of transcripts were analyzed by the lead researcher and a second coder.

Focus group procedure

Prior to participating in the study, all participants signed an informed consent form approved by the University's Institutional Review Board, which explained that participation was voluntary and that they could withdraw from the study at any time with no penalty. Fictitious names were assigned to each participant to protect their anonymity in the groups, with women whom they were not previously acquainted, with the researcher, and for the purposes of confidentiality with recordings. These self-chosen aliases are used throughout this article. While some women were already familiar with one another from attending the same OBGYN practice and participating in weekly centering groups, many of the participants did not attend focus groups that corresponded to their usual centering group times due to scheduling conflicts (e.g., some needed to come early rather than stay late, and vice versa). Thus, many of the participants did not know one another since they attended different centering sessions

and mixed into focus groups with participants from alternate centering session times. The participants who were previously acquainted from centering groups greeted each other, sat together, and often engaged in small talk prior to beginning the focus group sessions, appearing more at ease to share their thoughts candidly, as they were used to sharing questions and concerns openly with the physician leader and fellow participants during centering group sessions. Thus, the dynamics associated with focus groups in this setting were interesting to observe, particularly as first-time expectant mothers seemed more tentative, instead deferring to the more experienced (and vocal) women who already had children and had been through it all before.

After completing the informed consent documentation, the lead researcher provided a brief introduction and then asked open-ended questions derived from a semi-structured focus group guide, that all of the researchers participating in this study created together. The focus group guide in its entirety was designed with the premise of the Theory of Reasoned Action, which states that underlying beliefs affect intentions and subsequent behavior through attitudes and/or subjective norms. Thus, it was important to understand participants' underlying vaccine beliefs and intentions. The semi-structured guide first included questions based on the SAGE Working Group Model Determinants of Vaccine Hesitancy, related to confidence, complacency, and convenience. Questions included: have you begun to think about childhood vaccinations yet, where are you in the vaccine decision making process, and as of today, do you think that your child will get some, all, or no vaccines?; which sources will you trust the most to make decisions for your infant's health; and have you seen anything or met anyone advising you not to vaccinate for any reason? Then, the lead researcher asked focus group participants to answer and comment on existing questions about childhood vaccination, compiled from previous research, primarily the Parent Attitudes About Childhood Vaccination Survey Tool (PACV) (See: Opel et al., 2011a; Opel et al., 2011b, Opel et al., 2013). Due to time constraints, each focus group was verbally read a portion of the 100 questions, many of which were repetitive or asked the same thought in a slightly different manner, ensuring that all questions were discussed during one or more groups, to prompt open-ended dialogue. Examples of items discussed included: "I trust the recommended shot schedule is good for my child," and/or "Children get more shots than are good for them."

The open-ended discussion allowed for deeper insights into participants' thought process than a closed-ended survey would permit and provided rich details for further work to develop a quantitative survey for this target population, since the PACV was designed for parents with children rather than expectant parents. Topics discussed in every group included the individuals and groups perceived to benefit from vaccination, information sources that participants trusted, each of the 16 individual vaccines recommended by the CDC and AAP, including Hepatitis B at birth, beliefs about vaccine safety and efficacy, and how expectant parents were beginning to formulate their knowledge, attitudes and beliefs about infant and childhood vaccines (e.g., doctors, media, peer networks). Depending on participants' responses, some groups spurred conversation deeper into a topic of interest to them (e.g., the MMR vaccine and refuted autism claim), which did not seem to interest other groups to the same extent – something that the semi-structured guide allowed for, and one reason that the focus group method was so useful in conducting these discussions. The lead researcher did not impose a strict agenda onto the discourse within these groups other than making sure that the main topical areas (listed above) were addressed by asking questions from that category and ensuring that the groups contained their discussions within the 60-minute time

limit. Hence, not all groups received the same exact list of questions in the same order, as they would on a survey, but the groups did touch on the same major topics across the board. Participants received a gift bag containing items worth approximately $20 in value for their participation.

Analysis

The lead researcher used Rev to create word-for-word transcripts for each audio-recorded focus group right after it occurred and double checked the transcripts for accuracy. Two coders trained in qualitative analysis reviewed transcripts and met bi-weekly to discuss emerging themes, resolving any discrepancies that arose. Terms and emerging themes were clarified with participants during each subsequent focus group to ensure complete understanding as a form of member checking (Maxwell, 2013). For instance, the term “one-size-fits-all” regarding the perceived inappropriateness of the standardized vaccine schedule emerged early on, and the lead researcher made sure to probe future participants about this term when it was mentioned or alluded to during discussions about recommended childhood vaccines to ensure that participants’ thoughts were properly portrayed.

