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Perceptions of Human Milk Banks as a Response to the US Infant Formula Shortage: A Mixed Methods Study of US Mothers

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Abstract: Human donor milk from established milk banks is the safest alternative to mother's own milk. The current study examined US mothers' perceptions of human milk banks as a response to the ongoing infant formula shortage in the United States. A cross-sectional study with closed and open-ended items was administered through nine Facebook groups, and a final sample of 863 responses was retained in the study. We used descriptive and inferential statistics for statistical analysis, and content and thematic analyses were conducted on open-ended responses. In our sample, 77.4% of respondents perceived human milk banking as a feasible response to the formula shortage crisis. Marital status, education, religion, and willingness to donate milk were associated with respondent perceptions of milk banking as a response to the formula shortage. US mothers' concerns around the accessibility of milk banks and the cost of human milk were the primary reasons accounting for the hesitancy toward milk banking as a response to the infant formula shortage crisis. The study findings indicate support for milk banking as a potential 'temporary' solution to the formula shortage and reveal that milk banking is a tool that is currently being underutilized. It is imperative that stakeholders address the challenges identified by the current study to improve infant feeding and health.

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Keywords: human donor milk; milk bank; infant formula; shortage; infant nutrition

1. Introduction

Human milk banking has been in existence since the twentieth century, with the first human milk bank (HMB) established in Vienna in 1909 [1]. In 1919, milk banking was introduced in North America [2], and the UK followed suit in 1939 [3]. Currently, there are more than 570 human milk banks globally [1], with about 31 of these located in the USA and Canada [4]. Breastmilk is widely accepted as the ideal food for newborns and infants [5]. The American Academy of Pediatrics [6] and the World Health Organization [7] continue to recommend exclusive breastfeeding for the first 6 months of a newborn's life, with the concurrent and gradual introduction of complementary foods in addition to breastmilk for a period of 1 year or longer [6,7]. Existing research has extensively documented the benefits of breastfeeding and the use of breastmilk for both mother and child [8,9].

While breastfeeding is hailed as the “normative standard for infant feeding and nutrition” [8] (p. 827), it may not always be possible for all infants right away after birth. For instance, preterm babies and newborns whose mothers have passed away during childbirth may not have immediate access to mother's own milk [10]. In such instances, donor milk is offered as the closest thing to mother's own milk (MOM). Human milk banks (HMB), therefore, play a crucial role in promoting infant wellbeing and nutrition [10]. Among the many benefits of donor milk for preterm babies is the protection that it offers from the development of diseases such as necrotizing enterocolitis and sepsis [10,11]. In order to make donor milk wholesome and safe for consumption, donated breast milk is screened, pasteurized, and fortified with essential nutrients [10]. Donating mothers

usually have a supply that exceeds the needs of their nursing baby; these women are “carefully selected and are screened for HIV-1, HIV-2, human T-cell leukemia virus 1 and 2, hepatitis B, hepatitis C, and syphilis” [10] (p. 10). Over the past few years, donor human milk has been recognized as the best alternative when mother’s own milk is not available [12] and is reported to promote better health outcomes for newborns relative to formula feeding [10,11].

Human donor milk from milk banks, though primarily supplied to hospitals for feeding preterm and ill infants, is also available for purchase by lactating mothers and families who may need it [13]. The mother’s milk bank provides donor milk to mothers who have undergone breast surgery, those who are ill or on certain types of medications, and women who do not have enough supply to meet the needs of their babies [14]. Additionally, families of infants who fail to thrive on formula and babies who are adopted, fostered, or surrogate-born may also request to purchase human milk from milk banks [15]. Donor milk is available to families with outpatient newborns only via a doctor’s prescription [16].

In February of 2022, a recall of several major brands of powdered infant formula resulted in a formula shortage crisis that has lasted several months in the US [17]. Consequently, families have resorted to alternative ways to feed their infants, including receiving or buying breastmilk directly from individuals on the web and even attempting to make their own formula at home, both of which pose significant risks to infants’ health [18,19].

Human milk from milk banks has been established as a safer way to feed infants, second to mother’s own milk. It is thus important to examine US mothers’ opinions on milk banking as a response to the infant formula shortage, as the information provided will help to make recommendations for the safer feeding of US infants. This study, therefore, sought to understand US women’s opinions on milk banking as a viable response to the current infant formula crisis in the United States.

The study aimed to answer the following research questions:

- a. What are US mothers’ opinions about milk banking as a response to the current infant formula shortage?
- b. What demographic factors are associated with opinions about milk banking as a response to the formula shortage crisis?

2. Materials and Methods

2.1. Study Design and Participants of the Study

We developed a survey that asked US women about their opinions on whether human milk banks could be a viable response to address the current baby formula shortage in America. Data were collected between 23 May 2022 and 16 June 2022 using Qualtrics survey software and distributed via an anonymous link immediately following approval from the institutional review board of the author’s institution (IRB Number: 15,476).

