ORIGINAL PAPER

J Health Inequal 2023; 9 (1): 58–64

Submitted: 07.09.2022; accepted: 12.03.2023

DOI: https://doi.org/10.5114/jhi.2023.126908

JOURNAL of Health Inequalities

Composition of human milk in women with the risk of postpartum depression symptoms

Agnieszka Dombrowska-Pali[1,2], Agnieszka Chrustek[3], Grażyna Gebuza[1], Marzena Kaźmierczak[1]

[1]Department of Perinatology, Gynecology and Gynecologic Oncology, Faculty of Health Sciences, Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Torun, Poland
[2]Department of Obstetrics and Gynecology, Multi-Specialist Hospital of Dr Ludwik Błażek in Inowrocław, Poland
[3]Department of Pathobiochemistry and Clinical Chemistry, Faculty of Pharmacy, Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Torun, Poland

ABSTRACT

Introduction: Breast milk is seen not only as a nutritional substance, but also as a functional food. It contains many bioactive ingredients, including bacteria that are transferred, among other things, from the mother's intestines to the child during breastfeeding. It is known that maternal postpartum psychiatric disorders can alter her intestine's microbiota, which in turn can affect the bacteria present in the milk. However, it is not known whether postpartum mental disorders in women differentiate the nutritional composition and energy value of breast milk. Therefore, the aim of the study was to assess the content of total protein, fats, carbohydrates, dry matter and energy value of milk of women at risk of postpartum depression symptoms four weeks after delivery.

Material and methods: The research was carried out in the fourth week after delivery. Seventy five women participated. The Edinburgh Postnatal Depression Scale (EPDS) research tool was used in the study. The analysis of the human milk composition was performed with the Miris HMA.

Results: The prevalence of the risk of PPD symptoms in the study sample was estimated at 28% on the EPDS. It was not found that the risk of PPD symptoms differentiate the nutritional composition and calorie content of human milk ($p > 0.05$).

Conclusions: Human milk is a perfectly selected and well-balanced food for a baby, regardless of the presence or absence of the risk of postpartum depression symptoms in the study sample.

KEY WORDS: postpartum depression, breastfeeding, human milk.

ADDRESS FOR CORRESPONDENCE: Dr. Agnieszka Dombrowska-Pali, Department of Perinatology, Gynecology and Gynecologic Oncology, Faculty of Health Sciences, Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Torun, Poland, e-mail: agnieszka.pali@cm.umk.pl

INTRODUCTION

Recent studies reveal a relationship between the risk of postpartum depression (PPD) symptoms and early termination of breastfeeding or not attempting to feed human milk. Scientists believe that women with postpartum depression have low self-esteem and thus experience low effectiveness in breastfeeding [1]. Some women diagnosed with postpartum depression give up breastfeeding because of the medications they take. However, it should be emphasized that there are antidepressants which, after determining the optimal dose, guarantee the correct treatment of mental disorders during breastfeeding [2, 3].

It is also important that few studies have assessed the relationship between the risk of postpartum depression symptoms and the composition of breast milk. Previous studies have focused on postnatal mental health disorders involving hormones and immune factors in milk as a physiological response to stress [4, 5]. However, the relationship between the risk of PPD symptoms and the nutritional composition and value of breast milk is not well understood. Therefore, the research attempted to establish

a relationship between the presence of risk of postpartum depression symptoms and the nutritional composition of human milk in the study sample. The amount of total protein, fats, carbohydrates, dry matter and energy content of milk in women at risk of postpartum depression symptoms four weeks after delivery was analysed.

MATERIAL AND METHODS

RECRUITING STUDY PARTICIPANTS AND RESEARCH PROCEDURES

Initially 165 puerperae were included in the study. However, 75 puerperae were finally included in the study, which was carried out in the fourth week after delivery. Ninety puerperae were excluded from participating in the research project due to lactation suppression and feeding the baby modified milk. The selection of study participants was purposeful. Participation in the research project was voluntary. The participants gave written informed consent. The study inclusion criteria included: 1) breastfeeding or feeding the child expressed human milk using a bottle/tube; 2) good, logical verbal contact with the participant of the study; 3) no history of depression or no anxiety or anti-depressive therapy over the last year; 4) physical and mental condition allowing the participants to express milk on their own and complete a questionnaire. The study was conducted after having obtained a positive opinion of the Bioethics Committee of the Nicolaus Copernicus University in Toruń – no. 121/2019 (Poland).