Open coding, or “the process of breaking down, examining, comparing, conceptualizing, and categorizing data" (Strauss & Corbin, 1990, p. 61) allowed concepts and ideas to be coded line-by-line using a descriptive content analysis approach followed by axial coding. Coders then winnowed and grouped data into categories of constructs, and finally subthemes, which were reduced into overarching themes to develop a contextual understanding of primary relationships among the data (Creswell, 2007; Glaser, 1965; Wong & Chou, 2017; Wilkinson, 1998). Through theoretical sampling as outlined by the constant comparative method, data was collected until theoretical saturation was reached, or the codes became repetitive (Glaser, 1965).

Results

Four overarching themes were identified: the need for evidence-based childhood vaccine information during pregnancy; perceived trustworthiness of sources and the social media paradox; maternal concerns about a “one-size-fits-all” vaccine schedule; and risk-benefit analysis of first-time expectant mothers.

The need for evidence-based childhood vaccine information during pregnancy

Across the board, participants described an absence of information about childhood vaccines provided to them by a healthcare provider during pregnancy. Jakita explained: “They don't really discuss that while you're pregnant. It's just kind of once you have the baby, they ask you.” Participants described remaining uniformed unless they made a specific effort to sit down with their child’s future pediatrician. Along these lines, participants expressed frustration that they were not given more information up front.

> It is surprising that they waited this long. I feel like, now that they've scheduled all my ultrasounds until the end of the pregnancy, that they might start talking to me about it. But the fact that I'm only a month and a half, maybe, left in my pregnancy and they still haven't mentioned anything about it…this is something that

> you can research even before you try to get pregnant, and they just haven't even said anything about it." (Veronica)

Only one participant indicated having received comprehensive childhood vaccine information from a provider during pregnancy. However, the information provided was in response to the participant's initiation of the topic and direct questioning of her provider:

> They were just saying the importance of vaccinations and if I didn't decide to go with the baby being vaccinated, the pros and cons. Just giving me a full update of what could happen if I didn't get him vaccinated. (Pat)

Another participant received a "general mother's magazine" from the obstetrician which happened to contain an article about childhood vaccinations. Aside from that, she did not receive any information directly. This was consistent for both first-time expectant mothers and mothers with other children; first-time expectant mothers were more likely to be considering pediatrician selection, but the vast majority had not yet scheduled a prenatal visit, with many expressing intentions to wait until after the child was born. Meanwhile, most mothers of older children planned to stay with the same pediatrician and saw no real need for a prenatal visit for this baby. Therefore, with a lack of prenatal visits being scheduled, a need for evidence-based vaccine information during pregnancy clearly emerged, describing in contrast, an "extreme lack of information."

> But, if the woman's doctor's office took the forefront and made sure the information was at least relayed, you wouldn't have so many confused people that didn't know what they wanted to do…because you need to know what you're going to do with vaccinations when you go into labor, because that first vaccine is in 24 hours. You need to know then, that's one of the things that you need to prepare for. I really think that most women don't talk to a pediatrician before they give birth…When it comes down to it, I'm the one who's done the research on the little information I have…I think honestly, at a certain time period, once you hit 30 weeks, I think that information should be relayed. That way you have the information you need before something happens, and then it's too late to make an informed decision." (Marie)

Harriet, who plans to use the pediatrician that her older children see, reported that she has not visited her children's pediatrician in three to four months and did not receive much information about infant vaccination during her latest pregnancy from either the pediatrician or obstetrician.

> I think the lack of information is a really big issue. I think that honestly, doctor's offices, their prenatal should really start informing women about things like this because when it comes down to it, it is the pediatrician's job to vaccinate the baby. (Harriet)

Multiple participants, some of whom would be induced within the following week, described our focus group conversation as the first dialogue they had had about this subject. As Jamie articulated: "I definitely didn't know they get a shot in the first 24 hours. I would have wanted to know that beforehand, I'm glad you [the researcher] know."

