



Choking, allergic reactions, and pickiness: A qualitative study of maternal perceived threats and risk avoidance strategies during complementary feeding

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ABSTRACT

An infant's early eating experiences influence later growth and health. However, motivators for mothers' complementary feeding decisions for their infants, such as the process of introducing solid foods, remains unclear. This qualitative study identified maternal perceived threats surrounding complementary feeding and strategies mothers use to mitigate perceived threats of adverse feeding-related health outcomes for their infants. Twenty-seven mothers participated in private, semi-structured interviews. Inductive and deductive qualitative content analysis revealed three primary themes of maternal perceived threats: a) choking, b) allergic reaction, and c) pickiness. Within each primary theme were sub-themes that further delineated the perceived threats and outlined specific and focused complementary feeding practices (CFPs) mothers used for each type of perceived threat. Findings suggest mothers have difficulty with estimating the likelihood and severity of risks and rely on elevated threat perception to guide their feeding decisions. CFPs used to prevent perceived threats were disproportionate to risks, and, at times, actually introduced additional, alternative risks.

1. Introduction

¹The complementary feeding period is a brief, yet important developmental phase in which an infant transitions from a diet consisting exclusively of breastmilk or infant formula to one of diverse foods and textures (World Health Organization (WHO), 2017). Complementary feeding practices (CFPs), such as the timing and type of complementary food introduction, have been found to influence the development of dietary patterns, creating a pathway for growth and disease risk across the lifespan (Baidal et al., 2016; Emmett, Hays, & Taylor, 2018; Koletzko et al., 2017; Komninou, Halford, & Harrold, 2019; J.; Pearce & Langley-Evans, 2013; Pluymen et al., 2018). The WHO has long provided complementary feeding recommendations to support optimal growth and development (WHO, 2017); yet, until recently, there were very few evidence-based guidelines in the United States (US). In 2020,

for the first time ever, the Dietary Guidelines for Americans (DGA) released focused complementary feeding guidelines for infants from birth to 23 months (US Department of Health and Human Services (DHHS) and US Department of Agriculture (USDA), 2020). These new guidelines provide an opportunity for researchers, educators, policy makers and healthcare providers to reassess former feeding recommendations and incorporate new evidence into practice.

According to key DGA complementary feeding guidelines, infants should exclusively consume breastmilk (or iron fortified infant formula if breastmilk is unavailable) until around six months old, at which point they should also begin to consume a variety of nutrient dense complementary foods (DHHS and USDA, 2020). In addition, the DGA guidelines state that along with complementary foods, parents should offer potentially allergenic foods (e.g., peanut products, eggs, shellfish, milk products, tree nut products, wheat, fish, and soy), avoid unhealthy

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¹ Abbreviations: complementary feeding practices (CFPs), American Academy of Pediatrics (AAP), Supplemental Nutrition Assistance Program for Women Infants and Children (WIC), Dietary Guidelines for American (DGA), United States Department of Health and Human Services (DHHS), United States Department of Agriculture (USDA), by Consolidated criteria for REporting Qualitative research (COREQ).

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additives (e.g., sugar and sodium), strive for a healthy dietary pattern that includes foods from all food groups, avoid foods with a high risk of choking, and utilize a responsive feeding style (DHHS and USDA, 2020).

1.1. Complementary feeding practices and health outcomes

Complementary feeding practices are the ways in which caregivers transition their infant to a diet of diverse foods and textures. CFPs discussed within the guidelines provided by the WHO and DGA, include the *types of complementary foods introduced* (e.g., vegetables, fruits, or infant cereal), *timing of complementary food introduction*, *feeding method* (e.g., spoon-feeding or infant self-feeding), *food texture* (e.g., puree, lumpy, chunky, or crispy), and *timing/type of allergenic food introduction* (DHHS and USDA, 2020; WHO, 2017).

A growing body of evidence suggests a relationship of CFPs with health outcomes (Emmett et al., 2018; Koletzko et al., 2017; Komninou et al., 2019; J. Pearce, Taylor, & Langley-Evans, 2013; Pluymen et al., 2018). In low-income/low-resource regions, CFPs have been associated with underfeeding, wasting, and stunting (Paramashanti & Benita, 2020; Stewart, Iannotti, Dewey, Michaelsen, & Onyango, 2013; Tessema, Belachew, & Ersino, 2013). In the US and other high-income/high-resource regions, however, health outcomes associated with CFPs are quite different. For example, in the US, Australia, and the United Kingdom (UK), the introduction of complementary foods prior to four months of age (*timing of CF introduction*) has been associated with excessive weight gain and risk for obesity throughout childhood (Gingras et al., 2019; J. Pearce et al., 2013). Also in the US, infant consumption of juice, nutrient-poor snacks, and desserts/sweets (*type of CF introduction*) is associated with an increased risk for obesity (Auerbach et al., 2017; Mennella et al., 2021; Moore et al., 2019). An additional study in the US study found an association between delayed introduction of lumpy foods (*food texture*) and an increased risk of pickiness and decreased consumption of health promoting foods, such as fruits and vegetables (Coulthard, Harris, & Emmett, 2009). An association between infant self-feeding (*feeding method*) and a reduced risk for pickiness emerged in a review of research from the UK and New Zealand (A. Brown, Jones, & Rowan, 2017). Finally, a growing body of evidence from the US, UK, Australia, and Finland, suggests a reduced risk of food allergy if allergenic foods are introduced prior to six months old (*timing/type of allergenic food introduction*), rather than after twelve months old (G. Du Toit et al., 2015; George Du Toit et al., 2008; Koplin et al., 2010; Nwaru et al., 2010; Peters et al., 2019; Poole et al., 2006).