The research project was conducted from April 13, 2019 to January 20, 2020. Four weeks after delivery, the patients completed a 10-item questionnaire of the Edinburgh Postnatal Depression Scale (EPDS) by Cox *et al.* [6] to assess their mental state. Each participant of the study chose one of the four possible answers that best described her well-being. Zero to 3 points could be obtained for each answer. The maximum number of points that could be obtained was 30. The most common cut-off point in the conducted studies was 12-13 points [7, 8]. According to the authors of the EPDS, this value indicates the "probability" of depressive disorders of various severity levels [6]. The respondents who were at risk of mood disorders (EPDS score of 12 or item 10) were informed that they needed to see a psychologist or a psychiatrist for the further diagnosis of perinatal mental disorders. According to the criteria specified in DSM-V, postpartum depression is diagnosed when the first depressive episodes occur within four weeks after delivery [9]. EPDS is the most popular tool to assess the mood of puerperae [10]. It is characterized by good psychometric properties (test sensitivity 86%, prognostic accuracy 73%, specificity 78%, Cronbach's alpha reliability coefficient (α) 0.88 [6].

HUMAN MILK ANALYSIS

The analysis of human milk composition and the energy content was performed by means of the Miris Human Milk Analyzer (HMA) at the Human Milk Bank in Toruń. The device assessed the calorie content of human milk (kcal/100 ml) and the amount of total protein (g/100 ml), fat (g/100 ml), carbohydrates (g/100 ml) and dry matter (g/100 ml) in human milk. The milk (10 ml) was collected from four time intervals during one day (6 a.m. – 12 p.m., 12 p.m. – 6 p.m., 6 p.m. – 12 a.m. and 12 a.m. – 6 a.m.), collecting milk at the beginning (5 ml) and at the end of feeding (5 ml). In order to ensure overall quality of the sample, the milk, after having been collected, was frozen and stored at –20°C until the analysis for no longer than 6 months. Prior to the start of the analysis of milk composition, the consistency of each sample was checked, including the temperature of milk storage, signs of any damage to the container with the milk sample or whether the container had been unsealed. The process of milk thawing for the analysis was slow – the milk was left overnight in the refrigerator (4°C). The energy content of human milk and its composition were measured according to the procedure of the manufacturer of Miris HMA (Sweden). The accuracy (< 0.1%) and repeatability (< 0.05%) of the Miris HMA device make it compatible with other technologies [11].

STATISTICAL ANALYSIS

Statistical analysis was carried out using the PQStat package, 1.8.0.338 version. The results of milk composition depending on the group in terms of EPDS were compared by means of Student's *t*-test (if the distributions did not differ significantly from the theoretical normal distribution) or the Mann-Whitney *U* test (if the distributions differed significantly from the theoretical normal distribution). The test probability at the level of $p < 0.05$ was considered significant.

RESULTS

DEMOGRAPHIC AND CLINICAL CHARACTERISTICS OF THE STUDY SAMPLE

The mean age of the study sample of women was 31 years (30.99 ± 5.24 years). The youngest participant was 20 years old and the oldest one was 46 years old. The majority of the 75 respondents had higher education (57.33%) and secondary education (30.67%). Only one woman (1.33%) reported having only primary education. Women with vocational (8%) and lower secondary school education (2.67%) were in the minority. The vast majority of the respondents (69.33%) lived in the city; only one in three (30.67%) lived in the countryside. Almost 99% of the patients were in a relationship on the day of the study. They were usually married (65.33%). One third of all respondents stated that they were cohabiting. Only one patient was single (1.33%). The entire sample ($n = 75$) described their socioeconomic conditions as "good". Almost three quarters of the respondents worked. Every fourth patient (28%) was unemployed. The vast majority of the surveyed women were multiparous (60%), while 40% of the participants gave birth for

the first time. All patients gave birth to a single baby. Only one third of the surveyed women (33.33%) gave birth on their due date. 50 women (66.66%) who took part in the study had a preterm labour; mothers of late preterm babies (33-36 weeks of pregnancy) constituted half of this group (33.33%). The remaining 33.33% of women gave birth before 32 weeks of pregnancy. A slight majority of women (50.67%) gave birth via caesarean section, while 38 patients had a natural birth (49.33%).

