

Association between losses of donated human milk and the characteristics of donors

Associação entre perdas de leite humano doado e as características das doadoras

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Resumo

INTRODUÇÃO: O leite humano é o padrão-ouro de alimentação de lactentes sendo ainda mais elementar para bebês prematuros. **OBJETIVO:** Analisar a associação entre perdas de leite humano doado e as características das doadoras. **MÉTODOS:** estudo do tipo caso-controle, quantitativo, realizado através da análise de 619 registros de doadoras de leite humano que foram atendidas em um Banco de Leite Humano. **RESULTADOS:** Observou-se 48,3 % das doadoras apresentaram algum tipo de perda, sendo a sujidade e Acidez Dornic maior que 8° os tipos de perdas mais frequentes. Verificou-se que as condições de moradia não apresentaram associação com a perda de leite humano, bem como com as variáveis das características socioeconômicas, obstétricas e puerperais. **CONCLUSÃO:** Observamos que não há significância na associação entre as variáveis expositivas e a variável de desfecho. Contudo, visto que, houve uma perda de quase metade do leite doado e que a demanda por parte dos recém-nascidos é elevada, nota-se uma necessidade de intervenção para dirimir os problemas.

Palavras-chave: aleitamento materno; leite humano; bancos de leite

Abstract

BACKGROUND: Human milk is the gold standard for infant nutrition even more for those there are preterm. **OBJECTIVE:** To analyze the association between losses of donated human milk and the characteristics of donors. **Methods:** a case-control, quantitative study was carried out through the analysis of 619 records of human milk donors who were treated at a Human Milk Bank. **RESULTS:** It was observed that 48.3% of the donors presented some type of loss, with dirt and Dornic Acidity greater than 8th being the most frequent types of losses. It was found that the housing conditions were not associated with the loss of human milk, as well as with the variables of socioeconomic, obstetric, and puerperal characteristics. **CONCLUSION:** We observed that there is no significance in the association between the exposure variables and the outcome variable. However, since there was a loss of almost half of the donated milk and the demand from newborns is high, there is a need for intervention in the exposing factors to lead to better use.

Keywords: breastfeeding; human milk; milk banks

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Introduction

The act of breastfeeding goes beyond the nutritional benefits of the baby and involves a direct interaction between the mother-child dyad, generating a basis for the biological and emotional effects on the child's development, as well as the ability to defend against infections, in addition to having repercussions on health physical and mental health of the mother.(1-3)

Human milk (HM) is a complete, essential and ideal food for the newborn (NB) due to its rich composition in immunological factors. This way, the baby receives protection against many diseases. Thus, HM constitutes an ideal food for the health of preterm infants, as they are more fragile than full-term NBs and require special care. (4-6)

To ensure that premature NBs benefit from HM, Human Milk Banks (HMBs) act as a food and nutritional security strategy(7) and aim to promote, protect and support breastfeeding, in addition to collecting, processing, quality control and distribution of pasteurized human milk for premature babies, those with low weight or those hospitalized in a Neonatal Intensive Care Unit. Thus, they constitute a strategic element to contribute to the reduction of infant morbidity and mortality, specially on the neonatal component. (8,9)

The HMBs work as an alternative so that babies, whether premature or full-term, who cannot be breastfed directly from the mother's breast, can have access to the consumption of human milk. This milk is a result of the donations from voluntary mothers who produce excess milk, even breastfeeding their children.(5) Resolution RDC No. 171 of September 4, 2006 defines a human milk donor as a "healthy nursing mother who has higher lactic secretion to the demands of her son, who is willing to milk and donate the surplus; or those who

express their own milk to maintain lactation and/or feed their child.”(8)

Donated HM undergoes rigorous quality control and is then directed by the HMBs to a target audience: premature, low-weight babies or those with some nutritional need.