Respondents were recruited via closed social media groups on Facebook. Specifically, we recruited participants from nine (9) Facebook groups: Undersuppliers breastfeeding/pumping; Buy, sell, and donate breastmilk (strictly women); Exclusively pumping mamas; Doctoral mom group; Tenure-track moms; Ph.D. mamas; Academic mamas with babies born or due in 2018; Moms of newborns and toddlers; and Gentle parenting. We received a total of 1165 survey responses. We excluded women who did not reside in the US ($N = 54$) and those who did not self-identify as parents ($n = 28$). We further excluded responses with missing data ($n = 220$) on milk banking as a viable alternative (outcome variable) and other covariates included in the multivariate model. All respondents were 18 years and older. The final sample consisted of 863 participants.

2.2. Eligibility Criteria

To be included in the current study, respondents had to be 18 years or older, reside in the US at the time of the study, and self-identify as a parent.

2.3. Assessment Measures

2.3.1. Dependent Variable: Milk Banking as a Viable Alternative

For this study, “viable” was defined as the ability of milk banks to effectively and feasibly respond to the formula shortage. The viability of milk banking as an alternative to the current formula shortage was assessed by a single survey item. We asked the question *“In your opinion, do you think that donor milk from the milk bank could be a viable alternative to address the baby formula shortage?”*. Response options were “yes” coded as 1 and “No” coded as 0. Prior to receiving this question, respondents were presented with a brief definition of human milk banks and donor milk.

Additionally, respondents were asked to provide explanations for why they thought that donor milk from milk banks may or may not be a viable response to address the formula shortage crisis. Participants were presented with one of the following questions based on the specified display logic:

- i. *“You indicated that you think that milk banking could be a viable alternative to address the baby formula shortage. Please briefly share why you think so”.*
- ii. *“You indicated that you DO NOT think that milk banking could be a viable alternative to address the baby formula shortage. Please briefly share why you are of this opinion”.*

Respondents were provided with a text box for open-ended responses.

2.3.2. Independent Variables: Sociodemographic Variables

Respondent opinions on milk banking as a viable alternative to responding to the formula shortage and participant sociodemographic characteristics were examined. Specifically, we assessed associations for participant age, race, sexual orientation, marital status, education, religion, geographic location, and residence type. These demographic factors have been shown to be associated with opinions on human milk banking in prior studies [20–22].

2.3.3. Covariates

Furthermore, we adjusted for potential confounders, including participants’ self-reports of whether they were currently breastfeeding/lactating, the ages of the respondents’ children, prior knowledge about human milk banking, and respondents’ reported willingness to donate milk.

2.4. Statistical Analysis (Quantitative Data Analysis)

Descriptive statistics for each variable (frequencies and proportions) were computed. Pearson’s chi-square test was used to examine differences in responses between the two groups of respondents on whether or not milk banking could be a viable alternative to address the formula shortage. Additionally, we examined differences by all socio-demographic information and each of the covariates in the study. A logistic regression analysis was performed to examine the independent associations between the outcome variable and all the independent variables in the model. The Hosmer–Lemeshow Goodness of Fit Test was performed to determine the model’s goodness of fit. It produced a result of $p = 0.553$, indicating that the model was a good fit. Multicollinearity was checked using the variance inflation factor (VIF). Using a conservative threshold of a VIF value of 3.5, no collinearity was detected. The threshold for declaring statistical significance was a p -value of less than 0.05. All analyses were performed in R version 4.2.1 (R Core team, 2022; Boston, MA, USA).

2.5. Content and Thematic Analysis (Qualitative Data Analysis)

We carried out content and thematic analyses of the open-ended responses. First, we reviewed the responses and used inductive processes to develop a codebook. We then coded all open-ended responses; in total, we coded 149 open-ended responses: 122 from women who indicated ‘Yes’ to the viability question and 27 from women who indicated ‘No’.

For content analysis, we grouped the data into categories by identifying patterns in responses. The thematic analysis comprised interpreting the data following the data description. We followed Braun and Clarke's phases of thematic analysis [23], whereby we organized our results into key themes that we identified during our analysis. Lastly, we supported the study findings with participant quotes.

3. Results

3.1. Quantitative Results

3.1.1. Characteristics of the Whole Sample ($n = 863$)

Table 1 presents the characteristics of the study sample. More than half of the sample (53.4%) were aged 30–39, the majority identified as White/Caucasian (78.3%), 85.1% of the women were married, 72.5% had a bachelor's degree or higher, and 71.6% were religious/spiritual.

Table 1. Descriptive statistics of the study sample ($N = 863$).

	Overall n (%)
Milk banking as viable alternative	
Yes	668 (77.4)
No	195 (22.6)
Age	
18–29	205 (23.8)
30–39	461 (53.4)
40–49	177 (20.5)
50 and older	20 (2.3)
Race	
White/Caucasian	676 (78.3)
Black/African American	52 (6.0)
Hispanic/Latino	63 (7.3)
Asian/Pacific Islander	29 (3.4)
Other	43 (5.0)
Sexual Orientation	
Heterosexual/straight	752 (87.1)
Gay/lesbian	10 (1.2)
Bisexual	54 (6.3)
Other	47 (5.4)
Marital status	
Single/never married	108 (12.5)
Married/civil union	734 (85.1)
Divorced/separated/widowed	21 (2.4)
Education	
High school or less	49 (5.7)
Some college	162 (18.8)
Bachelor's	183 (21.2)
Graduate	469 (54.3)
Religion	
Religious/spiritual	618 (71.6)
Non-religious	245 (28.4)
Geographic Location	
Northeast	138 (15.9)
Midwest	239 (27.7)
South	325 (37.7)
West	161 (18.7)
Residence	
Urban	187 (21.7)
Rural	212 (24.5)
Suburban	464 (53.8)

