Human milk sufficiency for premature babies in Intensive Care Units

Suficiência de leite humano para prematuros em Unidades de Terapia Intensiva

Suficiencia de leche humana para prematuros en Unidad de Cuidados Intensivos

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Abstract

Objective: To analyze human milk sufficiency in Neonatal Intensive Care Units in the Metropolitan Region of São Paulo according to the number of premature babies, estimated demand for human milk and actual consumption.

Methods: This is a cross-sectional study, carried out at Human Milk Collection Stations and Human Milk Banks registered with the São Paulo Network of Human Milk Banks in 2017. Data from 2017 census vital statistics were used to identify premature baby distribution in Regional Health Care Networks.

Results: 100% of Human Milk Collection Stations and 84.6% of Human Milk Banks in São Paulo participated in the study. Pasteurized human milk distribution insufficiency was identified between estimated demand and actual consumption by premature babies. During the study period, only the Center and Southeast regions met 100% of human milk coverage, followed by the Greater ABC region, with 44.62%.

Conclusion: Most Human Milk Collection Stations and Human Milk Banks in the metropolitan region of São Paulo do not assist all premature children. The management of these units can contribute to encouraging donor recruitment and collected human milk optimization.

Resumo

Objetivo: Analisar a suficiência de leite humano nas Unidades de Terapia Intensiva Neonatais da Região Metropolitana de São Paulo, segundo o quantitativo de prematuros, demanda estimada de leite humano e consumo efetivo.

Métodos: Estudo transversal em Postos de Coleta e Bancos de Leite Humano cadastrados na Rede Paulista de Bancos de Leite Humano em 2017. Utilizou-se dados de estatísticas vitais censitárias de 2017 para identificar a distribuição dos prematuros nas Redes Regionais de Atenção à Saúde.

Resultados: Participaram do estudo 100% dos Postos de Coleta e 84,6% dos Bancos de Leite Humano de São Paulo. Identificou-se uma insuficiência na distribuição do leite humano pasteurizado, entre a demanda estimada e o consumo efetivo dos prematuros. No período do estudo, apenas as regiões Centro e Sudeste atendiam 100% da cobertura de leite humano, seguidas da região do grande ABC com 44,62%.

Conclusão: A maioria dos Postos de coleta e Bancos de Leite humano da região metropolitana de São Paulo, não atendem todas as crianças prematuras. O gerenciamento destas unidades pode contribuir para estimular a captação de doadoras e a otimização do leite humano coletado.

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Conflict of interest: nothing to declare.

Resumen

Objetivo: Analizar la suficiencia de leche humana en las Unidades de Cuidados Intensivos Neonatales de la Región Metropolitana de São Paulo, de acuerdo con la cantidad de prematuros, la demanda estimada de leche humana y el consumo efectivo.

Métodos: Estudio transversal en Puntos de Recolección y Bancos de Leche Humana registrados en la Red Paulista de Bancos de Leche Humana en 2017. Se utilizaron datos de estadísticas vitales censitarias de 2017 para identificar la distribución de los prematuros en las Redes Regionales de Atención en Salud.

Resultados: Participaron en el estudio el 100 % de los Puntos de Recolección y el 84,6 % de los Bancos de Leche Humana de São Paulo. Se identificó una insuficiencia en la distribución de leche humana pasteurizada entre la demanda estimada y el consumo efectivo de los prematuros. En el período del estudio, solo las regiones Centro y Sudeste atendían el 100 % de la cobertura de leche humana, seguidas por la región del Gran ABC con el 44,62 %.

Conclusión: La mayoría de los Puntos de Recolección y Bancos de Leche Humana de la región metropolitana de São Paulo no atiende a todos los bebés prematuros. La administración de estas unidades puede contribuir para estimular la captación de donantes y la optimización de la leche recolectada.

