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Original article

How do characteristics of donors and their children influence volume and composition of banked milk?

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Abstract

When own mother's milk is not available, donor human milk (DHM) is the first choice in preterm infant feeding. Although worldwide strong efforts have been made to implement human milk (HM) donation, there is currently little available research on donors characteristics and their influence on volume and composition of DHM.

The present study aimed to evaluate the relationship between social-demographic variables of donating mothers (age, residence, job, number of children), as well as gestational age and birth weight of their babies, and volume and composition of donated HM.

The analysis of data revealed a statistically significant impact of maternal age and profession, as well as babies' birth weight and donation duration, on the volume of milk donation, but no effect of donor's place of residence. Gestational age also had an effect on the volume of milk donation, but the effect was not statistically significant (p-value on the verge of significance).

Regarding milk composition, gestational age < 29 weeks, low birth weight and overall donation period were statistically correlated to higher protein content. Statistical analysis of other DHM components did not result significant except for carbohydrates, being their content inversely associated with birth weight, with p-value at the margin of significance.

Keywords

Human milk donors, volume donation, milk bank composition, preterm infant feeding.

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Introduction

Human milk (HM) is the gold standard in infant feeding, especially preterm ones, including those born extremely prematurely. The benefits of HM for preterm infants are well recognized and include better feeding tolerance [1-4], protective effect against necrotizing enterocolitis [5-9], lower incidence of sepsis [7, 8] and meningitis [3, 10, 11], shorter need of central catheter and, therefore, lower incidence of catheter infections, better pulmonary outcome [12].

Preterm infant feeding with HM, thus, should begin as early as possible and when own mother's milk is insufficient or unavailable, banked donor milk is the first choice [11-21].

The increasing awareness of role of donated breast milk has promoted the implementation of donor milk programs [21-27] as standard component of health care for premature infant [24].

Many studies have dealt with aspects of the function and the organization of HM banks (HMBs) [28, 29], as well as the use of donor HM [26, 30]. However, there is currently little available research on donors characterics [31-33] and their influence on volume [34, 35] and composition of DHM [32, 36, 37].

Moreover, whereas fetal growth status appears not to affect milk fat content [38], gestational age of infant, maternal age [39, 40] and nutrition status can determine dramatic differences in macronutrient and energy levels [41].

Milk expressed by mothers who deliver prematurely is well known to be higher in protein [42].

Breastfeeding rates among mothers 30 years and older are significantly higher than those of younger mothers [43].

Fat content of colostrum has proved to be much higher in older mothers and in lower gestational age at delivery [30].

Diet-controlled gestational diabetes and high post-pregnancy BMI levels impose statistically significant effect on milk's macronutrients and energy [44].

The present study, thus, aimed:

- to evaluate the relationship between different features of HM donors and their children and volume and composition of donor HM (DHM);
- to draw suggestions to improve management and outcomes of our HMB.

Methods

The HMB of the Hospital "Casa Sollievo della Sofferenza" (CSS) in San Giovanni Rotondo, Italy, is integrated into the Neonatology Service of the same hospital and provides preterm infants (< 1,500 grams at birth) admitted to Neonatal Intensive Care Unit (NICU) with DHM, under medical prescription.

Donor candidates are selected according to the following data: lifestyle, medical anamnesis, past transfusions or piercing and tattoos, drugs taking, as well as demographic data.

A dedicated shuttle service allows home collection and transportation to hospital.

Blood tests are performed to detect hepatitis B and C, HIV, HTLV I and II, CMV and syphilis.

Exclusion criteria are positive serology for the above-mentioned infections and any risk factor of exposition to a sexual or blood transmissible disease in the previous 6 months. Also, smokers, habitual alcohol consumers and women who usually take coffee in excess are excluded.

A HM analyzer using infrared spectroscopic method (MIRIS) evaluates macronutrients (proteins, lipids, carbohydrates) and energy value of milk.

The milk donation is allowed till the sixth month post-partum. There is no limit to the volume of DHM.

All data are routinely processed by HMB database.

Participants and procedures

The present study included 90 women, who were enrolled for donation by the HMB of the CSS Hospital from January 1st 2014 to December 31st 2015.

Donors' social demographic data, such as age, place of residence, job, title and previous pregnancies were studied. As for the infants, the information collected regarded gestational age and birth weight. All the procedures followed the ethical standards of the Ethical Committee of the CSS Hospital.

In order to properly evaluate the eventual effect of donors' place of residence, some mothers of preterm infants had been excluded from the assessment, since part of their donation was collected at hospital, while their children were recovered.

Statistics

Demographic and clinical donors' characteristics, as well as milk nutritional values, were reported as mean and standard deviation (or as median and range). Continuous variables were shown as frequencies, categorical variables as percentages.

Gestational age at birth was categorized into three groups: ≤ 29 weeks, 30-36 weeks, and > 36 weeks.

Infants' birth weight was categorized into four groups: ≤ 1,500 g, 1,501-2,500 g, 2,501-3,000 g, > 3,000 g.

According to the job, donors were divided into two big categories: one including housewives, workers and unemployed people, the other one including all the remaining professions.