1.2. Complementary feeding decision-making

Mothers are noted to make the majority of infant feeding decisions (Blissett, Meyer, & Haycraft, 2006; Earle, 2000; H. M.; Wasser et al., 2013); however, they are not likely to adjust their CFPs solely based on guidelines (Harrison, Brodribb, & Hepworth, 2017). Historically, there has been a discrepancy between the limited professional guidelines available and maternal feeding practices. Even with an ongoing 25-year recommendation from the American Academy of Pediatrics (AAP) for exclusive breastfeeding from birth until around six months old, only 25% of infants in the US are exclusively breastfed at six months (Centers for Disease Control and Prevention, 2020; Eidelman & Schanler, 2012; Georgieff, Piovaneli, & Queenan, 1997; Gingras et al., 2019). The AAP also recommends waiting until around six months to introduce complementary foods; however, approximately 20% of US mothers introduce complementary foods before four months old (Gingras et al., 2019). To promote the healthiest CFPs, we must consider how mothers make decisions about how and what to feed their infants during this period.

1.3. Maternal beliefs and complementary feeding practices

Decision-making models suggest that an individual's beliefs about

risks, benefits, and barriers influence his/her behaviors (Ajzen, 1991; Janz & Becker, 1984; Rosenstock, 1974). A large body of evidence indicates that mothers' beliefs influence health behaviors on behalf of their child (Chambers, Markson, Diamond, Lasch, & Berger, 1999; Nguyen, 2013; Puri, Murti, & Dermatoto, 2016; Salari & Filus, 2017; Smith et al., 2011). In low-income/low-resource regions, a growing body of research links maternal beliefs with *timing of complementary food introduction* (CFP) and infant health outcomes, such as underfeeding and stunting (Hyvönen, 2019; Kajjura, Veldman, & Kassier, 2019; Monterrosa, Peltó, Frongillo, & Rasmussen, 2012; Muluaem, Henry, Berhanu, & Whiting, 2016). However, in high-income/high-resource regions, where obesity and food allergies are the more prevalent adverse feeding-related health outcomes (Fryar, Carroll, & Afful, 2020; M. L.; Tang & Mullins, 2017), findings of maternal beliefs related to complementary feeding may be quite different.

Research investigating decision-making related to infant feeding in high-income/high resource regions has been limited. A large body of qualitative research has explored maternal attitudes and beliefs and their influence on breastfeeding in these regions (Earle, 2000, 2002; Nelson, 2006). Overall findings suggest that beliefs about social norms, health benefits, and barriers influence a mother's decision to initiate and continue breastfeeding (Earle, 2000, 2002; Nelson, 2006). However, beliefs about complementary feeding are likely to be different than those for breastfeeding, which so strongly affects a mother's body and autonomy (Earle, 2000, 2002; Nelson, 2006). One qualitative study in Australia found that maternal beliefs about the health benefits of an infant self-feeding method influenced her selected *feeding method* (Swanepoel, Henderson, & Maher, 2020); however, qualitative investigation of maternal beliefs related to other facets of complementary feeding is limited. In high-income/high-resource regions, emerging but limited quantitative evidence reveals a potential relationship of maternal attitudes and beliefs about fussiness, hunger or satiety, and one CFP: *the timing of complementary food introduction* (Clayton, Li, Perrine, & Scanlon, 2013; Hamilton, Daniels, White, Murray, & Walsh, 2011; Wang et al., 2019; H.; Wasser et al., 2011). Yet, a gap exists in our understanding of mothers' beliefs surrounding complementary feeding and the factors behind their selected CFPs.

The professional guidelines by the DGA aim to avoid adverse infant feeding-related health outcomes by providing complementary feeding guidelines (DHHS and USDA, 2020; WHO, 2017). However, evidence suggests that additional, potentially modifiable psychosocial factors, such as beliefs may influence mothers' decisions about complementary feeding, which have been associated with health outcomes (Gingras et al., 2019; Grummer-Strawn, Scanlon, & Fein, 2008; Pluymen et al., 2018; Scott, Dashti, Al-Sughayer, & Edwards, 2015; Ssemukasa & Kearney, 2014; L.; Tang, Lee, & Binns, 2015). Therefore, this exploratory, qualitative study addressed the following research questions: 1) what are maternal beliefs about complementary feeding, and 2) how do maternal beliefs influence CFPs?