Introduction

The prevalence of premature births in the world varies from 5% to 18%[1] and, in Brazil, it is around 11%, with the Northeast and Southeast regions being those with the highest concentration of premature births at 28% and 39%, respectively.[2]

Among the care strategies for preterm newborns and those admitted to Neonatal Intensive Care Units (NICU), human milk (HM) is important to promote their adequate development, growth and health recovery, being considered the most complete food. HM helps with immunity, contributing to a lower incidence of enterocolitis and other illnesses, in addition to its positive effects on disease prevention for mothers.[3] Although breast milk is the first choice for feeding premature children, some mothers have difficulty maintaining sufficient milk production to meet their children's needs, making it necessary to use supplements.[4-7]

In this regard, as a second choice, pasteurized HM is provided by Human Milk Banks (HMB) through the donation of a breastfeeding mother. HMB is an important strategy to promote breastfeeding among children who cannot be breastfed directly from their mother's breast, and HM must be available in sufficient quantity to meet their needs in emergency occasions and in special clinical conditions.[6,7] Human Milk Collection Stations (HMCS) are units technically linked to an HMB and administratively linked to it or to a health unit, distributing raw HM exclusively from mother to child, not being able to process the donated HM for its distribution.[8,9]

The Brazilian Network currently has 229 HMB and 236 HMCS and, in 2022, totaled 163,358 donors and 181,827 recipients, having collected almost 200 thousand liters of human milk and distributed almost 150,000 liters. The state of São Paulo has the largest HMB Network, and in the same year, it had a total of 37,923 donors and 32,955 recipients, having collected around 50,000 thousand liters of human milk and distributed almost 40,000 liters.[10]

The São Paulo Metropolitan Region (SPMR) is the area with the highest concentration of HMB and HMCS in Brazil and the world[8] and, despite this, there is a complaint about the lack of availability of HM to meet the entire demand of several NICUs in the region. Despite the recognized importance of HM for these children, there are no studies that explore HMB's capacity to meet the needs of children admitted to hospital.

Thus, this study aimed to analyze HM sufficiency for SPMR NICUs according to the number of premature babies, estimated demand and actual consumption.

Methods

This is a cross-sectional study carried out with the HMB and HMCS of the cities that make up the SPMR, Brazil.

The SPMR covers 39 municipalities divided politically and administratively into six Regional Health Care Networks (RHCN) such as: Greater ABC (region 1); *Alto do Tietê* (region 2); *Franco da Rocha* (region 3); *Mananciais* (region 4); *Rota dos Bandeirantes* (region 5); and City of São Paulo (region 6), organized into North, Center, Southeast, South, West and East.[9,11] These regions have 26 HMB and eight HMCS.

All SPMR HM distribution units that were registered in the São Paulo HMB Network in 2017 took part in the study. Units that did not accept to participate were excluded, either due to refusal or lack of response to the invitation sent by email to the coordinator.

Collection was carried out by a trained nurse who, after contacting the coordinators and upon acceptance, sent an online questionnaire using the REDcap (Research Electronic Data Capture) software. The data collection instrument was developed by the research team containing data characterizing the units and the profile of children, such as gestational age and number of births of premature babies. Subsequently, the researchers identified the number of premature births by RHCN, estimated average HM volume and effective HM volume consumption by newborns in the study regions.

Children's gestational age and the number of premature births due to RHCN were identified in DATASUS. [12] The prematurity variable was categorized according to the standardized and pre-defined classification as <22 weeks, 22 to 27 6/7 weeks, 28-31 6/7 weeks and 32-36 6/7 weeks in consulted databases: DATASUS,[12] referring to Greater São Paulo, and Coordination of Epidemiology and Information (CEInfo), [13] reference to the city of São Paulo. In RHCN 6 regions, the CEInfo database [13] does not present prematurity stratification by gestational age, only the total number of premature children below 36 weeks.

To calculate estimated average HM volume, children's average weight, prematurity classification and average length of stay in the NICU were taken into account. For each prematurity range, we stipulated an average weight of 500 grams based on the weighted average of children under 22 weeks, 800 grams for those with a gestational age (GA) of 22 to 27 6/7 weeks, 1,250 grams for those with 28-31 6/7 weeks, and 2,000 grams for those 32-36 6/7 weeks. [14] The average length of stay in the NICU was estimated at 11 days, based on a study that indicates a stay of around 6 to 19 days. [15]

To estimate the need for HM, the volume consumed in 11 days was taken into account. To this end, it was necessary to calculate, among the total number of premature babies per RHCN according to prematurity range, the percentage of participation, i.e., of all premature babies according to birth intervals. The percentage corresponding to each RHCN was verified. Based on this value, estimated demand was calculated considering the volume of HM consumed in 11 days in the NICU multiplied by the absolute value of premature babies due to RHCN in 2017, identified in DATASUS.[12]

HM consumption was estimated in milliliters (mL), considering a variation in intake of 10 to 20 mL/kilogram/day.[16] Thus, an estimate of the volume of HM consumed in 11 days per child/GA group was established for the study: 336 ml for children under 22 weeks; 810 ml for those aged 22 to 27 6/7 weeks; 2,300 ml for those 28-31 6/7 weeks; and 2,920 ml for those with 32-36 6/7 weeks.