The disregard of milk occurs due to changes in its properties, which makes it unfit for consumption and may be related to environmental contaminants, flaws in the collection technique, pre-storage, maintenance of the cold chain, handling of the bottle, among other factors. (10) Because it is a labile product, milk collection and conservation need to be strictly controlled to maintain its quality, as milk is easily altered by heat and the proliferation of microorganisms.(11) Therefore, nursing mothers should be instructed about the time of collection at home, to avoid loss of donated milk and ensure quality.(9,12)

Due to the wide range of benefits related to breast milk, the donation is more than an act of generosity; it is an effective alternative for those who cannot breastfeed their children. Several factors can influence the loss of human milk, including maternal environmental, social and economic characteristics.

Materials and Methods

Sample and type of study

This is a case-control, quantitative, retrospective study, carried out through the analysis of donor registration forms. The case group was represented by the donors who lost human milk for some reason. The control group was the mothers who had no losses. The population of this study was composed of mothers who donated human milk.

The sample consisted of women registered as human milk donors from 2017 to 2020 at the HMB of the University Hospital of the Federal University of



Maranhão (HUUFMA). The sample used for the analysis consisted of sample units with complete data, according to the inclusion and exclusion criteria, totaling 619 registration forms.

Research delimitation

Data collection was carried out in April and May 2021, at the HMB - HUUFMA located in the Maternal and Child Unit Care.

The structure of the HMB is formed by a milk processing and pasteurization room, a pediatric office, a meeting room for lectures with mothers, a study and research room and a room for weighing babies. Assistance is for babies born in the Maternal and Child Unit Care, also monitoring mothers who have difficulties with breastfeeding, pediatric consultations, home collection of human milk (correct guidance for breastfeeding and milk collection), pasteurization and quality control of milk collected before its distribution to premature babies in the Neonatal Intensive Care Unit of the hospital, in addition to teaching and research activities.

Inclusion and Exclusion Criteria

All donors who had records filed at the HMB - HUUFMA, as well as the Donor Registration Form, during the period from 2017 to 2020 were considered as research participants. Donor Registration Forms that contained erasures that made it impossible to collect fundamental information for the analysis of the variables were excluded. In addition to forms with inaccurate, incorrect and pencil-marked data, as they could compromise the validity of the data.

Procedures

Data were collected through Donor Registration Forms, considering the following variables:

1. Sociodemographic: age at birth/age; Level of education; Profession; Family income; the number of pregnancies; the number

of abortions; the number of stillbirths, number of live births; carrying out prenatal care; delivery date; place of birth; information on smoking and alcoholism; use of medications and health treatments.

2. Housing conditions: Type of housing; water supply; destination of waste; garbage disposal; cold chain information.

3. General health data: Blood pressure (in mmHg), Pulse (in beats per minute), Weight (in Kg), and Respiratory rate (in movements per minute).

4. Data about the donor's child: age of the baby at the first collection, type of breastfeeding, and observation of breastfeeding..

5. Data on milk donation: Total volume collected (in ml), number of donations until the donor disconnects, and the total time that the donor remained registered and active.

In the Quality Control Sheet for Pasteurized Human Milk, the following variables on milk loss before and after processing were considered (6,8):

1. Dornic acidity: titratable acidity expressed in Dornic degrees, considering normal acidity in the range of 1 to 8°D;

2. Energy content (crematocrit): an analytical technique that allows the estimated calculation of the energy content of expressed human milk;

3. Color: may vary according to its components and reflects the predominance of a certain fraction, depending on the time of collection; colostrum usually varies from coconut water-like color to orange-yellow, transitional milk color gradually changes to bluish/opaque white until it becomes mature milk;

4. Presence of off-flavor: it is the organoleptic characteristic that does not conform to the original

aroma of milked human milk such as rancidity (smell of coconut soap), fish or egg in the decomposition phase, chlorine, plastic, rubber, and medicine;

5. Presence of dirt: when the milk contains a foreign body at the time of evaluation, such as hair, insects, dust, or nail fragments;

6. Package conditions: the package must be easy to clean and disinfect, present perfect sealing, and must be resistant to the sterilization process;

7. Microbiological examination: presence or absence of total coliforms.

Data analysis

The normality of numerical variables was tested using the Shapiro-Wilk test. Descriptive statistics frequencies and percentages were computed only with valid data (without computing values considered missing). For numeric variables with normal distribution, descriptive statistics were performed using mean and standard deviation. For the others, with a median and variation of the 25th and 75th percentiles to better describe the measure of central tendency. The dependent variable was defined as categorical (present loss) and through this association was made with the expository variables.