Table 1. *Cont.*

	Overall n (%)
Breastfeeding/lactating	
Yes	507 (58.7)
No	356 (41.3)
Children's Age	
0–6 months	299 (34.6)
6–12 months	174 (20.2)
1–2 years	134 (15.5)
2 years and older	256 (29.7)
Knowledge about milk banking	
Yes	813 (94.2)
No	50 (5.8)
Willingness to donate milk	
Agree	742 (86.0)
Disagree	64 (7.4)
Neutral	57 (6.6)

Abbreviations: %: Percent.

Of the 863 respondents, 77.4% were of the opinion that donor milk from a milk bank could be a viable response to the current infant formula shortage crisis. More than half of the sample was currently breastfeeding/lactating (58.7%), had knowledge about milk banking (94.2%), and expressed willingness to donate their milk (86%). Additional characteristics of the study sample are shown in Table 1.

3.1.2. Bivariate Results (Chi-Square Tests)

Table 2 displays the results of the bivariate analysis. We found that respondents' marital status ($p = 0.010$), education ($p < 0.001$), religion ($p < 0.001$), whether or not women were currently lactating/breastfeeding ($p = 0.031$), and respondent willingness to donate milk ($p < 0.001$) were significantly associated with respondents' opinion on whether milk banking could be a viable solution to the infant formula shortage in the US.

Table 2. Bivariate results of the study sample for milk banking as viable alternative ($N = 863$).

	Milk Banking as Viable Alternative		<i>p</i>
	Yes n (%)	No n (%)	
Age			0.246
18–29	169 (25.3)	36 (18.5)	
30–39	350 (52.4)	111 (56.9)	
40–49	133 (19.9)	44 (22.5)	
50 and older	16 (2.4)	4 (2.1)	
Race			0.271
White/Caucasian	527 (78.9)	149 (76.4)	
Black/African American	39 (5.8)	13 (6.7)	
Hispanic/Latino	46 (6.9)	17 (8.7)	
Asian/Pacific Islander	19 (2.8)	10 (5.1)	
Other	37 (5.5)	6 (3.1)	
Sexual Orientation			0.758
Heterosexual/straight	579 (86.7)	173 (88.7)	
Gay/lesbian	9 (1.4)	1 (0.5)	
Bisexual	43 (6.4)	11 (5.6)	
Other	37 (5.5)	10 (5.1)	
Marital status			0.010 *
Single/never married	96 (14.4)	12 (6.2)	
Married/civil union	556 (83.2)	178 (91.3)	
Divorced/separated/widowed	16 (2.4)	5 (2.5)	

Table 2. *Cont.*

	Milk Banking as Viable Alternative		<i>p</i>
	Yes <i>n</i> (%)	No <i>n</i> (%)	
Education			<0.001 **
High school or less	48 (7.2)	1 (0.5)	
Some college	136 (20.3)	26 (13.3)	
Bachelor's	150 (22.5)	33 (16.9)	
Graduate	334 (50.0)	135 (69.2)	
Religion			<0.001 **
Religious/spiritual	499 (74.7)	119 (61.0)	
Non-religious	169 (25.3)	76 (39.0)	
Geographic Location			0.097
Northeast	103 (15.4)	35 (17.9)	
Midwest	198 (29.6)	41 (21.0)	
South	249 (37.3)	76 (39.0)	
West	118 (17.7)	43 (22.1)	
Residence			0.076
Urban	137 (20.5)	50 (25.6)	
Rural	175 (26.2)	37 (19.0)	
Suburban	356 (53.3)	108 (55.4)	
Breastfeeding/lactating			0.031 *
Yes	406 (60.8)	101 (51.8)	
No	262 (39.2)	94 (48.2)	
Children's Age			0.168
0–6 months	229 (34.3)	70 (35.9)	
6–12 months	144 (21.5)	30 (15.4)	
1–2 years	106 (15.9)	28 (14.4)	
2 years and older	189 (28.3)	67 (34.4)	
Knowledge about milk banking			0.531
Yes	627 (93.9)	186 (95.4)	
No	41 (6.1)	9 (4.6)	
Willingness to donate milk			<0.001 **
Agree	604 (90.4)	138 (70.8)	
Disagree	27 (4.0)	37 (19.0)	
Neutral	37 (5.5)	20 (10.2)	

Abbreviations: %: Percent, *p*-values are derived from Pearson's chi-square test, * *p* < 0.05; ** *p* < 0.01.