The effective consumption of HM distributed corresponded to the total volume of HM distributed by HMCS and HMB in 2017, identified in the HMB Global Network System[12] and grouped by RHCN as well as the volume of HMB collected in the period.

HM sufficiency is the value of the volume distributed by the value of estimated total demand multiplied by 100, categorized as a percentage. The closer to 100%, the greater the HM sufficiency.

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS 20) (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.). Data were analyzed using descriptive statistics.

The study was carried out between June 2018 and June 2019 upon approval by the Research Ethics Committee of the *Universidade Federal de São Paulo* (UNIFESP), under Opinion 2,519,799 (CAAE (*Certificado de Apresentação para Apreciação Ética* - Certificate of Presentation for Ethical Consideration): 83261717.0.0000.5505). Authorization was obtained from the institutions involved and the coordinators of the participating units by the signature of the Informed Consent Form (ICF).

Results

Pasteurized HM distribution insufficiency between estimated demand and actual consumption of pre-

mature babies was found. The research was carried out with 84.6% of HMB and 100% of SPMR HMCS registered in the HMB network in 2017. The majority of HMB (20) and all of HMCS (8) participants were public. Only in RHCN 6, they were privately managed, with two HMB, one in the southeast and the other in the west, and two HMCS, one in the center and the other in the southeast, respectively. The data represents the distribution of HMB and HMCS included according to RHCN (Table 1).

Table 1. Distribution of HMB and HMCS referring to Regional Health Care Networks 1 to 6

RHCN (Regions)	Existing HMB n	Participants n	Existing HMCS n	Participants n
1 (Greater ABC)	3	3	0	0
2 (*Alto do Tietê*)	2	2	2	2
3 (*Franco da Rocha*)	0	0	0	0
4 (*Mananciais*)	2	2	0	0
5 (*Rota dos Bandeirantes*)	2	2	0	0
6 (São Paulo - north)	2	2	0	0
6 (São Paulo - center)	1	0	1	1
6 (São Paulo - southeast)	6	5	2	2
6 (São Paulo - south)	4	3	1	1
6 (São Paulo - west)	3	2	0	0
6 (São Paulo - east)	1	1	2	2

Table 2 data show consumption estimated values during the 11-day period of hospital admission in NICUs according to gestational age and the total number of children in the respective RHCN.

Table 3 presents estimated total demand and the distributed volume of HM in 2017 in NICUs, in addition to HM need and sufficiency.

Table 2. Human milk consumption over a period of 11 days according to the percentage of participation of premature babies by regional health care networks and age group

RHCN	Child GA	Total children	Participation of premature babies by RHCN and age group - %	Estimated consumption in 11 days - ml
1	<22 w.	11	11.8	39.6
	22 to 27 w.	188	11.7	94.8
	28 to 31 w.	345	11.2	257.6
	32 to 36 w.	3,190	11.4	332.9
Total	-	3,734	-	724.90
2	<22 w.	10	10.8	36.1
	22 to 27 w.	224	14.0	113.2
	28 to 31 w.	458	14.9	343.2
	32 to 36 w.	4,002	14.3	417.6
Total	-	4,694	-	910.1
3*	<22 w.	2	2.2	7.2
	22 to 27 w.	41	2.6	20.7
	28 to 31 w.	92	3.0	69.0
	32 to 36 w.	918	3.3	96.1
Total	-	1,053	-	193
4	<22 w.	1	1.1	3.6
	22 to 27 w.	106	6.6	53.6
	28 to 31 w.	158	5.2	118.5
	32 to 36 w.	1,601	5.7	167.6
Total	-	1,866	-	343.3
5	<22 w.	14	15.1	50.6
	22 to 27 w.	187	11.7	94.5
	28 to 31 w.	353	11.5	264.5
	32 to 36 w.	2,921	10.5	305.7
Total	-	3,475	-	715.3
6	<22 w.	55	59.1	198.7
	22 to 27 w.	856	53.4	432.8
	28 to 31 w.	1,664	54.2	1,246.6
	32 to 36 w.	15,271	54.7	1,598.1
Total	-	17,846	-	3,476.2