2. Methods

2.1. Subjects and setting

The study took place in the central, eastern United States between August and November 2019 and explored maternal beliefs surrounding complementary feeding and the factors behind their selected CFPs. Data collection, coding, and analysis was guided by Consolidated criteria for REporting Qualitative research (COREQ) (Tong, Sainsbury, & Craig, 2007). Supplementary File A includes the full COREQ checklist. The study team used purposive sampling to recruit a diverse sample of mothers with broad experiences of feeding across ethnic, educational, and socioeconomic backgrounds ($n = 27$) until responses indicated data saturation. Multiple recruitment strategies were used, including a) in person recruitment and posted flyers in WIC clinics in local health departments, b) online recruitment via Craigslist volunteer

advertisements, and c) posted flyers at community sites, including coffee shops, public libraries, restaurants, children's bookstores and laundromats, Latino grocery stores and community boards in neighborhoods that are predominantly inhabited by minority families. Participants received a \$25 gift card upon completion of one interview as compensation for their time.

Mothers were eligible to participate in one interview if they were: a) between 18 and 40-years-old, b) had at least one infant between 6 and 19-months-old, c) had the ability to read and speak English, d) and had no established relationship with the interviewer/PI. This age range was selected to include infants who presented for WIC clinic visits at 6, 12, and 18 months (± 1 month), as complementary feeding is frequently discussed during these appointments. Mothers were ineligible to participate if their infant had a medical issue that could affect feeding (e.g., cleft lip/cleft palate, Down Syndrome, diagnosed food allergy, or metabolic disorder), or if the infant was born prior to 35 weeks estimated gestational age. One mother who contacted the PI was ineligible for participation (age of the infant >19 months). No one approached in person refused, nor was ineligible to participate, and no participants withdrew from the study after completing the eligibility screening.

2.2. Interview guide

A semi-structured interview guide, based on a review of the literature and identified gaps, guided each interview. Six researchers with experience in maternal/child health, pediatrics, nutrition, public health, and qualitative methodologies reviewed and revised the interview guide to enhance rigor and trustworthiness of the results. Eight open-ended questions assessed the topical areas of beliefs related to complementary feeding and the impact on CFPs. The following are examples of interview questions: a) "what things are most important, the things you think about as you decide what solid foods that your baby eats?" and b) "tell me about any challenges or problems you have experienced while starting your baby on solid foods." A standard list of probes was used as needed to further guide discussion (e.g., safety, health, nutrition, convenience, etc.). The interview guide was pilot tested with three mothers for clarity, question overlap and completeness. The final guide incorporated their feedback.

2.3. Procedures

The [blinded] Institutional Review Board (IRB) and the [blinded] Department of Health IRB approved all study procedures (study numbers 201179 and 4027, respectively). Given the multiple recruitment strategies, mothers were either approached by the PI/first author (MG) and provided with a brief overview of the study, or they contacted the PI regarding their interest in the study. After explaining the purpose of the study and ensuring eligibility criteria, the PI/and the mother agreed on the most convenient time and place to meet for the interview: a) a private WIC office immediately following her appointment, b) a private conference room at the public library, or c) privately from her home via videoconference. Only the mother, her child(ren), and the PI were present for the interview.

Each interview was led by the PI, who at the time of the study was a female Registered Nurse, Certified Family Nurse Practitioner, and a PhD candidate in nursing science, with training and experience in qualitative interviewing of mothers. For the interview, mothers met privately with the PI in person or face-to-face via a videoconferencing platform of their choice (e.g., FaceTime, Skype, or WhatsApp). Prior to the start of the interview, the PI reviewed the study purpose and procedures, obtained verbal and electronic informed consent, and advised each participant of her right to withdraw at any time. Prior to starting the study, participants reviewed and consented to participation on the study tablet or their personal device (e.g., smart phone, tablet, or laptop) using Research Electronic Data Capture (REDCap), a secure, web-based application for managing online databases. The PI began each

interview with an introduction to explain her background, training, and reason for conducting the research, and to encourage the mother's comfort. Following the introduction, she asked a series of open-ended questions with probes from the semi-structured interview guide. The PI recorded the interviews using two digital voice recorders. Following the interview, mothers completed a short demographic questionnaire on their personal device or study tablet. Interviews lasted between 10 and 50 min, with the majority lasting for 30 min or longer.

2.4. Data analysis

Qualitative analysis of the interview responses was led by the PI (coder 1), in collaboration with an experienced qualitative researcher with a master's degree in social psychology (coder 2), and oversight from a senior psychologist, qualitative researcher. Based on the research questions, the team chose to use inductive and deductive qualitative content analysis to explore maternal beliefs related to complementary feeding and the relationship of beliefs to their selected CFPs (Kyngäs, Mikkonen, & Kääriäinen, 2019).

First, the team submitted digital audio files of the completed interviews to a professional transcription service. After transcription, the team organized verbatim transcripts within Microsoft Excel 2018, by isolating individual statements; each statement was treated as a separate quote. Using an iterative, inductive-deductive approach, based on the study questions and interview guide, the two coders established a preliminary hierarchical coding system to organize the quotations by codes. For the initial four transcripts, the two coders independently reviewed each quote and assigned relevant codes from the preliminary coding system. Additional codes were added, as new topics emerged. After the initial four transcripts were coded, the coders met to review the fit of the coding system, resolve discrepancies in coding, and establish inter-rater agreement. During this initial meeting, the coders identified common themes, as indicated by a majority of respondents reporting specific codes. Three main themes of perceived threats emerged, defined as beliefs about the likelihood of an adverse health outcome occurring and/or the severity of the consequences from that outcome (Rosenstock, 1974). The coders also identified subthemes of CFPs mothers used to mitigate perceived threats. Subthemes were identified by greater than two participants discussing a topic related to the main themes. The coding system was updated to include the primary themes of perceived threats and subthemes of CFPs. For the remaining transcripts, the PI used the modified coding system to identify the frequency of codes and to review quotes sorted by category, meeting weekly with the second coder to review findings and resolve any ambiguities. Finally, after the coding process was complete, the two coders, along with the senior researcher, met to identify the major patterns in the data and generate analytical themes that represented the major findings from the dataset. The entire study team discussed and refined major themes and subthemes to optimize the analytic potential of the data. They then selected illustrative quotes to support the themes identified during the analysis.