ASSESSMENT OF THE RISK OF POSTPARTUM DEPRESSION SYMPTOMS IN THE STUDY SAMPLE ACCORDING TO EPDS

Depression was an independent variable in the research project. The authors of the study set the score of 12 points or more obtained by puerperae as a cut-off point on the EPDS. The result was set as an indicator of the risk of postpartum depression symptoms. In the sample of 75 women, four weeks after the labour, a score of ≥ 12 points on the EPDS was obtained by 28% of the women (n = 21). No risk of postpartum depression symptoms was estimated at 72% (n = 54). The minimum score that the study sample obtained on the EPDS was 0, and the maximum was 25. The mean value was 7.57, with Me 5 and SD 5.72.

ANALYSIS OF HUMAN MILK COMPOSITION IN TERMS OF THE RISK OF POSTPARTUM DEPRESSION SYMPTOMS IN THE STUDY SAMPLE

The study attempts to determine whether there is a relationship between the presence of risk of postpartum depression symptoms and the nutritional composition of human milk in the study sample. For this purpose, the score value on the EPDS (≥ 12 points) was set as the indicator of the occurrence of risk of postpartum depression symptoms. The study sample was divided into two groups: women with the risk of postpartum depression symptoms (n = 21) and without the risk of postpartum depression symptoms (n = 54). The mean value of nutrients, median and standard deviation were calculated for each group (Tables 1-4). Our study showed that the amount of total protein in human milk in the study

TABLE 1. Comparison of total protein content in human milk (g/100 ml) in terms of the risk of postpartum depression symptoms in the study sample

Total protein content in human milk		Women without the risk of postpartum depression symptoms (n = 54)	Women with the risk of postpartum depression symptoms (n = 21)
Arithmetic mean		1.6	1.67
Median		1.6	1.5
Standard deviation		0.25	0.78
Minimum		1.2	1.1
Maximum		2.4	5
Lower quartile		1.4	1.4
Upper quartile		1.7	1.6
Mann-Whitney *U* test	*Z*	0.96	
	p	0.34	

TABLE 2. Comparison of fat content in human milk [g/100 ml] in terms of the risk of postpartum depression symptoms in the study sample

Fat content in human milk		Women without the risk of postpartum depression symptoms (n = 54)	Women with the risk of postpartum depression symptoms (n = 21)
Arithmetic mean		3.68	3.44
Median		3.7	3.5
Standard deviation		0.93	1.18
Minimum		2	1.3
Maximum		6.2	6.2
Lower quartile		2.93	2.8
Upper quartile		4.28	4
Brown-Forsythe test	*F*	0.66	
	p	0.42	
Student's *t*-test	*t*	0.93	
	df	73	
	p	0.36	

TABLE 3. Comparison of carbohydrate content in human milk [g/100 ml] in terms of the risk of postpartum depression symptoms in the study sample

Carbohydrate content in human milk		Women without the risk of postpartum depression symptoms (n = 54)	Women with the risk of postpartum depression symptoms (n = 21)
Arithmetic mean		7.89	7.56
Median		7.9	7.9
Standard deviation		0.52	1.32
Minimum		6.2	3.3
Maximum		8.8	8.4
Lower quartile		7.5	7.5
Upper quartile		8.3	8.3
Mann-Whitney *U* test	*Z*	0.14	
	p	0.89	

TABLE 4. Comparison of dry matter content in human milk [g/100 ml] in terms of the risk of postpartum depression symptoms in the study sample