Expectant mothers expressed a desire to receive comprehensive information from a doctor earlier to make an informed decision for their child. While participants described receiving in-depth information on other topics, such as breastfeeding, through evidence-based videos while waiting for the doctor in the exam room, infant vaccination – not limited to Hepatitis B administered within 24 hours of birth – was not discussed with patients.

> In my honest opinion, I think the doctor should be the one to bring it up. Even early on, or even when you're trying to plan a pregnancy, to make sure that that information is available, and you can sit down and talk to that doctor and be like, "This is what's gonna happen." You shouldn't have to feel like you need to ask a doctor something, especially when it comes to vaccines. (Phyllis)

In the absence of comprehensive information from a healthcare provider, expectant mothers often voiced intentions to “do their own research” to become informed.

Perceived trustworthiness of sources and the social media paradox

The primary sources of healthcare information referenced by participants as most trustworthy were doctors, followed by family and friends, and then Google and online resources. The vast majority relied on family for healthcare advice to some extent, such as their mothers and grandparents with years of experience, or on peers who shared similar parenting style ideals and values and then cross-checked advice from "real world people" with online articles. For instance, Marie shared: “I'll cross-check it. I will get online and I will look and see if there's a lot of information about it… if there are 15 articles about it being true. I basically just use Google to cross-check.”

Participants repeatedly expressed the value that they placed on research and consulting multiple sources to verify the validity of health information.

> Especially if you can find sources that are not just like bloggers, but from hospitals or the CDC, or trusted doctors... Whether it's talking to people or looking online, it can kind of help everything fall into place in your own mind regardless of where you stand on the matter. Because if you just look at anti-vaxxers or if you just look at pro-vaccination people, obviously the sides of their stories are going to be biased. If you get a mix and then look at see what the doctors say versus the CDC and all of that. You'll have a better whole picture of it. (Grace)

Interestingly, “the media,” defined in previous research to include books, magazines, newspapers cable/TV news, and/or radio, was referenced infrequently in our study and often with a sense of distrust. Only one participant mentioned consulting a book at all, such as *What To Expect When You Are Expecting*. Media sources were often verified with Google searches. On the other hand, participants did mention relying on apps such as Ovia, The Bump, and WebMD, which was cited frequently as a trustworthy health-related resource, both as a website and an app. Despite distrust in “the government” and “Big Pharma” broadly, the participants mostly felt like individual government officials and doctors were doing the right thing and acting in the best interest of their patients. However, participants still reported a distrust for vaccine companies who were “just in it for the money” and explained their individual processes of cross-checking information that they received.

> I trust the government, but it's on us to read about these things as well and know what the research shows. Sometimes you can't trust the government. [I] look for information straight from the source, from the people that study these drugs and study these effects. (Jessica)

In an interesting paradox, participants expressed increased trust in closed Facebook “Mama Groups.”

> I'm part of one. A couple of my friends are in it. It's called Momtourage. Again, if it's something that I'm looking for, then ... Especially in the mom groups and things like that, then I would trust it a little bit more than just some ad or something that popped up on my screen. (Veronica)

Participants reported a clear distinction between the quality of information from these closed groups and “social media” in general, which was disdained as a poor-quality source overall. Amelia described the distinction in trust as varying and dependent on “if you're involved in certain groups,” articulating that group involvement makes a difference regarding the trustworthiness of health-related information provided on Facebook.

Participants described that the value in these closed groups derived from surrounding themselves with other expectant mothers. As Janine expressed "it feels better that way" in terms of associating heightened trust associated with the information provided. Participants described reading the topical discussions in these groups to get feedback from other mothers and expressed surprise at the amount and type of personal information that is often shared in closed groups as opposed to public social media pages.

> I am in a Facebook Mamas' group [about diabetes when you are pregnant]. You have to join, or someone adds you…most of those moms ask questions that they should ask the doctor. Like if they get the insulin, how many should I put? That's a question for your doctor. He should tell you. Not someone on the Internet…. It's some dumb questions. But, a lot of women give answers about it… They follow the answers. (Dorothy)

Despite all participants stating that "social media" is not seen to be credible, "closed" groups appeared to be the main exception. Additionally, the majority of participants expressed frequent scrolling on Facebook throughout the day, and "a few minutes here and there" added up to an average of three hours per participant per day. When asked how they evaluated the credibility of information found in the Facebook News Feed or on Google, participants described looking in particular for dot.orgs or medical websites, which were perceived to be more credible than Wikipedia. Then, they expressed arriving at a "gut feeling" of accuracy regarding the information or relying on the number of shares, comments, or overall online outlets that publish a similar story about the same topic to lend legitimacy to its content. Likewise, multiple comments echoing a similar perspective were seen to validate the truth of that perspective that consensus lends legitimacy.