Correlations among continuous variables were assessed using Spearman coefficients. Groups comparison were performed using Kruskal-Wallis or Mann-Whitney U test as appropriate. P-values < 0.05 were considered statistically significant. All analyses were performed using SAS® (Statistical Analysis Software, www.sas.com).

Results

The data resulting from our study are presented in **Tables 1-3**.

The median age of women was 32 years. 81% of donors were aged between 30 and 39 years, 12.7% of women were aged between 20 and 29, 5.8% were 40 or older and only 0.5% were under 20.

Among the donors, 56.7% (51/90) had more than one child and 43.3% (39/90) were primiparous, who nevertheless donated 55% of the total DHM volume.

11.1% (10/90) of donors had preterm infants; 4.4% was under 32 weeks of gestational age and 6.7% was between 32 and 36 weeks of gestational age.

The average duration of the donation was 3 months and 9 days.

The total DHM volume was 576.440 liters. The average milk delivered was 6.6 L, the median was 3.2 L (min 0.5 L, max 64.6 L).

About the professional status, 46.51% of donors were housewives, 13.95% teachers, 9.3% administrative employees, 9.3% self-employed, 6.98% workers, 3.49% unemployed and 2.33% students (**Tab. 1**).

Mothers working in health professions (doctors, nurses, physiotherapists, pharmacists, biologists) were more than 12% of the total (8.14% nurses) and their average milk donation was 9 L.

Only 14.94% of donors lived in San Giovanni Rotondo.

In summary, the analysis of data revealed a statistically significant effect of profession, maternal age, birth weight and duration of donation on the volume of donated HM (**Tab. 2**):

Table 1. Main characteristics of the study population.

Variable	Category	Mean %, SD
Gestational age	≤ 29 weeks	3.49
	30-36 weeks	5.81
	> 36 weeks	77.01
Maternal age	≤ 35 years	77.01
	> 35 years	22.99
Birth weight	≤ 1,500 g	5.75
	1,501-2,500 g	5.75
	2,501-3,000 g	14.94
	> 3,000 g	73.56
Job categories (1)	Housewives	46.51
	Teachers	13.95
	Self-employed	9.3
	Administrative employees	9.3
	Nurses	8.14
	Workers	6.98
	Unemployed	3.49
	Students	2.33
Job categories (2)	Group 1	56.32
	Group 2	43.68
Place of residence	SGR	14.94
	No SGR	85.06
Duration of the donation (months)	-	3.27 ± 1.85
DHM volume	-	6.95 ± 9.5
No. of children	1	45.98
	> 1	54.02

Group 1: housewives, workers, unemployed; group 2: self-employed, teachers, administrative employees, health professions; SGR: San Giovanni Rotondo; DHM: donor human milk.

- the volume of donation increased with increasing maternal age;
- birth weight was inversely related to volume of DHM (p-value < 0.05);
- the volume of donor milk was directly related to the duration of donation itself;
- including housewives, workers and unemployed people in one group and the other professional categories in another one, the volume donated by the former category (median 2.80 L, min 0.50 L and max 64.60 L) appeared to be lower than the volume donated by the latter category (median 5.55 L, min 1 L, max 48.20 L);
- the place of residence did not modify the amount of DHM.

Gestational age also had an effect on the volume of milk donation, but the effect was not statistically significant (p-value on the verge of significance).

Regarding milk composition data, the precious DHM produced by mothers who delivered < 36 weeks resulted to be higher in protein: plus 32% than "term" milk.

In particular, the correlation between gestational age < 29 weeks, birth weight, overall donation period and protein content of DHM was statistically significant (**Tab. 3**).

Statistical analysis of the other DHM components did not result significant except for carbohydrates, being their content inversely

Table 2. Relationship between variables of human milk (HM) donors and their children with the volume of HM delivered.

Variable	Category	DHM volume	p-value
Gestational age (1)	≤ 29 weeks	3.2 (3-6.30)	0.5769
	30-36 weeks	6.5 (2-10)	
	> 36 weeks	2.88 (0.50-64.60)	
Gestational age (2)	-	-	0.0573
Maternal age	-	-	**0.015**
Birth weight	-	-	**0.027**
Job categories	Group 1	2.80 (0.50-64.60)	**0.0169**
	Group 2	5.55 (1-48.20)	
Place of residence	No SGR	3.25 (0.50-64.60)	0.3838
	SGR	2.60 (1.10-48.20)	
Duration of the donation (months)	-	-	**0.0035**
No. of children	1	2.95 (1-64.6)	0.8084
	> 1	3.40 (0.50-20.80)	

DHM: donor human milk; group 1: housewives, workers, unemployed; group 2: self-employed, teachers, administrative employees, health professions; SGR: San Giovanni Rotondo.

Table 3. Relationship between variables of human milk (HM) donors and their children with the composition of HM delivered.