3. Results

3.1. Participant characteristics

The study sample consisted of 27 mothers. Most participants ($n = 21$) enrolled from the community, with 6 mothers recruited from WIC Clinics. The median maternal age was 29.8 years (Interquartile Range (IQR) 27.8–34.7), with ages ranging from 22.3 to 40.7 years. The median age of the infant discussed in this study was 11.6 months (IQR 8.0–13.0) and ranged from 6.2 to 18.0 months. Participants reported a median of 16.0 years of education (IQR 13.0–17.0), ranging from 7 to 20 years. Most participants were non-Hispanic/non-Latinx (92.6%) and Caucasian/white (57.5%); however, there was racial diversity among the sample. About one-third of participants identified as African American or black (30.8%), and the sample included some representation

PERCEIVED THREATS					
CHOKING		ALLERGIC REACTION		PICKINESS	
COMPLEMENTARY FEEDING PRACTICES					
FEEDING WITH CAUTION	PRESENTING THE FOODS	MINIMIZING THE RISKS	PREPARING FOR AN EVENT	STRUCTURING THE FOOD PALATE	MODELING THE IDEAL
Consider Teeth	Feed Purees	Delay Allergenic Foods Introduce Allergenic Foods Early	Collect Information	Expose to Variety of Foods	Allow to Finger Feed
Observation	Feed Simple Textures		Monitor New Foods	Expose to Healthy Foods	Avoid Purees
Limit the Amount of Food	Slow Transition		Space Introduction of New Foods	Model Healthy Eating	Avoid Commercially Prepared Foods
CPR or First Aid Courses	Cut/Chop Foods		CPR or First Aid Courses	Avoid Unhealthy Foods	
	Feed Large Items		Antihistamine Available	Offer in Specific Order	
	Avoid Choking Hazards				

Fig. 1. Perceived threats and corresponding complementary feeding practices.

from Asian backgrounds (7.7%) and multiple races (3.8%). There was approximately the same number of low-income and high-income participants with 40% reporting an annual household income of \$40,000 or less (the threshold for WIC eligibility in the state of recruitment), and 44% reporting \$80,000 or more. Most participants (61.5%) had commercial, private, or military health insurance, while almost a third (30.8%) had state funded health insurance. Most mothers (77.8%) were married or living with a partner, were first-time mothers (63%), and breastfed their infant at the time of enrollment (66.7%). Over half of participants (52%) were unemployed.

3.2. Primary themes and subthemes

Three primary themes of maternal perceived threats related to complementary feeding emerged: 1) choking, 2) allergic reaction, and 3) pickiness. Within each of these primary themes were subthemes that delineated mothers' perceived threats and the specific and focused CFPs mothers used to approach each perceived threat (See Fig. 1). The perceived threats were very similar across mothers; however, selected CFPs varied. Each primary theme and subtheme is described below along with illustrative statements presented in quotations. Each quote is followed by a "P," with a number indicating the interview order of the participant and age of the infant. Ellipses are used within quotes to eliminate extraneous information and ease readability.

3.2.1. Perceived threat of choking

Most mothers ($n = 23$) identified choking on food as a perceived threat during the complementary feeding period. One mother said, "every time she eats, I get worried she's going to choke ..." (P3-13 months). Several mothers ($n = 7$) reported episodes in which their infant experienced a choking or near-choking event (e.g., coughing, choking, or gagging on foods), and discussed how they had adapted their complementary feeding strategies as a result. However, misunderstanding of choking also seemed to elevate mothers' perception of threat. Several mothers reported episodes in which their infant had experienced a choking event; however, mothers often gave examples of gagging or coughing. For example, one mother explained, "She choked on a potato chip one time ... she was just ... coughing ... and I patted her on the back and she ... spit ... little pieces of potato chip ..." (P21-11 months). Mothers

discussed various CFPs they used to mitigate the threat of choking, and two subthemes emerged: a) feeding with caution, and b) presenting the foods.

3.2.1.1. Feeding with caution. Many mothers reported using cautious or vigilant strategies to structure the complementary feeding environment to lessen the threat of their infant choking, or to respond optimally in the case of a choking event. Many mothers reported waiting for the emergence of infant teeth to introduce complementary feeding. One mother said, "She only has a couple teeth ..., so I don't give her anything that causes her to ... use her chewing" (P22-6 months). Also, to lessen the threat of choking, and to respond appropriately if it occurred, many mothers mentioned attentively watching, observing, or remaining with their infant as they ate. One mother said "... when I give him food, I'm always there. I'm not in the kitchen trying to do something else. I'm there, right with him" (P19-12 months). Several mothers also discussed limiting the amount of food on their infant's plate or tray. One mother explained, "I've just been giving him ... three or four ... bite sized pieces, and then let him ... feed himself ... because he's stuffed his mouth to the point of having to ... stick my finger in there and pull it all out" (P20-13 months). To be prepared to best respond in the case of a choking event, several mothers reported taking infant safety and CPR courses.