Maternal concerns about a "one-size-fits-all" vaccine schedule

All of the participants in these focus groups expressed pro-vaccination attitudes overall (to exclude the influenza vaccine due to prevailing distrust and/or fear that it causes the flu). However, even some of the staunchest vaccine supporters expressed some doubt about the standard childhood vaccination schedule recommended by the CDC and instead proposed solutions that might include spacing vaccinations out or giving children fewer injections at one time to prevent pain or adverse reactions.

> I feel like spreading out the shots and not getting them all at once is [better]... I think it is kind of too much all at one time [right now]. Because what if they have a reaction to it? And how would you know which one they reacted too? I've heard of people like delaying and getting, you know, shots all separated and stuff. (Mary)

Discussions often centered on the vaccines participants recalled receiving as a child and the increased vaccines available now, which in many cases was seen as a negative due to more injections and potential for side effects as opposed to a positive medical innovation. The child's age was also brought into question, with some mothers wondering if babies are getting too many vaccines too soon and sharing support for "alternative" schedules which allow for children to receive all of the necessary vaccines once their immune systems are "more developed." This also applied to mothers who had older children in recent years but were worried about whether vaccinating the new baby would be the correct course of action.

> So, I think when they're younger they have a lot less fighting chances with their immune systems, they haven't had a chance to develop yet, they're more suppressed…and that goes back to us talking about whether we want to vaccinate the second child…We would talk to the pediatrician about what are the most important ones that are needed right now versus what we can get later. Space the rest of them out; that

> way it gives their poor little bodies time to recuperate. 'Cause my son's spiked a 104 fever every time he got vaccinated. (Chelsea)

In addition to spacing out vaccinations for the perceived well-being of all children, many expectant mothers focused on the individual differences between children and how more personalized vaccine schedules could accommodate various children's needs. Not every child's body will respond the same, the participants explained, expressing a desire for more individual discussion about their own baby and situation instead of a "one-size-fits-all" universal schedule.

> I have seen on the Internet, which probably isn't all true about some babies could react differently to some shots than other babies. I don't think that all shots would be good for all babies. (Sue)

Expectant mothers expressed that there is no "textbook" answer because there is "no textbook baby." Due to each child being an individual, the child's particular health conditions would need to be considered prior to vaccinating. Interestingly, even expectant mothers who expressed strong pro-vaccination attitudes still felt highly concerned about the effectiveness and safety of the influenza vaccine in particular and the overall childhood immunization schedule as recommended by the AAP and CDC. Pro-vaccine mothers expressed intentions to decide their child's vaccination schedule on an "individual basis," taking it "case by case." Many participants expressed the desire to find a pediatrician who would respect their schedule and declared this to be "each parent's personal decision."

Risk-benefit analysis of first-time expectant mothers

Two of the focus groups were comprised of only first-time expectant mothers, and one focus group had solely expectant mothers who already had older children. The rest of the groups comprised a mixture of first-time expectant mothers and mothers with older children. In these mixed groups, the first-time expectant mothers often followed the lead of more experienced mothers. For example, "Clara" declared that she "definitely thinks she is doing the same thing," in terms of vaccinating her baby with the "basic vaccines only" — excluding the flu shot — after another mother expressed her intention to follow this plan. Many of the first-time expectant mothers seemed less confident speaking up in groups with mothers with older children, and even more so, they did not seem to want to contradict the overall flow of the group discussion led by the more experienced mothers. They also seemed to be more concerned about vaccine safety and efficacy in general – because with your first baby, you just "don't know what you don't know." Consistent with the published literature, first-time mothers also seemed unsure about side effects and expressed greater initial childhood vaccine hesitancy.