3.1.3. Multivariate Results (Logistic Regression)

In the multivariate model, we found that compared with single/never married women, married women were less likely to be of the opinion that milk banking could be a viable solution to address the formula shortage crisis (OR, 0.41; 95% CI 0.19, 0.81; *p* = 0.014). Again, in terms of education, women with higher than a high school education had lower odds of perceiving milk banks as a viable alternative to address the current baby formula shortage. Thus, compared with women with a high school education, respondents with some college (OR, 0.11, 95% CI 0.01, 0.58; *p* = 0.037), bachelor's (OR, 0.07, 95% CI 0.00, 0.39; *p* = 0.014), and graduate-level education (OR, 0.05, 95% CI 0.00, 0.24; *p* = 0.004) were less likely to think that milk from a milk bank could be a viable alternative to address the formula shortage. We found significant associations in terms of religion: compared with women who reported being religious/spiritual, non-religious respondents were less likely to think that milk banking could be a viable response to address the formula shortage (OR, 0.47, 95% CI 0.32, 0.69; *p* < 0.001). Respondents' willingness to donate milk to a milk bank was also associated with opinions in terms of the viability of milk banks as an alternative to address the formula shortage. Compared with women who agreed that they would be willing to donate, the odds of perceiving milk banks to be viable alternatives were lower among women who disagreed to donating (OR, 0.11, 95% CI 0.06, 0.20; *p* < 0.001) and women who remained neutral on donating (OR, 0.41 95% CI 0.22, 0.78; *p* = 0.006). Table 3 shows the results of the logistic regression.

Table 3. Results of logistic regression for milk banking as viable alternative ($N = 863$).

	Milk Banking as Viable Alternative	
	OR (95% CI)	<i>p</i>
Age		
18–29	Reference	
30–39	1.03 (0.62, 1.67)	0.917
40–49	1.28 (0.66, 2.49)	0.463
50 and older	1.79 (0.47, 8.33)	0.423
Race		
White/Caucasian	Reference	
Black/African American	0.77 (0.37, 1.67)	0.494
Hispanic/Latino	0.79 (0.41, 1.58)	0.493
Asian/Pacific Islander	0.73 (0.31, 1.83)	0.478
Other	2.48 (1.02, 7.08)	0.062
Sexual Orientation		
Heterosexual/straight	Reference	
Gay/lesbian	6.95 (1.12, 138.84)	0.084
Bisexual	1.30 (0.62, 2.93)	0.512
Other	0.79 (0.37, 1.83)	0.557
Marital status		
Single/never married	Reference	
Married/civil union	0.41 (0.19, 0.81)	0.014 *
Divorced/separated/widowed	0.39 (0.11, 1.49)	0.148
Education		
High school or less	Reference	
Some college	0.11 (0.01, 0.58)	0.037 *
Bachelor's	0.07 (0.00, 0.39)	0.014 *
Graduate	0.05 (0.00, 0.24)	0.004 *
Religion		
Religious/spiritual	Reference	
Non-religious	0.47 (0.32, 0.69)	<0.001 **
Geographic Location		
Northeast	Reference	
Midwest	1.08 (0.61, 1.91)	0.78
South	0.86 (0.51, 1.45)	0.58
West	0.74 (0.41, 1.33)	0.316
Residence		
Urban	Reference	
Rural	1.46 (0.85, 2.52)	0.171
Suburban	1.29 (0.83, 1.98)	0.257
Breastfeeding/lactating		
Yes	Reference	
No	0.68 (0.38, 1.22)	0.196
Children's Age		
0–6 months	Reference	
6–12 months	1.60 (0.95, 2.74)	0.083
1–2 years	1.62 (0.89, 3.03)	0.119
2 years and older	1.44 (0.72, 2.91)	0.305
Knowledge about milk banking		
Yes	Reference	
No	1.90 (0.87, 4.55)	0.127
Willingness to donate milk		
Agree	Reference	
Disagree	0.11 (0.06, 0.20)	<0.001 **
Neutral	0.41 (0.22, 0.78)	0.006 *

Models adjusted for age, race, sexual orientation, marital status, education, religion, geographic location, residence, currently breastfeeding, children's age, knowledge about milk banking, and willingness to donate milk. Note: OR = odds ratio, CI = confidence interval, * $p < 0.05$; ** $p < 0.01$.

3.2. Qualitative Results

On the basis of the content and thematic analysis we conducted on the 149 open-ended responses, we discuss the salient themes and use quotes to illustrate the reasons for US women's positionality in terms of milk banking as a response to the current infant formula shortage in America.

3.2.1. Milk Banking as a Viable Alternative: "Yes"

We identified five themes:

1. Breastmilk is better than formula

In our sample, several respondents cited their preferences and opinions about breastmilk in relation to formula. Women who perceived milk banks as a viable alternative to address the formula shortage perceived breast milk to be inherently better than formula and believed that breast milk was essential for infant nutrition. For instance, a respondent wrote, "I believe it's a viable alternative because breast milk is better than formula, in my opinion". Respondents' emphasis on human milk as being better than formula is again expressed in this quote: "human milk is very nutritious and generally easier on a baby's stomach than formula".

2. Milk banking is safe

Again, some US women who indicated that milk banking could be a viable option to address the formula shortage perceived milk banks to be a safer option. This is evident in the following quote "I feel that it is safe through a milk bank and a great source of nutrition for babies". Additionally, some respondents expressed their opinions that donor milk from milk banks should be an option for US families who are unable to obtain formula, as expressed in this quote: "If there is a supply of donor milk available for those in need of formula, I believe it should be used".