Dry matter content in human milk		Women without the risk of postpartum depression symptoms (n = 54)	Women with the risk of postpartum depression symptoms (n = 21)
Arithmetic mean		13.35	12.99
Median		13.3	13
Standard deviation		1.13	1.9
Minimum		10.7	6.9
Maximum		16.8	16.7
Lower quartile		12.5	12.7
Upper quartile		13.98	14.1
Mann-Whitney *U* test	*Z*	0.19	
	p	0.85	

sample without the risk of PPD symptoms was 1.6 g/100 ml, whereas in the study sample with the risk of PPD symptoms it was 1.67 g/100 ml. The amount of fat in human milk of the study sample without the risk of PPD symptoms was higher (3.68 g/100 ml) than the amount of fat in human milk of the study sample with the risk of PPD symptoms (3.44 g/100 ml). Nevertheless, no significant correlation was found ($p > 0.05$). No significant correlation between the amount of carbohydrates in human milk and the risk of PPD symptoms was demonstrated in the studied material either. The average amount of carbohydrates in human milk of the study sample without the risk of PPD symptoms was 7.89 g/100 ml, and in the sample with the risk of PPD symptoms it was 7.56 g/100 ml. The amount of dry matter of the study sample without the risk of PPD symptoms was higher (13.35 g/100 ml) in comparison with the study sample with the risk of PPD symptoms (13.0 g/100 ml).

ANALYSIS OF THE ENERGY CONTENT IN HUMAN MILK IN TERMS OF THE RISK OF POSTPARTUM DEPRESSION SYMPTOMS IN THE STUDY SAMPLE

In the conducted research, an attempt was made to determine whether there is a relationship between the calorie content of human milk and the presence of risk of postpartum depression symptoms (Table 5). It should be noted that the samples of the analysed human milk from the conducted daily milk collection come from the fourth week after giving birth. At the time, we are talking about mature milk, the energy content of which is about 75 kcal/100 ml [12, 13]. In our study the energy content of human milk in the study sample with the risk and without the risk of PPD symptoms is comparable (73.43 kcal/100 ml and 74.13 kcal/100 ml, respectively) to the energy content of human milk reported in the literature.

DISCUSSION

In the study it was not found that the risk of PPD symptoms differentiate the nutritional composition and calorie content of human milk. However, given that human milk provides not only energy and nutrients, but also bioactive factors that are crucial to the infant's growth and development, research into human milk composition should be continued in order to identify factors that may be related to changes in its composition. All the research carried out on the composition of human milk can contribute to the optimal growth, development and health of infants. It should also be noted that PPD

TABLE 5. Comparison of calorie content of human milk [kcal/100 ml] in terms of the risk of postpartum depression symptoms in the study sample

Calorie content of human milk		Women without the risk of postpartum depression symptoms (n = 54)	Women with the risk of postpartum depression symptoms (n = 21)
Arithmetic mean		74.13	73.43
Median		74	73
Standard deviation		9.09	11.69
Minimum		55	50
Maximum		100	99
Lower quartile		67.25	69
Upper quartile		79	80
Brown-Forsythe test	*F*	1.11	
	p	0.3	
Student's *t*-test	*t*	0.28	
	df	73	
	p	0.78	

is the most common disorder that occurs during pregnancy and after childbirth. It leads to long-term negative effects for infants as well as their mothers and fathers. The data before the COVID-19 pandemic show that 1 in 5 women will develop psychiatric disorders in the perinatal period [14-16]. On the other hand, the limited data that have been published so far show that an increase in mental disorders in pregnant and postpartum women has been observed since the beginning of the COVID-19 pandemic [17, 18].

Despite abundant research on postpartum depression and breastfeeding, no studies on the relationship between the nutritional composition and energy value of human milk and the risk of PPD symptoms have yet been published.