> I don't know. I just don't like the whole idea. I mean, this is my first child. I don't know if I'm okay with having the fevers and whatnot. I feel like if they were more spread out, it wouldn't be as bad? I raised my nephew, and he gets fevers like 103, 104 after shots and that's just insane to me. But I don't know if even spreading them out would decrease the risk of having fevers. (Leeann)

Many came into the group leaning toward vaccinating because they had been vaccinated as children and had not really engaged in dialogue about this issue yet. However, first-time expectant mothers seemed more susceptible to concerns expressed in the group and less likely to stick to their initial viewpoints in the face of opposing opinions when compared to expectant mothers with older children. In an attempt to weigh the pros and cons, first-time

expectant mothers often engaged in risk-benefit analysis, whether externally, thinking aloud in the group, or outlining an internal cognitive process or plan of action to make an informed decision.

> I will talk to my doctor obviously, and also other mothers ... You know, just to get their opinion so I can kind of, at least, if they point me in the right direction… "This is my opinion, but read this," kind of thing. So, just since this is my first baby I really don't know where to go…And when I've asked the moms and everything, they show me little articles here and there of people that didn't vaccinate... (Veronica)

Ultimately, many first-time expectant mothers who initially expressed pro-vaccine attitudes still expressed intentions to vaccinate their children (at least to some extent, perhaps not exactly on schedule,) at the end of the focus group in order to "protect" their child from risk, following the lead of other, more experienced pro-vaccine expectant mothers.

Discussion

The purpose of this study was to explore expectant mothers' knowledge, attitudes, and beliefs about vaccination in the United States and how first-time expectant mothers might differ in their approach to infant vaccination decision making in comparison to expectant mothers with children. In thematic analysis of 11 focus groups with 29 participants, all conducted with expectant mothers in various stages of pregnancy, four overarching themes were revealed: the need for evidence-based childhood vaccine information during pregnancy; perceived trustworthiness of sources and the social media paradox; maternal concerns about a "one-size-fits-all" vaccine schedule; and risk-benefit analysis of first-time expectant mothers. Notably, one feature in qualitative work is a smaller number of participant insights, which are limited to a specific geographic region and are not generalizable to the population at large. However, saturation was reached as participants' ideas became repetitive, and similar themes reoccurred in each focus group context, such as the overall absence of childhood vaccination information during standard prenatal care. These insights may be transferable to other settings and contribute to the scholarly body of knowledge related to vaccine attitudes and beliefs during pregnancy, which according to the Theory of Reasoned Action, inform intentions and eventual vaccine uptake. Thus, this qualitative study provides an in-depth answer to RQ1) How expectant mothers in the United States formulate knowledge, attitudes, and beliefs about childhood vaccination, and RQ2) whether first-time expectant mothers approach childhood vaccination decision making differently than expectant mothers with children. Collectively, these insights can inform future work, which may seek to quantitatively test the model.

Practical implications

Perhaps most strikingly, this study identified that pregnant women in the United States currently experience a *childhood vaccination information gap*, as expectant mothers are not receiving adequate information about childhood vaccinations from healthcare providers during the prenatal period. Likewise, many expectant mothers reported not meeting with their child's future pediatrician before the birth of the child; those who did meet with the pediatrician did not report vaccinations to be a topic that was covered in the prenatal meeting. The absence of healthcare provider discussion and pro-vaccine recommendations can have

major consequences, as highlighted in previous research on adolescent HPV vaccine uptake. Research by Lindsay et al. (2021) identified the "critical influence" of healthcare providers' recommendations on parents' uptake of the HPV vaccine for their adolescent children, which illustrated that uptake was much higher for adolescent females, whose mothers all reported receiving a recommendation to vaccinate their daughter against HPV, in contrast to a much lower uptake in adolescent males whose mothers received a provider's recommendation to vaccinate their sons far less often.