3.2.1.2. Presenting the foods. Most mothers discussed the strategies they used to decide how they prepared and offered complementary foods to mitigate the threat of their infant choking. Many reported only feeding their infant pureed foods, and many even delayed advancing the texture of food from pureed foods to lumpy, mashed, or chopped foods. Speaking about her apprehension of feeding non-pureed foods, one mother said, "I'm kind of nervous ... because I'm a first-time mom, so I don't want to mash up a banana and give it to him ... What if he starts choking ..." (P24-8 months). While transitioning their infant from pureed to more complex foods, many reported feeding simple, modified textures (e.g., softened, steamed, pre-chewed, ground, lumpy, chunky, or mashed foods). Many mothers also discussed slowly transitioning from least to most complex textures to give the infant time to adjust and avoid the threat of choking. One mother explained, "In the beginning I ... checked how he's ... swallowing ..., but once he was swallowing fine ..., I ... started to make the purees a little bit more chunky ... It was puree, chunky puree, a little

bit more chunky puree, ...just eat whatever you want" (P19-12 months). As infants progressed to eating table foods, mothers reported cutting or chopping the food into small pieces to avoid the threat of choking. One mother explained that when she first started feeding her infant table foods, she *"started cutting up the banana and giving him small pieces of that" (Interview 11-11 months).* Paradoxically, some believed small pieces to present a greater threat of choking, so they prepared larger items for their infant. One mother explained, *"a lot of people say cut it into small pieces, but ... I feel like she could choke more on that stuff. If I give her bread or something ... I give her big pieces ..."* (P7-8 months). Most mothers noted they avoided "choking hazards," like grapes, raisins, popcorn, nuts, beans, and hotdogs.

3.2.2. Perceived threat of allergic Reaction(s)

A majority ($n = 23$) of mothers described a perceived threat of their infant experiencing an allergic reaction to foods during the complementary feeding period. One mother said, *"I think the hardest part was just figuring ... out ... what's okay to give her ... If she had an allergy, what would it look like?" (P20-13 months).* Many reported heightened emotional arousal (i.e., terrified, anxious, afraid, scared, worried, nervous, and concerned), thus increasing their perception of threat. Beliefs of potential sources of an allergic reaction varied across mothers. Some believed only highly allergenic foods (e.g., peanuts, eggs, or shellfish) presented a threat of allergic reaction, but others believed allergic reactions were possible with any food. Mothers' beliefs about the possible severity of allergic reactions also varied, with some mothers believing a reaction would present as a topical skin rash or diarrhea, but many believing it would present as a severe and life-threatening emergency. One mother said *"what if she just ... throat closes up, stops breathing. Oh, my God, I was so scared" (P21-11 months).* Mothers' beliefs about the timing of onset of an allergic reaction to food varied. Some mothers believed a reaction would occur suddenly and immediately after exposure, while others believed it could occur days later. Mothers used multiple complementary feeding strategies to mitigate the perceived threat of their infant experiencing an allergic reaction or to lessen their infant's risk of major illness or death in the case of an allergic reaction. Strategies clustered into two subthemes: a) minimizing the risks, and b) preparing for an event.

3.2.2.1. Minimizing the risks. Some mothers approached their perceived threat of allergic reaction by avoiding highly allergenic foods, such as peanut products, shellfish, and eggs, and many waited for an optimal time and place to introduce them. One mother said, *"we don't really give him any type of shellfish right now ... or peanut butter ... because I don't know if he's allergic ... I don't want him to breakout with an allergic reaction and us not be able to rush him to where he needs to go" (P11-11 months).* Even when advised by their healthcare provider to introduce allergenic foods, some mothers opted to delay introducing them due to a perceived threat of an allergic reaction. One mother explained, *"the pediatrician did say ... next month ... when he's nine months ... she wants us to have certain foods in him for allergies. So far, the only thing we did was peanut butter ... there's ... nervousness if the baby ... ate a food and he was allergic to it, what would I do?" (P24-8 months).* Conversely, several mothers exposed their infants to allergenic foods early in the complementary feeding period to determine if their infant was allergic to a food, and to be prepared when they encountered that food in the future. One mother explained, *"we have let her try eggs and dairy ... fish and shrimp ..., just in case ... There are times where I know that she's probably going to be somewhere, and I would just hate ... if she ate a cupcake and there were eggs in it and now, she's allergic and we didn't know that" (P16-12 months).* Some mothers also exposed their infants to allergenic foods to reduce their likelihood of developing a food allergy. One mother explained, *"We definitely have been ... introducing to him all the allergenic foods. He had all the nuts ... the shellfish and crab and ... one evening ... he had shrimp, crab and lobster" (P19-12 months).*