Simple logistic regression was used to verify the odds ratio between household conditions and the presence of milk loss. For all tests, P values less than or equal to 0.05 were considered significant. All tests

were performed using the SPSS statistical software (IBM®, version 26).

Ethical Aspects

The present study is an integral part of the project “Characterization of donors registered in the Human Milk Bank of the University Hospital of the Federal University of Maranhão” which was approved by the Scientific Committee of the University Hospital of UFMA (COMIC). The project was approved by the Research Ethics Committee (CEP) of HUUFMA with opinion number 4,688,729. The researchers requested the waiver of obtaining the Free and Informed Consent Form (TCLE) from the participants, according to section IV, item IV.8 of Resolution nº 466 of December 12, 2012. Regarding the exposure of the personal data of donors, everything is settled, avoiding ethical obstacles in data collection and publication of results.

Results

Data from 619 human milk donors with records at the HUUFMA Human Milk Bank, who were disconnected between 2017 and 2020, were used. A total of 299 donors (48.3%) presented losses at some point in the period in which they were registered. In the sample studied, 9 types of loss were recorded, which are shown in Table 1. The most common loss was due to dirt, followed by Dornic Acidity > 8°. The lowest loss frequencies were due to flocculated milk and the presence of off-flavor.

Table 1 - Description of recorded human milk losses from milk donors registered in the Human Milk Bank of the University Hospital of UFMA, São Luís, 2017-2020.

	N	Median (P25-75)
Dornic acidity > 8°	137	250 (250-715)
Presence of dirt	154	300 (237,5-572,5)
Insufficient volume for pasteurization	26	40 (30-80)
Raw milk > 15 days (expiration)	111	300 (170-650)
Positive microbiological test	100	250 (240-500)
Presence of <i>Off-flavor</i>	24	260 (112,5-465)



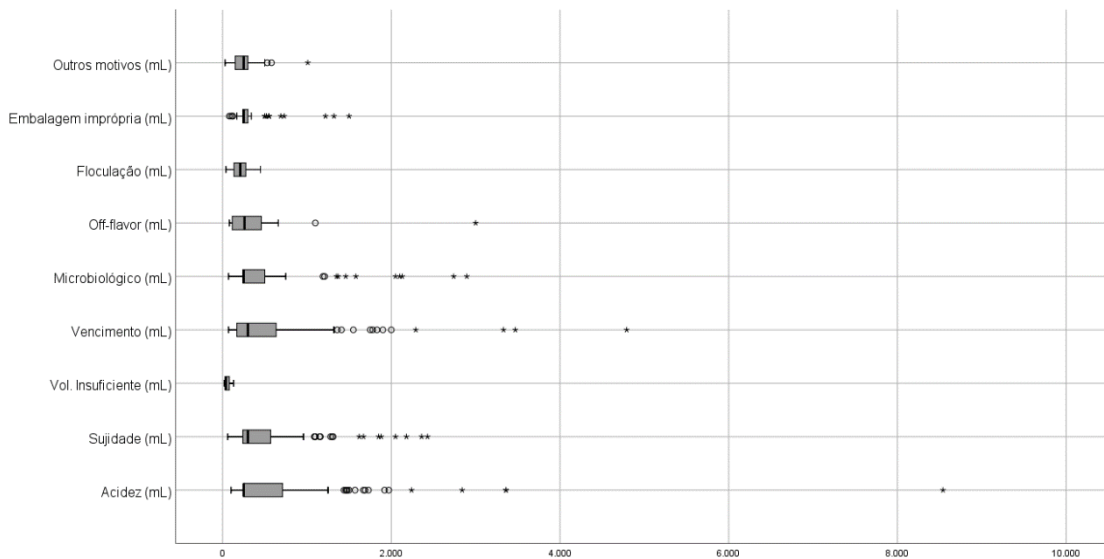
	N	Median (P25-75)
Flocculated milk*	16	207,5 (25,666)
Inappropriate packaging	50	250 (240-310)
Other reasons not categorized	41	250 (140-300)

Notes: * variable with normal distribution, presented as mean (\pm standard deviation)

Graph 1 shows the box-plot comparison of the reasons for loss of human milk in the studied sample. Losses due to Dornic acidity $> 8^\circ$ and maturity present aberrant values, demonstrating the

variability of volumes recorded due to losses. In the graphic representation, the values presented distribution below 2000mL for all types of losses.