3. Relative benefits of donor milk compared with other "unsafe" methods.

Another reason provided by respondents for their position on why they thought that milk banking could be a viable alternative to address the current shortage revolved around the relative benefits of donor milk compared with other unsafe methods that parents could potentially be adopted to feed their hungry babies. This included concerns around parents attempting to make formula at home ("It's better than parents try to "make" homemade formula") and unease about parents watering down formula to make it last longer ("I'm concerned that people maybe watering down formula to make it last longer or making homemade recipes"). For many respondents, the benefits of milk banking far outweighed the risks inherent to "unsafe" alternatives: "there are so many unsafe "recipes" for formula substitutes going around that scientifically tested and approved breast milk from a donor seems like the safest alternative".

4. Oversupply of breastmilk

Respondents reported their knowledge of or perceptions around a general oversupply of breastmilk at the individual level. Many women believed that other mothers have an oversupply of breastmilk, which could potentially be donated and distributed to families who might need it. For instance, a respondent wrote, "there are mothers that over produce and store milk, this could be given to parents of young children needing milk/formula". Another woman wrote, "There are mother's with freezers full that their own babies won't even need for a while that they could donate".

5. Issues with accessibility

While many respondents in the sample recognized the potential of donor milk from milk banks as a viable option to address the formula shortage, participants nevertheless did not fail to bring up potential challenges that could impede it from becoming a reality. For instance, respondents brought up concerns about the cost of donor milk: "It is a safe, better option than formula anyway. The cost is typically the barrier", accessibility of donor

milk to low income families: “If the milk bank was made more widely accessible, especially to low income families, I think parents who could not find formula would use it”, limited awareness about milk banking: “I think that if more parents had knowledge of and access to milk banks, more babies could have access to food”, and eligibility constraints: “If milk banks can allow donor milk to be provided to babies who aren’t considered high-risk, that would be wonderful. The issue right now is that milk banks do not allow milk to be provided to anyone who wants it; it is only to high risk babies or if the mom has a prescription from her doctor”.

3.2.2. Milk Banking as a Viable Alternative: “No”

We identified three main themes:

1. Low supply of donor milk to meet the current demand

Respondents in our sample provided reasons why they believed that donor milk from milk banks would not be a viable option to address the current formula shortage. Many women attributed their position to the low supply of donor milk to meet the current demand for all American babies. For instance, respondents indicated that “the magnitude of milk needed could cause an issue with supply of human milk” and that they did not think “there are/would be enough donors”. Furthermore, some respondents expressed the burden that would be placed on women to produce enough milk for the banks. This was expressed by the following quote: “I think it is also unrealistic and completely unfair to put the burden of keeping all of the babies in America fed on lactating women. Women should not be expected to shoulder this responsibility when supply chains fail”.

2. Accessibility concerns

Several respondents attributed their stance to the access issues surrounding milk banking. Similar to issues raised by the ‘Yes’ group, the majority of respondents in our sample cited the prohibitive cost of donor milk, especially for low-income families, as a major reason why they believed that milk banks would not be a viable alternative to address the formula shortage. This was evident in the following quote: “I believe that human milk banks would not be a viable alternative to address the formula shortage because they are not common and they are expensive. Lots of families around here can’t even afford reliable transportation to get to a human milk bank, much less be able to purchase human milk”. Another respondent highlighted the geographic disparities in access to milk banks: “Milk banks are not located near rural areas and are not always accessible for low-income families”.

3. Dietary needs of babies

Several respondents in our sample brought up concerns about the dietary needs of babies that could not be addressed with human milk. For instance, many women cited the fact that many babies are on special diets and formulas, and as a result, milk banking would not be an alternative or solution for them. This was expressed by the following respondent quote: “A lot of people need special formula which cannot be replaced by breastmilk”. Again, babies with allergies would not benefit from milk banking: “many babies require special formula due to sensitivities or allergies”.

4. Discussion

This study examined US mothers’ opinions about milk banking as a response to the current infant formula shortage. In our sample, mothers with more than a high school education were less likely to think that milk banking could be a viable solution. While prior research suggests that women with a higher education level express more positive attitudes toward milk banking in general [24], we did not find the same associations in our sample. This may be a result of our sampling strategy of recruiting participants on several closed Facebook pages, which may have been promoting the informal sharing of milk rather than formal milk banking. Again, in our study, married women were

relatively less likely to perceive that donor milk from milk banks could feasibly address the shortage. This is an interesting finding because existing research shows that married and well-educated women are more likely to be milk donors [20] and, in effect, tended to have a more favorable opinion and perception of milk banking. While our findings contradict those of prior studies in this area, we believe that these results are novel and should be explored further, as existing research acknowledges that there is substantial variation in the sociodemographic characteristics of milk bank donors [22], which may be directly influenced by donor perceptions and attitudes toward milk banking.

In our sample, non-religious women were less likely to perceive donor milk as a viable response to the formula shortage. While there is extensive research detailing associations between religion and willingness to donate or utilize banked human milk [25], there is a significant lack of studies that examine motivations, attitudes, and perceptions of milk banking among non-religious samples. To our knowledge, no existing studies have examined differences in attitudes and perceptions toward human milk banking among non-religious samples. Most studies that discuss religion in the context of human milk banking and donor milk examine the different considerations involved with human milk donations and milk banking in Islamic contexts [26–28], in which milk kinship may present as a challenge but does not prohibit human milk donation or milk banking. Additionally, one study [29] discussed possible hesitancy toward human milk banking among Jehovah's Witnesses, whose religion prohibits the acceptance of blood transfusions. It is possible that human donor milk may be likened to blood transfusions, and while there seem to be no concrete rules regarding human milk banking in the Jehovah's Witness faith [26,29], this is an area that may require further investigation.