*There is no HMB in the region; Abbreviations: w = weeks

Discussion

An imbalance in HM distribution was identified according to territorial layout, despite SPMR having the highest quantitative concentration of HMB and HMCS in Brazil and the world.[8,17]

In relation to HMB in São Paulo, the highest concentration is found in RAAS 6, which comprises the city of São Paulo, with 65.3% of the total HMB. Southeastern São Paulo is home to the largest number of HMB, almost all of which are from the public network. The same occurs for HMCS, and RAAS 6 has the largest number of units, both public and private. In the other administrative regions, only in RAAS 2, *Alto do Tietê*, there are two HMCS. RAAS 3, *Franco da Rocha*, has discovered both HMB and HMCS. This fact can be explained by the high concentration of large hospitals that have NICUs. In other regions, the number of HMB varies between two and three.

Although HMB and HMCS activities were designed with a view to low implementation costs and ease of replication,[8] which would help with access to less economically favored places, the existence of these services is linked to areas with better hospital medical access, providing care to people who migrate to maternal and child care in these regions or who have access to the private network in these locations.[10]

Table 3. Total number of premature babies under 36 weeks and volumes of human milk related to estimated consumption per premature baby in 11 days, estimated total demand, volume collected and actual consumption, need and coverage in 2017

RHCN	Total number of premature babies less than 36 weeks	Estimated HM consumption by premature babies in 11 days (ml)*	Estimated total demand (liters)	Collected HM 2017 (liters)	Effective consumption of HM distributed in 2017 (liters)	Need	Coverage (HM distributed/demand - %)
1	3,734	1,572.4	5,871.52	3,428.00	2,620.00	2.24	44.62
2	4,694	1,686.9	7,918.27	1,807.00	1,603.10	4.94	20.25
3	-	-	-	-	-	-	-
4	1,866	1,846.7	3,446.02	635.00	496.70	6.94	14.41
5	3,475	1,469.1	5,105.22	1,329.00	735.60	6.94	14.41
6	17,748	1,569.4	27,853.62	16,554.00	13,898.80	2.00	49.90
North	3,610	1,569.4	5,665.52	1,252.20	888.10	6.38	15.68
Center	420	1,569.4	659.15	2,446.40	2,446.40	0.27	371.15
Southeast	3,779	1,569.4	5,930.74	7,181.30	6,435.40	0.92	108.51
South	4,390	1,569.4	6,889.64	1,861.60	1,404.00	4.91	20.38
West	1,426	1,569.4	2,237.96	2,822.50	2,124.50	1.05	94.93
East	4,123	1,569.4	6,470.61	851.20	600.40	10.78	9.28

*Average weighted by the participation of each group of premature babies

Despite this, the distribution of premature newborns less than 36 weeks is greater in the city of São Paulo and in RHCN 2, which concentrate the largest cities in SPMR, capital and Guarulhos.[18]

The Southeast region is the one that concentrates the largest amount of HMB and HMCS, presenting the highest values of HM supply. The center of the city of São Paulo has greater HM coverage and is represented by an HMCS from a private institution, where milk is offered from mothers to their own children, and there is no external HM gathering, i.e., practically all milk collected is distributed and the total number of premature babies is lower when compared to the others. The Eastern region represented by an HMB with low coverage, in which the estimated need for HM is 10 times greater than what is provided. The same happens to the Northern region, *Mananciais* and *Rota dos Bandeirantes*, which have the service related to the need for HM six times lower than the ideal. In regions where there are a greater number of premature babies and a lower number of HMB and HMCS, in general, there was not a good milk collection and processing capacity, i.e., there is a greater need for HM. However, the difference between the quantity of HMB/HMCS and the number of premature births is small, and there is a need to consider possible intervening factors for discrepancies in variations.