3.2.2.2. Preparing for an event. To cope with their perceived threat of allergic reaction, many mothers noted how they prepared themselves to identify and handle a reaction if one occurred. Prior to initiating the transition to complementary feeding, many mothers collected information about allergic reactions from friends, family, healthcare providers, or the internet. Many mothers reported strategically introducing new foods, offering each slowly, over several days, and as single ingredients, to ensure their ability to identify the source in the case of an allergic reaction. One mother explained, *"we'd do the carrots for three days ... then the sweet potatoes for three days and so on ... when we got comfortable with her not having an allergy ... we'd start combining them or making sure we're only introducing one at a time ..." (P13-6 months).* Also, to ensure easy recognition of the source, some mothers used a method of monitoring, (i.e., keeping track of what the infant ate). One mother said, *"I have a baby journal in case she has an allergic reaction to anything. Then I can go back and look and see" (P3-13 months).* Like strategies to prepare for a choking event, several mothers completed medical training and preparation such as a CPR or first aid course to be able to recognize and respond to a potential allergic reaction quickly and effectively. One mother even mentioned purchasing a children's antihistamine prior to starting complementary feeding to be prepared in the case of an allergic reaction.

3.2.3. Perceived threat of pickiness

Emerging across all interviews was a perceived threat of infant pickiness. Mothers' described pickiness as an infant having strong food, flavor, or texture preferences, characterized by frequent refusals, limited acceptance, and difficulty adjusting to new items, and preferring less healthy foods over healthy foods. Mothers most often reported a belief that pickiness could lead to adverse health outcomes such as unhealthy food preferences and adverse growth patterns (i.e., overweight, obesity, or underweight) for their infant in childhood and later in life. One mother explained, *"everything scares me for her ... I think that I have a bigger fear of her not liking food or eating well. That drives me to make sure she is eating healthy and eating a good variety of food" (P15-9 months).* Several also cited potential negative consequences of pickiness related to the inconvenience of having to prepare separate meals for the infant than for the rest of the family. Across participants was a belief in a time-sensitive period during complementary feeding, in which specific strategies could influence an infant's risk of, or protection from pickiness. To mitigate the threat, many mothers introduced foods in strategic ways. These strategies comprised two subthemes: a) structuring the palate and, and b) modeling the ideal.

3.2.3.1. Structuring the food palate. To avoid the threat of their infant developing pickiness, most mothers used strategies to influence and guide the development of their infant's palate, striving for their acceptance of a variety of healthy foods, flavors, and textures. One mother explained, *"my sister's two children were very picky eaters, and that's one of the reasons why I'm trying to introduce him to so many different things, because I do not want him to be a picky eater" (P2-11 months).* Many mothers strategically exposed their infants to foods they believed to be healthy during the complementary feeding period (e.g., fruits, vegetables, nutritious, colorful, whole, or real foods), with hopes they would continue to eat the foods as they grew older. One mother explained, *"hopefully by starting with ... vegetables and fruits, that'll help encourage the vegetable and fruit eating as he grows up because he's used to the flavors" (P1-9 months).* To encourage food acceptance, mothers also reported offering previously refused food items multiple times. One mother explained, *"I do know that the more you expose them to things they seem to not like, the better your chances of them actually liking them are. He's not ... too picky with textures" (P18-16 months).*

Mothers also frequently reported ways that they restricted foods to prevent narrowing dietary variety and the perceived risk of their infant developing pickiness. Many mothers limited exposure to unhealthy, but more palatable ingredients or foods (e.g., salt, sugar, fat, junk food,

sweets, processed foods, fast-food, fried foods, and red meat). One mother expressed this as, *"I think that what they eat now can really affect them later in life ... I don't want to give her a bunch of sugar now and that be what she gets used to when she's older ... be a picky eater and not want to eat her vegetables"* (P21-11 months). Some mothers restricted their infant's foods by the order they offered them to prevent narrowing of accepted foods. One mother explained, *"At mealtimes I just introduce the food I want him to eat the most, first, because otherwise he'll eat the most attractive food to him first"* (P18-16 months). To maintain a diet inclusive of healthy food items (i.e., a broad food palate), one mother restricted her infant to a single healthy item. She said, *"We get set in our ways and I know he'll eat certain things, so I'm just like, 'Eat a ton of broccoli because it's healthy'"* (P18-16 months).

3.2.3.2. Modeling the ideal. Mothers frequently reported using social modeling, in which they showed their infant how they themselves gardened, shopped, prepared, ate, and enjoyed healthy foods, as a strategy to prevent pickiness. One mother explained, *"I don't want her to be so picky ... She eats everything that we're eating and sees what we're eating ... starting young, then ... as she grows up, she's not going to just like ... her gummy snacks and pizza ..."* (P17-6 months). Many mothers encouraged their infant to self-feed as a strategy to reduce the threat of pickiness. One mother explained, *"we ... would put it in front of her and let her feed herself ... and ... the benefits as far as how we started introducing foods, she's always very curious about what we want to eat. She's not a picky eater"* (P16-12 months). Similarly, many mothers discussed specifically avoiding spoon feeding of traditional pureed foods to avoid the threat of pickiness. One mother explained, *"when you give them food in jars, it feels like, you know, they eat it ..., but they've never seen it, so when they actually see it, they're like, Oh, what is that?"* (P19-12 months). Several mothers reported avoiding social modeling of pickiness to their infants. One mother explained, *"growing up, my mom didn't like avocado, and so we didn't eat it ... and [I am] just making sure that whatever food stigmas that we have, I don't say ... I don't like this, so you won't like it either"* (P14-12 months).