Again, women who disagreed with or remained neutral regarding the question about their willingness to donate milk were less likely to think that human milk banks could respond to the formula shortage crisis. This is consistent with existing research [21,30] that has indicated that women who reported willingness to donate their milk typically had more positive attitudes and perceptions about milk banking as a powerful tool for infant health and nutrition. While there may be varied reasons for women's unwillingness to donate excess breastmilk, prior studies have found that concerns about the safety of donated milk, spousal approval, and personal preferences [31–33] are some reasons for women's hesitancy toward donating to human milk banks. Findings from the qualitative analysis in the current study may inform the reasons and motivations for US mothers' unfavorable perceptions toward human milk banking and subsequently serve as an indicator of willingness to donate to milk banks.

Surprisingly, we did not find significant associations by geographic region, place of residence, or age, characteristics that have been found to be associated with perceptions of donor milk and milk banking [34]. Current breastfeeding/lactation and the age of children were not significantly associated with perceptions of milk banking in response to the formula shortage crisis. This was surprising, as we hypothesized that these factors would have an influence on US mothers' perspectives on milk banking. We believe this to be a result of the relatively small sample size. Future studies should explore these associations further with larger samples.

US women who perceived milk banks as a viable response to the current formula shortage attributed their positionality to the idea that breastmilk is better than formula and that milk banking is a safer alternative compared with other unsafe methods currently in use by some US parents. For instance, one study [19] reported severe life-threatening complications in two American infants who were fed homemade formula by their parents. Again, study participants perceived milk banking as a viable response to the formula shortage, as several respondents reported their knowledge of several lactating women who oversupplied breastmilk, and thus, if the excess milk was donated, it could provide a solution for many families. While respondents in the 'Yes' group seemed to believe that there was an oversupply of breastmilk, which, if donated, could help with the formula crisis, several US mothers in the 'No' group cited the relatively low supply of donor milk to meet

the demand. Again, dietary restrictions for certain infants and infants with galactosemia would not be able to use donor milk [35].

Interestingly, both groups cited issues with accessibility as the biggest barrier. Accessibility in terms of the location of donor milk banks makes it challenging for families residing in remote areas to obtain human milk if they needed it [36]. Awareness about milk banks and narrow eligibility to obtain donor milk was also an issue [25,36,37]. Although a 100% human milk-based diet has the possibility to increase savings in medical care [38], concerns about the cost of donor milk, which would be prohibitive for low-income families, were a major concern. The abovementioned barriers cited by study respondents are consistent with existing research that advocates for creating policies that increase the accessibility of milk banks and human donor milk [39,40]. This is especially important, as the formula shortage crisis has exposed grave shortcomings of the current food supply system and the importance of creating safe, alternative ways of feeding US newborns and infants.

Limitations

The current study has some limitations. We did not define “viable” in our survey, and thus, respondent interpretations may differ. This was evident in some of the open-ended responses, in which participants referred to ‘milk sharing’ in response to the milk banking questions. Again, we had a highly educated sample, which may have influenced our findings. Specifically, about 72.5% of our sample had a bachelor’s degree or higher. Consequently, our sample is not representative of the general US population, which limits the generalizability of the study findings. Lastly, respondents were recruited from breastfeeding/lactating and parenting social media groups, which may have an effect on participants’ level of knowledge about milk banking. Our findings may be impacted by self-selection bias; we believe that because more than half (54.8%) of the sample reported having children 12 months and younger, this may have an impact on how important or invested they were in the topic.

Despite these limitations, the current study has some strengths. The study is useful in understanding the perceptions of milk banking among US mothers. Additionally, our findings shed light on system-level shortcomings of milk banking as a feasible response to improving infant nutrition. Lessons learned are important for planning effective campaigns and programs to make banked human milk more accessible to US families, especially during a time of crisis evidenced by the current infant formula shortage.

5. Conclusions

From this research, it is evident that there is some level of support for milk banking as a potential ‘temporary’ solution to the formula shortage and a tool that is currently being underutilized. Based on our findings we suggest that policymakers re-evaluate the conditions around donor milk, at least during a crisis period, by making milk more affordable by either lowering cost or making it free for a period of time. One milk bank has already set the pace [14], and many others can follow this trend to help starving babies. Milk can be delivered to families in remote areas. Again, campaigns should be launched to encourage women to donate excess milk. Medical practitioners can encourage mothers who have an oversupply to donate to milk banks to increase supply. Our findings show that US mothers’ educational level, marital status, and religious affiliation are associated with opinions about human milk banking. We recommend that future research examine these associations further; the findings will inform the development of targeted programming to increase human milk donation and utilization. Understanding US mothers’ perceptions around donor milk from milk banks, especially in this time of crisis, will help inform strategies that aim to promote safe infant nutrition and assess the barriers and facilitators of milk banking as a much-needed response to the US infant formula shortage.