Since childhood vaccination decision-making begins during pregnancy (Danchin et al., 2017), and the first vaccine, Hepatitis B, is recommended within 24 hours of birth, an effective communication strategy to inform and persuade decision making would include vaccine information dissemination during standard prenatal care. This would help to counter the recommendations and advice that first-time, expectant, and new mothers may find from peers online who may seek to discourage vaccination for a variety of reasons (Bradshaw et al., 2020). However, healthcare providers should proceed with caution in how to best go about encouraging vaccine uptake for first-time expectant mothers, who may be particularly hesitant (Cunningham et al., 2018; Danchin et al., 2017). An interpretive review of 34 qualitative studies that examined the factors that bolster vaccine hesitancy, rejection, and delay (Majid & Ahmad, 2020) identified that parents in approximately 41% of studies reported perceiving an intense "pressure" to vaccinate their children stemming from interactions with healthcare professionals, which were often dismissive of parental concerns, and ultimately eroded trust in the provider. Parents in these studies described receiving copious information – but when it was too late, such as when a nurse was standing there ready to perform the vaccination at that moment. Overwhelmingly, Majid & Ahmad (2020) identified a parental preference for healthcare providers who engaged in shared decision making (SDM), were open to a wider range of beliefs about vaccines, and who implemented less punitive office vaccine policies. Similarly, Ward et al. (2017) recommended that healthcare professionals maintain an "open door policy" to discussing vaccination *respectfully* with parents who are both hesitant and non-hesitant in order to begin building and maintaining trust while providing children with appropriate information, advice, and access to services. Both SDM and respectful interactions between healthcare providers and patients were referenced by participants in our study as well, and could go a long way toward building trust and positive maternal intentions to vaccinate their babies.

Theoretical implications

Theoretically, the reasoned action model was applied in a qualitative context to examine expectant mothers' knowledge, attitudes, and beliefs about childhood vaccinations. "Reasoned action theory emphasizes that attitudes are a reasonably accurate indicator of what people will do, provided certain conditions are met" (Perloff, 2017, p. 172). Likewise, previous research has identified the correlations between positive beliefs about the direct benefits of HPV vaccine — which can be influenced, in part, by healthcare providers' recommendations — and mothers' higher uptake and initiation of this vaccine for their adolescent daughters (Lindsay et al., 2021).

Since expectant mothers in our study were questioned about a highly relevant, and impending event (e.g., vaccinating an infant), their expressed intentions to vaccinate or delay vaccinating

may be viewed as a proxy for future behavior. In this study, perceived norms (both descriptive and injunctive) appeared to play an important role in this complex decision; participants often referred to advice from their parents, peers, and even from other mothers gleaned in closed Facebook groups as influencing or shaping their attitudes about infant vaccination.

Even though many participants reported not engaging in dialogue about this topic prior to the focus group initiated in this current study, most individuals appeared to have at least rudimentary knowledge of the topic and pre-existing beliefs that did not form in a vacuum. In an absence of information from healthcare providers, most expectant mothers reported doing their own online research and referenced other mothers' decisions both positively (e.g., I trust my sister; she is a wealth of information) and negatively (she doesn't vaccinate her kids, but I do not trust her opinions anyway.) Notably, some participants were misinformed about the process of vaccination, including the vaccines that are recommended to be administered at the recommended time intervals as well as the effects of vaccinations (as articulated in many discussions surrounding the flu vaccine causing the flu). As no such instrument currently exists according to the researchers' search at the beginning of the study, this qualitative exploratory work could inform the design and development of an appropriate and applicable survey instrument which would further test the five components of the theory of reasoned action: attitude toward vaccinating, perceived norm or social pressure to perform the action, perceived behavioral control, behavioral intent, and behavior itself.

Notably, the decision of whether to vaccinate one's infant remains complex and involves a variety of factors. The fear of and argument against a "one-size-fits-all" childhood vaccine schedule identified in our study echoes previous research conducted in the UK, which identified that "vaccine critical groups" construct risk as non-random and individual, based on genetic, environmental, and social variables (Hobson-West, 2007). The "new public health" discourses over the past ~50 years, which trend toward personalized medicine and patient choice means that "vaccine critical groups may well represent a challenge to vaccination policy but express conformity with, and provide an articulation of, broader cultural attitudes" (Hobson-West, 2007, p. 211). These cultural attitudes, also reflected in our study, can potentially culminate in a context predicted by Rogers and Pilgrim (1995) in which mass vaccination, rather than vaccination opposition, appears to be the historical anomaly (Hobson-West, 2007). Markedly, research by Nordtug (2022) identified that in a Western country like Denmark (or the United States in our study), individuals are expected to be responsible for their own health, whether they want to be or not. Some parents have reported feeling unprepared and overly burdened with this "responsibilization" to attempt to understand vaccine information on their own, preferring instead to place their trust in other actors, such as healthcare professionals, who are more knowledgeable, and effectively delegate the task of sifting through scientific vaccine information to make the right choice for their child. Thus, even in the digital age with vaccine information overload available to anyone who cares to access it, healthcare providers still play a pivotal role as part gatekeeper and part trusted advisor, with participants in our study describing a strong desire for comprehensive vaccine information during pregnancy. They view this vaccine information provision as the combined "responsibility" of the OBGYN and pediatrician, to ensure that parents-to-be are fully informed to make a knowledgeable healthcare decision for their baby, rather than leaving them to fend for themselves.