The study by Keim *et al.* seems to be interesting; in it, the relationship between the risk of depression symptoms during pregnancy and the concentration of long-chain polyunsaturated fatty acids (LC-PUFA) in human milk is analysed. Two hundred eighty-seven women participated in the study. The CES-D (Center for Epidemiologic Studies Depression Scale) was used to assess the risk of depression symptoms during pregnancy (below 20 weeks of pregnancy and between 24 and 29 weeks of pregnancy). In order to determine the level of long-chain polyunsaturated fatty acids, samples of human milk were collected four months after delivery. The authors of the study emphasized the significant role of fatty acids (LC-PUFA), especially docosahexaenoic acid (DHA), in maintaining positive mental health in women. The results of the study indicate that the risk of depression symptoms below 20 weeks of pregnancy was associated with a lower concentration of DHA. However, no correlation between the risk of depression symptoms below 20 weeks of pregnancy and the concentration of other fatty acids was observed. There was also no relationship between the risk of depression symptoms diagnosed from 24 to 29 weeks of pregnancy and the level of LC-PUFAs [19]. On the other hand, Hibbeln found that higher DHA concentration in human milk (r = –0,84, $p < 0.0001$) predicted a lower prevalence rate of postpartum depression symptoms, based on reports from 23 countries (n = 14,532 patients). However, no relationship was found between the level of eicosapentaenoic acid and arachidonic acid concentration in human milk and the risk of PPD symptoms [20]. Further research results showed that the composition of microorganisms in breast milk may be variable due to stress, anxiety or depressive symptoms experienced by women in the postpartum period. Changes in the composition of microorganisms in breast milk can occur both directly and indirectly. The direct route is related to the transfer of abnormal maternal gastrointestinal flora to the milk ducts via the entero-mammary barrier [21, 22]. Studies conducted on both animals and humans, including pregnant women, indicate that the experience of stress and psychiatric disorders is associated with an altered intestinal microbiome [23, 26]. This affects the microbiological composition of breast milk, which can be altered by transferring the altered intestinal microflora into breast milk. The intermediate barrier is related to the effect of maternal psychosocial stress on the nutrient content of breast milk, which may possibly affect the bacterial composition of the milk. A clinical study conducted by Keith *et al.* showed that maternal mood has an influence on changes in the fat content of milk [27]. In turn, changes in fatty acids are associated with changes in the microbial composition of milk, which is confirmed by the results of the study by Kumar *et al.* – higher levels of fatty acids can increase the pH of milk and, as a result, change the composition of milk bacteria [28].

Scientific reports indicated that the occurrence of depressive disorders reduces milk production [29]. In our study, despite the high prevalence rate of postpartum depression symptoms, every woman who participated in the study provided a sufficient amount of milk for her baby to meet its needs.

This study provides a comprehensive assessment of the nutritional and energy composition of human milk. To our knowledge, this is one of the few studies that has focused on the relationship between postpartum depression and the nutrient levels and energy content of human milk. The milk sampling procedure was carefully planned and conducted to minimize errors resulting from physiological factors and, consequently, influencing the composition of human milk. An additional advantage of this study is the advanced techniques to test human milk in accordance with the recommended protocol, which allowed us to minimize possible errors in the composition of human milk. There are also some limitations of this study. First of all, the study was conducted among a small number of participants, so further large-scale studies in diverse populations are warranted. Secondly, the study did not take into account the maternal and infant factors that interact with and affect human milk composition.

CONCLUSIONS

The conducted research showed that human milk was optimal food for a baby, regardless of the risk of postpartum depression symptoms in a mother. The results of the study confirm the great value of human milk and the sense of feeding it to babies of women who suffer from the risk of postpartum depression symptoms. Women with a risk of PPD symptoms should not be concerned about poor composition and energy content of milk, since the conducted research shows that human milk is perfectly selected and well-balanced food for a baby, regardless of the occurrence or absence of the risk of postpartum depression symptoms. Therefore, it is crucial to inform women about this fact and encourage them to feed their babies natural food.

ACKNOWLEDGEMENTS

The authors thank the patients for participating in the study.

DISCLOSURE

The authors report no conflict of interest.