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References

1. Arslanoglu, S.; Moro, G.E. Quality Standards for Human Milk Banks. *World Rev. Nutr. Diet.* **2021**, *122*, 248–264. [PubMed]
2. Kim, J.; Unger, S. Canadian Paediatric Society, Nutrition and Gastroenterology Committee. Human milk banking. *Paediatr. Child Health* **2010**, *15*, 595–598. [CrossRef] [PubMed]
3. Baumer, J.H. Guidelines for the Establishment and Operation of Human Milk Banks in the UK. *Arch. Dis. Child.-Educ. Pract.* **2004**, *89*, ep27–ep28. [CrossRef]
4. Human Milk Banking Association of North America. Find a Milk Bank. Donate Extra Breast Milk. Available online: <https://www.hmbana.org/find-a-milk-bank/overview.html> (accessed on 23 June 2022).
5. World Health Organization. Breastfeeding. Breastfeeding. Available online: <https://www.who.int/health-topics/breastfeeding> (accessed on 26 May 2022).
6. American Academy of Pediatrics. American Academy of Pediatrics Calls for More Support for Breastfeeding Mothers within Updated Policy Recommendations. Available online: <http://www.aap.org/en/news-room/news-releases/aap/2022/american-academy-of-pediatrics-calls-for-more-support-for-breastfeeding-mothers-within-updated-policy-recommendations/> (accessed on 13 July 2022).
7. World Health Organization. Breastfeeding-Recommendation. Breastfeeding. Available online: https://www.who.int/health-topics/breastfeeding#tab=tab_2 (accessed on 4 August 2022).
8. Eidelman, A.I.; Schanler, R.J.; Johnston, M.; Landers, S.; Noble, L.; Szucs, K.; Viehmann, L. Breastfeeding and the Use of Human Milk. *Pediatrics* **2012**, *129*, e827–e841.
9. Chowdhury, R.; Sinha, B.; Sankar, M.J.; Taneja, S.; Bhandari, N.; Rollins, N.; Bahl, R.; Martinez, J.C. Breastfeeding and maternal health outcomes: A systematic review and meta-analysis. *Acta Paediatr.* **2015**, *104*, 96–113. [CrossRef]
10. Haiden, N.; Ziegler, E.E. Human Milk Banking. *ANM* **2016**, *69* (Suppl. 2), 7–15. [CrossRef] [PubMed]
11. Simmer, K. The Knowns and Unknowns of Human Milk Banking. *Early Nutr. Impact Short- Long-Term Health* **2011**, *68*, 49–64.
12. Valverde, R.; Dinerstein, N.A.; Vain, N. Mother's Own Milk and Donor Milk. *Nutr. Care Preterm Infants* **2021**, *122*, 212–224.
13. Mother's Milk Bank Northeast. Receive Milk Mothers' Milk Bank Northeast. Mothers' Milk Bank Northeast. Share the Health. Available online: <https://milkbankne.org/receive/> (accessed on 23 June 2022).
14. Mother's Milk Bank. Rocky Mountain Children's Health Foundation. Rocky Mountain Children's Health Foundation | Mothers' Milk Bank. Available online: <https://rmchildren.org/mothers-milk-bank/buy-milk/buying-milk-for-your-baby/> (accessed on 23 June 2022).
15. Mother's Milk Bank. San Jose Mother's Milk Bank. Available online: <https://mothersmilk.org/get-milk/> (accessed on 23 June 2022).
16. Updegrove, K. Nonprofit Human Milk Banking in the United States. *J. Midwifery Womens Health* **2013**, *58*, 502–508. [CrossRef]
17. Abrams, S.A.; Duggan, C.P. Infant and child formula shortages: Now is the time to prevent recurrences. *Am. J. Clin. Nutr.* **2022**, *116*, 289–292. [CrossRef]
18. Keim, S.A.; McNamara, K.A.; Jayadeva, C.M.; Braun, A.C.; Dillon, C.E.; Geraghty, S.R. Breast Milk Sharing via the Internet: The Practice and Health and Safety Considerations. *Matern. Child Health J.* **2014**, *18*, 1471–1479. [CrossRef] [PubMed]
19. Vieira, M.A.; Kube, P.K.; van Helmond, J.L.; Hanley, P.C.; Graber, E.G.; Bialo, S.R.; Slamon, N.B. Recipe for Disaster: Homemade Formula Leading to Severe Complications in 2 Infants. *Pediatrics* **2021**, *148*, e2021050947. [CrossRef] [PubMed]
20. Osbaldiston, R.; Mingle, L.A. Characterization of Human Milk Donors. *J. Hum. Lact.* **2007**, *23*, 350–357. [CrossRef] [PubMed]
21. Wambach, K.; Bateson, T.; Matheny, P.; Easter-Brown, K. A Descriptive Study of the Attitudes, Perceptions, and Experiences of Human Milk Donation. *Adv. Neonatal Care* **2019**, *19*, 441–451. [CrossRef] [PubMed]
22. Martínez Sabater, A.; Siles González, J.; Escrivá Aparisi, M.V.; Ballestar-Tarín, M.L. Review of the Characteristics of Mothers Donor Milk Banks. 2014. Available online: <http://rua.ua.es/dspace/handle/10045/68428> (accessed on 28 June 2022).
23. Braun, V.; Clarke, V. Using thematic analysis in psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. [CrossRef]
24. Thomaz, A.C.P.; Loureiro, L.V.M.; Oliveira, T.D.S.; Montenegro, N.C.D.M.F.; Júnior, E.D.A.; Soriano, C.F.R.; Cavalcante, J.C. The Human Milk Donation Experience: Motives, Influencing Factors, and Regular Donation. *J. Hum. Lact.* **2008**, *24*, 69–76. [CrossRef]