Graph 1 - Box-plot of the reasons for milk loss in the Human Milk Bank of the University Hospital of UFMA, São Luís, 2017-2020.



In the univariate analysis between socioeconomic, obstetric and puerperal characteristics with the loss of human milk, it was observed that none of the variables showed a statistically significant association ($p>0.05$). Detailed values are

shown in Table 2. It can be noted that milk losses are concentrated in mothers aged between 18 and 30 years (59.9%), with more than 12 years of study (49.5%), with income between 1 and 3 minimum wages (36.7%).

Table 2 - Association analysis of socioeconomic variables with the loss of human milk from donors of the Human Milk Bank of the University Hospital of HUUFMA, São Luís, 2017-2020

	N (%)	Milk Loss		P value
		No n (%)	Yes n (%)	
Maternal age				0,150
Under 18 years old	31 (5,4)	17 (5,7)	14 (5)	
Over 18 to 30 years old	367 (63,4)	198 (66,7)	169 (59,9)	
Over 31 years old	181 (31,3)	82 (27,6)	99 (35,1)	



	N (%)	Milk Loss		P value
		No n (%)	Yes n (%)	
Maternal education				0,296
Up to 8 years of study	33 (5,4)	21 (6,7)	12 (4)	
Between 9 and 11 years of study	286 (46,5)	148 (47,3)	138 (46,5)	
12 or more years of study	291 (47,7)	144 (46)	147 (49,5)	
Family Income				0,562
Up to 1 minimum wage	196 (33,4)	107 (35,3)	89 (31,4)	
Over 1 to 3 minimum wage	205 (35)	101 (33,3)	104 (36,7)	
Over 3 minimum wage	185 (31,6)	95 (31,4)	90 (31,8)	
Smoker donor				1*
Yes	7 (1,2)	4 (1,3)	3 (1)	
No	595 (98,8)	306 (98,7)	289 (99)	
Consumption of alcoholic beverages				0,547*
Yes	11 (1,8)	7 (2,3)	4 (1,4)	
No	592 (98,2)	303 (97,7)	289 (98,6)	

Notes: *Fisher's exact test. Others, chi-square test; SM = minimum wages; HUUFMA = University Hospital of the Federal University of Maranhão

Regarding to prenatal and delivery data, shown in Table 3, it was observed that most of the donors who recorded losses were those who received prenatal care in a public service (50%), primigravidae (67.9%), cesarean delivery (67.8%). Most

of the sample reported having received prenatal and postpartum guidance on breastfeeding (44.2%). Most donors were exclusively breastfed, which was also similar among donors who experienced milk loss (83%).

Table 3 - Association analysis of obstetric and puerperal variables with the loss of human milk from donors of the Human Milk Bank of the University Hospital of HUUFMA, São Luís, 2017-2020

	N (%)	Milk Loss		P value
		No n (%)	Yes n (%)	
Prenatal care location				0,796
HUUFMA	45 (8,7)	22 (8,2)	23 (9,3)	
In some public service	254 (49,1)	130 (48,3)	124 (50)	
In private services	218 (42,2)	117 (43,5)	101 (40,7)	
Prenatal Complications				0,687
Yes	126 (21,6)	67 (22,4)	59 (20,8)	
No	457 (78,4)	232 (77,6)	225 (79,2)	
Number of Deliveries				0,748
1	402 (66,6)	203 (65,3)	199 (67,9)	
2	150 (24,8)	79 (25,4)	71 (24,2)	
3 ou mais	52 (8,6)	29 (9,3)	23 (7,8)	
Type of delivery				0,303
Vaginal	206 (34,3)	112 (36,2)	94 (32,2)	
Cesarean	395 (65,7)	197 (63,8)	198 (67,8)	