Limitations and future research

This study offered many insights into how expectant mothers formulate knowledge, attitudes, and beliefs about childhood vaccination and provided interesting angles for future research; however, it was not without its limitations. First, this study was confined to one obstetrics practice in one city in the southeastern United States. As vaccine hesitancy and vaccine education efforts vary geographically, it would be important to further investigate the efforts of other practices and medical providers to get a more holistic look at vaccine education and the formation of vaccination knowledge, attitudes, and beliefs among expectant mothers in other geographic areas. Second, some of the focus groups that were conducted included women who were already acquainted. This resulted in more candid discussion among some but may have also contributed to the silence and tentative nature of first-time expectant mothers, perhaps echoing a dynamic that was already present and established in prenatal centering care groups. Conducting focus groups with participants who have never met and do not have a pre-established dynamic could produce different results. Markedly, in our study, many of the participants did not know one another due to scheduling conflicts and the need to attend different sessions outside of their normally scheduled centering group time. Thus, this limitation is not all-encompassing or insurmountable in our study, but should be noted. Finally, our study design only included expectant mothers, rather than fathers or other caregivers, similar to other vaccine research which focuses only on mothers as the primary vaccine decision maker (Lindsay et al., 2021). However, as identified by Lindsay et al. (2021), it would also be important to understand the role that fathers play in their children's healthcare decisions and how families make vaccine choices by expanding such research studies to be more inclusive moving forward.

In terms of future research, although these participants attended the same practice, within practice confines, they experienced care from multiple providers (upwards of 12). Participants' varied interactions, sometimes with the same practitioner(s), point to the need for standardized vaccine education during prenatal care and follow-up work. Future research should consider dialogue with both obstetrics and pediatrics providers to close the loop in determining strategies for more effectively communicating vaccine information to expectant mothers during pregnancy. One such approach might include producing short educational videos about what to expect regarding infant vaccination to be viewed by mothers in the waiting room or exam room prior to their prenatal doctor's visits; the video module approach has been implemented for topics such as breastfeeding at various stages of pregnancy and was described by participants to be an effective informational approach to an infant health topic. Likewise, future research should continue to investigate eroding trust in the standardized schedule and the origins of increasing maternal requests to "space out" or "delay" vaccines, even while intending to have their child fully vaccinated "eventually" (except for the flu vaccine.)

Future research should also investigate the potential of closed Facebook groups to influence maternal decision making in accordance with perceived norms on a wide spectrum of child health and behavioral topics; in a paradox where social media was largely discredited, participants reported relying on and trusting these closed "Mama groups" due to the vast volume of experience contained within. The knowledge gleaned from these closed groups could be leveraged by healthcare professionals to disseminate accurate, scientifically based

vaccination information to counter the vast misinformation that abounds in a digital environment dominated by vox populi and user-generated content (Bradshaw et al., 2020).

Building on published research (Cunningham et al., 2018; Danchin et al., 2017), first-time expectant mothers did appear to be slightly more vaccine-hesitant and tended to follow the lead of mothers with older children, who were perceived to be more experienced. Future research should include individual in-depth interviews with these first-time expectant mothers since some of the participants in this study appeared to be more hesitant to speak up in a group setting.

In conclusion, the formulation of knowledge, attitudes, and beliefs about childhood vaccinations is a complex, multi-faceted process that begins during pregnancy. However, expectant mothers in the United States currently feel ill-prepared and uninformed to decide for their children, particularly surrounding infant Hepatitis B vaccine that is scheduled to be administered within 24 hours of birth. First-time expectant mothers especially reported feeling especially ill-informed based on an absence of evidence-based information during standard prenatal care. However, even expectant mothers with older children expressed a preference to be given updated information with each baby, as the standards and recommendations may have changed over time, reporting that it is the “responsibility” of their doctors to provide this information to them in a timely and compassionate manner. As a whole, expectant mothers revealed feeling particularly cautious about the increased number of vaccines overall, the number of vaccines given to children at one time, particularly as infants, and uncertainty about whether a one-size vaccine schedule truly fits all.

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