Variable	Category	Energy	p-value	Protein	p-value	Lipid	p-value	Carbohydrate	p-value
Gestational age	< 29 weeks	67 (65.8-67.3)	0.4613	1.7 (1.4-1.8)	**0.014**	4 (3.37-4)	0.4202	6.45 (6.45-6.69)	0.3443
Maternal age	-	-	0.5995	-	0.3789	-	0.9028	-	0.8323
Birth weight	-	-	0.5944	-	**0.047**	-	0.6093	-	0.0747
Job category	Group 1	61.75 (41-89)	0.4907	1.2 (0.65-2.20)	0.2811	3.41 (1.6-6.9)	0.2935	5.95 (4-8.65)	0.6873
	Group 2	58.75 (35.2-87.7)		1.1 (0.7-1.8)		3.11 (1.56-6.35)		6.06 (82.8-7.10)	
Place of residence	SGR	60.6 (48-74.73)	0.6891	1.2 (0.8-1.8)	0.6279	3.46 (2.4-5.25)	0.5153	5.9 (4.4-7.10)	0.5961
	No SGR	60.6 (35.2-89)		1.15 (0.65-2.2)		3.3 (1.56-6.9)		6.1 (2.8-8.65)	
No. of children	1	62 (41-89)	0.6969	1.2 (0.65-2.10)	0.888	3.3 (1.6-6.50)	0.6827	6.1 (2.8-8.65)	0.6549
	> 1	60 (35.2-87.7)		1.15 (0.77-2.20)		3.4 (1.56-6.9)		5.9 (4.58-7.3)	
DHM volume	-	-	0.7577	-	0.0933	-	0.8084	-	0.155
Duration of donation	-	-	0.9386	-	**0.0017**	-	0.93	-	0.2833

DHM: donor human milk; group 1: housewives, workers, unemployed; group 2: self-employed, teachers, administrative employees, health professions; SGR: San Giovanni Rotondo.

correlated to birth weight, with p-value at the margin of significance (p = 0.0747).

Discussion

Over the last few years the interest in preterm infant feeding has considerably increased. Specifically, mother's own fresh expressed milk has been considered to be the best nutrition [15, 16], followed by DHM as second choice [17-20]. The number of HMBs is increasing worldwide, though it is still far from fully satisfying the needs of the newborns and children who could benefit from it.

There are currently 34 HMBs in Italy. The HMB of the CSS Hospital was established in 2010 and has been collecting more than 2,000 liters of DHM.

In order to improve the performance of our HMB, we have decided to evaluate both the quantitative (volume) and qualitative (composition) aspects of our DHM related to the characteristics of donors. The achieved results, in our opinion, offer an interesting opportunity for reflection and in-depth analysis.

An overall overview of data showed that, although multiparous women, probably because of their better organizational skills, were more numerous than primiparous ones, the total volume donated by primiparous women was in percentage higher.

In our study the median volume of DHM was 3.2 L (range 0.5-64 L). It's a result very close to a previous study [33], although lower than another similar research [42].

Attitude to donation seemed to be associated to maternal age (81% of donors aged between 30 and 39 years). The higher rate can be explained by older mothers' better knowledge and understanding of the importance of breast milk feeding, both for their own children and the newborns who cannot use their mother's milk, but it reflects the general age increase of motherhood, as well.

Among professional categories, self-employed mothers donated the biggest volume of DHM. Donors working in health-care provision showed significant donation rate and confirm that knowledge and awareness of donation considerably affect the outcome of donation itself. Mothers of premature babies enrolled in our study contributed for a small part of total volume of donations. However, considering the whole number of preterm births in the covered period, the percentage of donor mothers in this category appeared high, indeed. Furthermore, an inverse relationship between gestational age and donated volume resulted statistically significant.

The present study confirms recent data [45, 46] that prove a general increase in breast milk feeding rates within the very group of women historically less ready for breastfeeding, such as mothers of preterm infants with a very low birth weight (VLBW). Moreover, promotion and support of breastfeeding among mothers of VLBW infants, even when clinical conditions are critical, have been proven not only to produce no additional risk of maternal stress, but to contribute to make them feel part of the care of their own children, as well [36, 47-49].

In our NICU, mothers of hospitalized babies can stay the whole day (24/24 h) in a room adjacent to the NICU itself. They support each others, share feelings and emotions and can better control mother-child separation anxiety stress [50].

The place of residence did not modify the volume donated, confirming the usefulness and effectiveness of our home-collection system. In fact, less than 15% of donors lived in San Giovanni Rotondo. This low percentage demonstrates how large our birth facility's outreach area is; furthermore, it emphasizes the importance of raising awareness of milk donation among local people, particularly among less-favoured social classes.

Conclusion

Data and correlations that emerged from our study are a good starting point for appraising our past achievements and can inspire and stimulate measures aimed at improving the performances of our HMB, i.e. volume and duration of donations.

These features must not be a prejudice to donation:

- advanced maternal age;
- low birth weight or premature birth, especially at gestational age < 29 weeks, when the protein content of HM is higher;
- primipara status.

Finally, our results confirm that the proper availability of DHM is related to the application of best practices for HM feeding of premature infants in a NICU: encouragement for mothers to initiate lactation; establishment and maintenance of maternal milk volume; support for mothers,

families and staff; management of HM feeding problems.

Declaration of interest

The Authors declare that there is no conflict of interest.

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