	N (%)	Milk Loss		P value
		No n (%)	Yes n (%)	
Place of Delivery				0,932
HUUFMA	129 (21,7)	68 (22,3)	61 (21,1)	
In some public service	234 (39,4)	120 (39,3)	114 (39,4)	
Private maternity hospitals	231 (38,9)	117 (38,4)	114 (39,4)	
Guidelines on breastfeeding				0,501
Only in prenatal care	38 (6,6)	19 (6,4)	19 (6,9)	
Only after delivery	190 (33)	96 (32,1)	94 (34,1)	
In prenatal and postpartum	247 (43)	125 (41,8)	122 (44,2)	
Never received guidance	100 (17,4)	59 (19,7)	41 (14,9)	
Breastfeeding experience				0,351
First child	395 (67,6)	202 (66,4)	193 (68,9)	
Breastfed a baby	169 (28,9)	94 (30,9)	75 (26,8)	
Breastfed more than one baby	20 (3,4)	8 (2,6)	12 (4,3)	
Exclusive Breastfeeding				0,823
Yes	480 (83,3)	246 (83,7)	234 (83)	
No	96 (16,7)	48 (13,3)	48 (17)	

Notes: HUUFMA = University Hospital of the Federal University of Maranhão

Table 4 presents the values related to the odds ratio between the housing conditions reported by the donors. A different analysis was carried out from the

others due to the relationship that human milk losses can have when linked to the housing conditions in which the donors live.

Table 4 - Univariate logistic regression between the dependent variable milk loss and the housing characteristics of the donors of the Human Milk Bank of the University Hospital of HUUFMA, São Luís, 2017-2020.

	N (%)	OR (95% IC)	P value
Masonry house	284 (98,6)	0,581 (0,168-2,008)	0,391
Piped water	248 (87,3)	1,346 (0,802-2,262)	0,261
Consumption of treated water	238 (84,4)	0,706 (0,460-1,083)	0,111
Regular waste collection	280 (97,9)	6,279 (0,751-52,482)	0,090
Adequate cold chain	191 (72,1)	0,834 (0,579-1,203)	0,332
Sewage network	205 (73)	1,159 (0,797-1,684)	0,440

Notes: OR = odds ratio. CI = confidence interval

However, it appears that housing conditions were not associated with loss of human milk ($p > 0.05$). In general, most of the sample had housing conditions considered ideal for donation (all values above 70%); moreover, all OR values go through 1, so these findings cannot yet indicate whether housing conditions can

influence the presence of loss of human milk.

Discussion

This research showed that there is no relationship between the socioeconomic, obstetric, and puerperal characteristics and living conditions of the donors with the loss



of human milk. Among the losses presented by the analyzed donors, the most prevalent were due to soiling and Dornic acidity measurement $> 8^\circ$, and the lowest, was due to flaked milk and the presence of off-flavor.

Even though there was no relationship between the characteristics of the donors and milk loss, milk loss in mothers aged between 18 and 30 years and with more than 12 years of schooling stands out. Opposite results were found in research that showed the association between the level of education and the loss of milk, in which 42.3% of the donors had primary education. (13) And about the age group, the highest frequency was 53.9% of losses in the age group of up to 19 years. The present study contradicts the justification that the higher the level of education, the better the understanding and discernment of information, and that age over 18 should indicate greater maturity. Therefore, it is assumed that there is no adequate understanding of the guidelines passed on by the professionals of the Banco de Leite due to a lack of preparation or lack of mastery of the guidelines or even the absence of these by the professionals.

No studies were found in the literature that analyzed the obstetric and puerperal characteristics of the loss of human milk, as well as the relationship with living conditions. It is important to emphasize that an association between obstetric and puerperal characteristics and living conditions with loss of milk cannot be attributed only to this research, although this study presents relevant information for better control of expositive variables concerning the donation of human milk.