Although HMB work in a network and there is technical cooperation,[19,20] part of HM gathering and processing is individualized in the service related to the institution to which HMB/HMCS is linked,[21] and the result of work to meet the demand of each NICU linked to HMB/HMCS does not always reflect the need to assist the public in the region where it operates.

To solve the gaps in the regions, it would be necessary to expand the human, physical and material resources structures of HMB and HMCS, in addition to studying how to change the current logistics so that more NICUs could be assisted with HM supply. Studies indicate the need for actions on structural and resource factors for greater coverage of services.[22-24]

The differences in "Coverage" and meeting the "Need" for HM in the SPMR reflect inequalities in HM gathering and distribution that may be related to the individual management of these institutions with work promotion and development activities. HMB work organization management has been addressed in studies due to its importance in understanding and influencing factors related to operation and performance and quality of services.[25,26]

There is a lack of research to compare and analyze the results of HMB and HMCS work management, the factors that can influence the effects of optimizing HM collection and distribution, such as regional goals and studies to meet the demand for premature newborns admitted to NICUs and supply the HM stock. Although it is understood that actions to donate HM directly influence its provi-

sion for premature newborns,[27] other conditions are little or not addressed in terms of their impact on the HMB/HMCS work outcome.[28]

Another aspect that draws attention in the results of this research are HMB/HMCS from private institutions that manage to optimize HM supply and demand, even without receiving external donations, such as those from public institutions. There could be an influence from the economic and social factors of the population assisted or greater support in terms of guidance and structure to welcome mothers to express and offer their milk to their children. From a public health and economic point of view, it would be ideal to encourage and commit to sufficient HM supply in NICUs to premature newborns, as the formula, in addition to having strict indication and causing risks of morbidity, makes expenses more costly for the public hospital sector, and breastfeeding mothers may have difficulty maintaining this means of nutrition post-discharge if there is difficulty in resuming breastfeeding and lactation if support is not offered during and after hospital admission of newborns.[29-32]

This fact demonstrates the importance of actions aimed at donating HM, such as awareness and support for postpartum women for breastfeeding, work that must be carried out throughout pregnancy.[33]

Thus, society's awareness is relevant,[34] and thus the Brazilian Standard for the Marketing of Food for Infants and Young Children, Nipples, Pacifiers and Bottles (NBCAL - *Norma Brasileira de Comercialização de Alimentos para Lactentes e Crianças de Primeira Infância, Bicos, Chupetas e Mamadeiras*) acts to standardize the regulatory guidelines for products that interfere with the success of breastfeeding.[35]

HM losses, resulting from the volume collected minus the volume distributed, partly explain the delay in meeting premature babies' needs, due to the volume discarded in the selection stage due to non-conformities, but also during the pasteurization process.[21,28]

Furthermore, HMB can act to reorient donors and constantly train professionals, maximizing the use of donated HM, which is so important[33,36] for the recovery of newborns admitted to hospital and lower infant morbidity and mortality.[21,28]

The results showed the need to expand HMB and HMCS for better coverage and better understand which factors need to be reviewed and worked on for better performance and scope of the service offered.

These issues need to be analyzed and known by institution managers so that the impact of the lack of HM supply in NICUs is minimized, thus ensuring a better quality of life for premature babies provided by breastfeeding.[37]

Conclusion

HM supply by HMB and HMCS in SPMR was insufficient according to the total number of premature babies, estimated demand and actual volume distributed in NICUs. Only two regions of the city of São Paulo, Center and Southeast, had their needs met in 100%, with the East and North regions showing a need 10 and 6 times greater, respectively, both from RHCN 6. The study made it possible to identify a representation of the distribution parameters, consumption, need and demand for HM in the SPMR areas of HM of HMB and HMCS by RAAS according to prematurity, estimated HM consumption and actual consumption data. The scarcity and absence of HMB and HMCS in certain regions suggests greater planning for the expansion of these services or reorganization of coverage of existing HM distribution services, especially in the region with the highest concentration of HMB and HMCS in Brazil, such as São Paulo. Other factors determining HM insufficiency need to be better known and discussed to improve HM management in NICUs.

Collaborations

Silva AM, Mattar MJG, Coca KP, Abrão ACFV contributed to project design, data analysis and interpretation, article writing, relevant critical review of intellectual content and approval of the final version to be published.

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