25. Doshmangir, L.; Naghshi, M.; Khabiri, R. Factors Influencing Donations to Human Milk Bank: A Systematic Review of Facilitators and Barriers. *Breastfeed. Med.* **2019**, *21*, 14. [CrossRef]
26. Ramli, N.; Ibrahim, N.R.; Hans, V.R. Human milk banks—The benefits and issues in an Islamic setting. *East. J. Med.* **2010**, *15*, 163–167.
27. Thorley, V. Milk Kinship and Implications for Human Milk Banking: A Review. *Womens Health Bull.* **2016**, *3*, 1–6. Available online: <http://womenshealthbulletin.neoscriber.org/en/articles/21306.html> (accessed on 28 June 2022). [CrossRef]
28. Ozdemir, R.; Ak, M.; Karatas, M.; Ozer, A.; Dogan, D.G.; Karadag, A. Human milk banking and milk kinship: Perspectives of religious officers in a Muslim country. *J. Perinatol.* **2015**, *35*, 137–141. [CrossRef]
29. Govender, N. Knowledge, Perceptions and Attitude of Community Members and Healthcare Workers Regarding the Donation of Breast Milk and Use of Donated Human Milk (DHM) in Empangeni, KwaZulu-Natal. Master's Thesis, University of Cape Town, Cape Town, South Africa, 2020.
30. Mackenzie, C.; Javanparast, S.; Newman, L. Mothers' Knowledge of and Attitudes toward Human Milk Banking in South Australia: A Qualitative Study. *J. Hum. Lact.* **2013**, *29*, 222–229. [CrossRef]
31. Abhulimhen-Iyoha, B.I.; Okonkwo, I.R.; Ideh, R.C.; Okolo, A.A. Mothers' perception of the use of banked human milk for feeding of the infants. *Niger. J. Paediatr.* **2015**, *42*, 223–227. [CrossRef]
32. Gelano, T.F.; Bacha, Y.D.; Assefa, N.; Motumma, A.; Roba, A.A.; Ayele, Y.; Tsige, F. Acceptability of donor breast milk banking, its use for feeding infants, and associated factors among mothers in eastern Ethiopia. *Int. Breastfeed. J.* **2018**, *13*, 23. [CrossRef] [PubMed]
33. Iloh, K.K.; Osuorah, C.D.; Ndu, I.K.; Asinobi, I.N.; Obumneme-Anyim, I.N.; Ezeudu, C.E.; Oluchi, U.M.; Anyanwu, O.U.; Ekwochi, U.; Ogoke, C.C.; et al. Perception of donor breast milk and determinants of its acceptability among mothers in a developing community: A cross-sectional multi-center study in south-east Nigeria. *Int. Breastfeed. J.* **2018**, *13*, 47. [CrossRef] [PubMed]
34. Jarmoc, G. Analysis of the Demographics and Characteristics of Milk Donors from Mothers' Milk Bank Northeast. Master's Thesis, Boston University, Boston, MA, USA, 2020. Available online: <http://www.proquest.com/docview/2433304280/abstract/B3CA2E690C7F47D0PQ/1> (accessed on 28 June 2022).
35. Berger, L.R. When Should One Discourage Breast-feeding. *Pediatrics* **1981**, *67*, 300–302. [CrossRef] [PubMed]
36. Ellsworth, L.; Sturza, J.; Stanley, K. An Alternative to Mother's Own Milk: Maternal Awareness of Donor Human Milk and Milk Banks. *J. Hum. Lact.* **2021**, *37*, 62–70. [CrossRef] [PubMed]
37. Gribble, K.D. Peer-to-Peer Milk Donors' and Recipients' Experiences and Perceptions of Donor Milk Banks. *J. Obstet. Gynecol. Neonatal Nurs.* **2013**, *42*, 451–461. [CrossRef] [PubMed]
38. Ganapathy, V.; Hay, J.W.; Kim, J.H. Costs of necrotizing enterocolitis and cost-effectiveness of exclusively human milk-based products in feeding extremely premature infants. *Breastfeed. Med.* **2012**, *7*, 29–37. [CrossRef]
39. Arnold, L.U.S. Health Policy and Access to Banked Donor Human Milk. *Breastfeed. Med. Off. J. Acad. Breastfeed. Med.* **2009**, *3*, 221–229. [CrossRef]
40. Rose, A.T.; Miller, E.R.; Butler, M.; Eden, C.; Kim, J.H.; Shah, S.I.; Patel, R.M. US state policies for Medicaid coverage of donor human milk. *J. Perinatol.* **2022**, *42*, 829–834. [CrossRef]