4. Discussion

Study findings expand our understanding of maternal beliefs surrounding complementary feeding and factors behind the selection of CFPs in a high-income/high-resource region. Findings are important, given the established relationship of CFPs with health outcomes (Fryar et al., 2020; M. L.; Tang & Mullins, 2017). In our sample of mothers from the central, eastern US, perceived threats surrounding complementary feeding were common, with the most prevalent related to choking, allergic reactions, and pickiness. These findings differed from previous research in low-income/low-resource regions, which identified perceptions of threats related to stunting, wasting, and underfeeding, as motivating factors for maternal decision-making surrounding CFP (Hyvönen, 2019; Kajjura, Veldman, Frederick, & Kassier, 2019; Monterrosa et al., 2012; Muluaem, Henry, Carol, Berhanu, & Whiting, 2016). In our study, mothers reported using a variety of CFPs to mitigate perceived threats related to complementary feeding; however, as with prior complementary feeding and breastfeeding research, (Centers for Disease Control and Prevention, 2020; Eidelman & Schanler, 2012; Georgieff et al., 1997; Gingras et al., 2019), their selected CFPs were not always in line with professional guidelines. Results offer new insight into these perceived threats, how they may influence maternal decisions about introducing solid foods during the complementary feeding period, and common CFPs mothers use during this period.

4.1. Overestimation of threat related to complementary feeding

Mothers in this sample often overestimated the likelihood of their infant experiencing an adverse health outcome and/or the severity of

consequences, which appeared to contribute to elevated perceived threats surrounding complementary feeding. For example, all mothers reported a perceived threat of pickiness. Pickiness is a developmentally normal presentation in infants and toddlers, typically resolving in early childhood (Cardona Cano et al., 2015; Carruth, Ziegler, Gordon, & Barr, 2004; Taylor, Wernimont, Northstone, & Emmett, 2015). However, mothers in this study, tended to perceive pickiness as a potential cause of health and growth issues, consequences that are associated with longer lasting, atypical pickiness (Finistrella et al., 2012; Taylor, Northstone, Wernimont, & Emmett, 2016). This lack of distinction between typical or mild pickiness, and more severe forms, may contribute to an elevated perception of threat, as well as confusion for mothers when they observe what may be developmentally normal pickiness.

There was also a prevalence in misunderstandings about food allergies. Consistent with other studies, mothers often confused food intolerance (i.e., an undesirable digestive response to food), with food allergy (i.e., a systemic immune response to food) (Harbron, 2017; Keet et al., 2014; Woods et al., 2002). With food intolerance, affected individuals can often consume small amounts of the food without experiencing problems; however, for those with true food allergies, any exposure to the allergen may cause a severe and life-threatening event (Harbron, 2017). This misunderstanding likely contributed to an overestimation of the likelihood of an allergic reaction, as well as the severity of consequences (Keet et al., 2014; Woods et al., 2002). While food allergies are relatively rare, mothers believed the more common, and less threatening food intolerances were true allergic reactions with the same corresponding health risks, thus contributing to elevated perceived threats during the complementary feeding period (Gupta et al., 2018). Mothers also frequently reported misperceptions related to choking. Many identified coughing and gagging events as choking episodes. However, coughing and gagging are actually protective against choking (Borowitz & Borowitz, 2018), again suggesting that mothers may be overestimating their perception of threat related to complementary feeding.

4.2. Perceived threats influenced CFPs

Consistent with prior research, mother's beliefs influenced their complementary feeding specific health behaviors (i.e., CFPs) on behalf of their infant (Chambers et al., 1999; Nguyen, 2013; Puri et al., 2016; Salari & Filus, 2017; Smith et al., 2011). Mothers approached their perceived threats with CFPs that were intensive and often introduced additional and alternative risks for their infant. Furthermore, many of the reported CFPs were not in line with professional guidelines. For example, many mothers reported delaying the progression of their infant's diet from purees to more advanced textures (i.e., chunky, lumpy, shredded, or chopped), and from spoon-feeding to self-feeding because of a perceived threat of choking. Yet, these strategies are not recommended in the DGA guidelines and may inadvertently place an infant at risk of developing pickiness (Coulthard et al., 2009; Emmett et al., 2018; Komninou et al., 2019; DHHS and USDA, 2020). Complicating matters, many mothers believed pickiness was a threat to health and used restrictive feeding practices, such as offering foods in a rigid order, completely avoiding some foods believed to be unhealthy, and pressuring infants to eat foods they deemed healthy, strategies that are contrary to DGA recommendations for responsive feeding (DHHS and USDA, 2020) and may actually reinforce pickiness and/or poor growth patterns (A. Brown et al., 2017; C. L. Brown & Perrin, 2019; Lumeng, Miller, Appugliese, Rosenblum, & Kaciroti, 2018).

As with perceived threats of choking and pickiness, mothers' perceived threats of allergic reactions prompted them to approach complementary feeding with excessive and at times inappropriate caution. For example, many mothers reported delaying the introduction of highly allergenic foods, a CFP that is contrary to the DGA recommendation to introduce allergenic foods around 6 months old (DHHS and USDA, 2020). Given that delayed allergenic food introduction may

increase the risk of developing a food allergy (Perkin, Togias, Koplin, & Sicherer, 2020; Togias et al., 2017), these mothers actually increased the likelihood of the threat they were trying to avoid.