The high rate of milk loss in this study finds little relative in the literature. A study carried out in Curitiba showed that in 2006 there was a loss of 24% of the milk collected and that, after applying a checklist, this loss was reduced to 10.5% in 2008(10), and in the HMB of a municipality in Juiz de Fora (MG), where 32.4% of

the bottles received showed non-compliance and were discarded. (13) At the Sorocaba HMB, a percentage of 62% of the donated milk volume was discarded in 2012, 41% in 2013, 38% in 2014, and 29% in 2015 and 2016(14), and another study showed a loss of 19.18% of the total amount of donated milk. (14) Based on this finding, it can be deduced that the great loss of milk may be a failure in the milking and maintenance of this milk, given the main reasons for disposal. In addition, in this study, total losses were accounted for, and some donors had more than one type of milk loss.

This study showed that of the present losses, the most frequent was due to dirt, followed by Dornic acidity greater than 8° . Previous research has revealed similar results. In a 2016 study, it was found that approximately 29% of the collected milk was discarded due to apparent soiling and acidity above 8° Dornic. (14) Another study highlighted that the greatest losses were due to soiling (17%) and acidity (10%). (13) A similar result was found in research that showed the presence of acidity as the major cause of loss of human milk donated to an HMB from 2009 to 2015, followed by loss due to dirt. (15)

Also, research that sought to identify the causes of human milk waste at the HMB found that there was a greater loss of milk due to Dornic acidity, the presence of off-flavor, and dirtiness. (16) In a Milk Bank in a municipality in the State of Paraná, the presence of dirt was found to be the main reason for milk loss, corresponding to 90.37% of total losses. (17) In line with some of these findings, in another study where samples of human milk were expressed at the HMB or at home, it was shown that only 2% of the sample from each location had acidity $\geq 8^\circ$ Dornic. (18)

According to the National Health Surveillance Agency (ANVISA), dirt such as hair, hair, nail fragments, pieces of paper, dust, and insects, among others, can be found in milked human milk. (9) Therefore, for home collection, it is recommended that



According to the Technical Norm on hygiene and conduct for donors, donors are properly instructed to perform the expression and storage of expressed milk, being instructed “to remove all adornments, avoid the use of perfumes, tie up their hair and clean their hands and forearms with unscented soap and water before expressing human milk”, as well as avoiding talking, smoking, eating, drinking or using a cell phone during milking. (8)

Thus, since the loss due to soiling was the most present in this study, it is suggested that there should be an intensification of guidelines on the part of professionals from the Milk Bank to donor mothers regarding hygiene when performing milk expression and storage and maintenance of the chain of cold. The use of a checklist with the step-by-step technique of expressing human milk, as done by a study in Curitiba(10), can contribute to reducing the volume of losses.

Because it is a retrospective study, in which handwritten forms were used and some information was missing, the reliability of the data may be impaired, as it depends on the individuality of who filled them out. However, due to the large sample size, it can be considered that this limitation was mitigated by considering random occurrences. In addition, total losses were

considered in this study, but some donors had more than one type of loss.

Considering the scarcity of literature on the association between milk loss and the characteristics of the donors, this work highlighted the importance of discovering the causes of such losses and whether there is a relationship with the donors, to know and mitigate the losses and overcome the milk demands. Therefore, there is a need for further studies in this area to better clarify this relationship.

Conclusion

This study aimed to analyze the association between the variables of maternal characteristics and the loss of human milk and concluded that there is no significance in the association between the expository variables and the outcome variable. However, the analysis carried out in this research took into account the total milk losses, and not the individual characteristics of each loss. Thus, since there was a loss of almost half of the donated milk in the period analyzed in this sample and that the demand from premature newborns is considerably high, there is a need to intervene in the causes so that there is better use of the donated milk .

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How to cite this article:

Oliveira NR, Soares LBC, Silva NBP, Batista CLC. Association between losses of donated human milk and the characteristics of donors. Rev. Aten. Saúde. 2024; e20248851(22). doi <https://doi.org/10.13037/ras.vol22.e20248851>