Further making it difficult for mothers to make informed feeding decisions, professional recommendations for complementary feeding can appear inconsistent and sometimes contrary to one another and to the mothers' own beliefs (DHHS and USDA, 2020; WIC, 2017; AAP, 2020; Carrus & Helwig, 2020). Therefore, it is not surprising that mothers relied on their own beliefs, often guided by misperceptions and overestimation of threat, for their decisions related to complementary feeding.

4.3. Limitations

Our study adds to the growing body of knowledge surrounding complementary feeding practices by exploring the unique and personal beliefs of mothers living in the central, eastern region of the US. Typical of qualitative research, this study included a small and geographically limited sample, and may not be generalizable to other groups of mothers and infants, especially in low-income/low-resource regions. Despite the limitation in regional generalizability, the in-depth interviews provided rich data from women with diverse backgrounds, and findings fill an important gap in knowledge related to maternal beliefs about complementary feeding in high-income/high-resource regions. Additionally, this study focused exclusively on mothers who are noted to make the majority of complementary feeding decisions (Blissett et al., 2006; Earle, 2000; H. M.; Wasser et al., 2013); however, there is growing recognition that multiple caregivers are involved in complementary feeding decision-making (e.g., fathers, grandmothers, and childcare providers) (H. M. Wasser et al., 2013). Potentially limiting our findings, was the lack of assessment for maternal knowledge of guidelines, which may be important to include in future work. However, knowledge does not always translate into practice; therefore, our findings of beliefs surrounding complementary feeding are an important piece of understanding the decision-making process surrounding complementary feeding.

The sampling strategy may limit some study findings. Most participants, especially those from high-income/high-resource backgrounds, self-selected and were therefore, more likely to be interested in the study topic. As a result, their responses and experiences may have been different from those who did not choose to participate. Nevertheless, the sample also included participants who were WIC clients, providing a unique perspective of mothers from low-income backgrounds.

4.4. Implications

The new DGA guidelines for infants 0–23 months old is a promising advancement in the world of complementary feeding (USDA & DHHS, 2020). We now have clear and consistent guidelines for clinicians and policy makers to provide evidence-based education and support to families. However, consistent with previous maternal decision-making research, study findings suggest that beliefs, rather than guidelines alone influence mothers' health behaviors on behalf of their infant (Clayton et al., 2013; Hamilton et al., 2011; Swanepoel et al., 2020; Wang et al., 2019; H.; Wasser et al., 2011). Our findings of elevated maternal perceived threats surrounding complementary feeding and their influence on CPFs provide additional opportunities for more focused education as these guidelines gain momentum. Moving forward, healthcare providers should focus on presenting complementary feeding guidelines in a clear and consistent way, while also addressing common beliefs related to perceived threats of choking, allergic reaction, and pickiness. To help with the formation of healthy eating behaviors, it is critical for healthcare providers to educate mothers about developmentally appropriate pickiness and discourage the use of restrictive feeding methods. Similarly, frank discussions with families about the risks of an allergic reaction and what constitutes one, paired with

encouragement to introduce allergenic foods around six months old, may help to reduce the risk of developing food allergies.

Professional bodies that publish feeding recommendations should also work together to define risks and develop recommendations that keep infants safe from food allergies, while also promoting introduction of a wide variety of foods and textures during a sensitive period of taste development. Variability across recommendations makes young children even more vulnerable and at risk for developing unhealthy eating habits, as mothers rely on beliefs and possibly inaccurate risk perceptions to guide their complementary feeding decision-making.

Findings highlight focal areas for future research. Future studies should include the perspective of multiple caregivers, as well as representation from both low-and high-income/high-resource regions, to explore beliefs and knowledge of complementary feeding guidelines and how these beliefs interact to influence CFPs. Given our findings of elevated perceived threats related to complementary feeding, future studies should examine the relationships among maternal psychosocial factors, such as anxiety, depressive symptoms, perceived threats, and CFPs. Finally, interventions and educational efforts should be tailored to manage and/or reduce maternal perceived threats and knowledge gaps uncovered in this study to reduce the risk of pickiness and food allergies in infants.

4.5. Conclusion

The complementary feeding period is a brief, yet important phase, from which the experiences may influence an infant's health and growth across the lifespan. This study provides new insight into underlying beliefs about perceived threats that may influence parental decisions regarding infant and toddler feeding. Understanding these perceived threats and their corresponding impact on CFPs is critical to shaping future research, education, and interventions to promote healthy lifestyles.

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Authors' contributions

All authors contributed to the conception and design of the research study. MG managed data collection and analysis. MG drafted the manuscript, and all authors contributed to, read, and approved the final article.

Ethical statement

Both Vanderbilt University Institutional Review Board IRB and the Virginia Department of Health IRB gave ethical approval for this study (study numbers 201179 and 4027, respectively). All participants gave informed consent before taking part in the study. Privacy and confidentiality were maintained throughout the study. All participants were made aware that they could withdraw from the study at any time.

Declaration of competing interest

The authors have no financial or personal relationships that could bias this work.

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Appendix A. Supplementary data

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