References

1. Silva CS, Lima MC, Sequeira-de-Andrade LAS, et al. Association between postpartum depression and the practice of exclusive breastfeeding in the first three months of life. J Pediatr (Rio J) 2017; 93(4): 356-364.
2. Payne JL. Psychopharmacology in pregnancy and breastfeeding. Med Clin North Am 2019; 103(4): 629-650.
3. Romaine E, McAllister-Williams RH. Guidelines on prescribing psychotropic medication during the perinatal period. Br J Hosp Med 2019; 80(1): 27-32.
4. Fallon V, Groves R, Halford JCG, et al. Postpartum anxiety and infant-feeding outcomes: a systematic review. J Hum Lact 2016; 32(4): 740-758.
5. Di Benedetto MG, Bottanelli C, Cattaneo A, et al. Nutritional and immunological factors in breast milk: a role in the intergenerational transmission from maternal psychopathology to child development. Brain Behav Immun 2020; 85: 57-68.
6. Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. Br J Psychiatry 1987; 150: 782-786.
7. Moraes GP, Lorenzo L, Pontes GA, et al. Screening and diagnosing postpartum depression: when and how? Trends Psychiatry Psychother 2017; 39(1): 54-61.
8. Kaźmierczak M, Gebuza G, Gierszewska M, et al. Screening for detection of the risk of perinatal mental disorders among women in Poland. Issues Ment Health Nurs 2020; 41(5): 438-444.
9. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Diorders, 5th Edition (DSM-5). Arlington, VA, American Psychiatric Association, 2013; 162-280. Available from: http://repository.poltekkes-kaltim.ac.id/657/1/Diagnostic%20and%20statistical%20manual%20of%20mental%20disorders%20_%20DSM-5%20(%20PDFDrive.com%20).pdf (accessed: 20 September 2022).
10. Smith-Nielsen J, Matthey S, Lange T, et al. Validation of the Edinburgh Postnatal Depression Scale against both DSM-5 and ICD-10 diagnostic criteria for depression. BMC Psychiatry 2018; 18(393): 1-12.
11. Miller E, Aiello M, Fujita M, et al. Field and laboratory methods in human milk research. Am J Hum Biol 2013; 25(1): 1-11.
12. Banaszkiewicz A. Pokarm kobiecy – skład i funkcja. W: Karmienie piersią w teorii i praktyce. Podręcznik dla doradców i konsultantów laktacyjnych oraz położnych, pielęgniarek i lekarzy [Breast milk – composition and function. In: Breastfeeding in theory and practice. Handbook for lactation advisors and consultants and midwives, nurses and doctors]. Nehring-Gugulska M, Żukowska-Rubik M, Pietkiewicz A. Wydawnictwo Medycyna Praktyczna, Kraków 2017; 51-57.
13. Hale TW, Hartmann PE. Textbook of human lactation. Hale Publishing, Amarillo, Texas, 2007.
14. Hahn-Holbrook J, Cornwell-Hinrichs T, Anaya I. Economic and health predictors of national postpartum depression prevalence: a systematic review, meta-analysis, and meta-regression of 291 studies from 56 countries. Front Psychiatry 2018; 8: 248.
15. Shorey S, Chee CYI, Ng ED, et al. Prevalence and incidence of postpartum depression among healthy mothers: a systematic review and meta-analysis. J Psychiatr Res 2018; 104: 235-248.
16. Fawcett EJ, Fairbrother N, Cox ML, et al. The prevalence of anxiety disorders during pregnancy and the postpartum period. J Clin Psychiatry 2019; 80(4): 18r12527.

17. Wu Y, Zhang C, Liu H, et al. Perinatal depressive and anxiety symptoms of pregnant women along with COVID-19 outbreak in China. Am J Obstet Gynecol 2020; 223(2): 240.e1-240.e9.
18. Durankuş F, Aksu E. Effects of the COVID-19 pandemic on anxiety and depressive symptoms in pregnant women: a preliminary study. J Matern Neonatal Med 2020; 35(2): 205-211.
19. Keim SA, Daniels JL, Siega-Riz AM, et al. Depressive symptoms during pregnancy and the concentration of fatty acids in breast milk. J Hum Lact 2012; 28(2): 189-195.
20. Hibbeln JR. Seafood consumption, the DHA content of mothers' milk and prevalence rates of postpartum depression: a cross-national, ecological analysis. J Affect Disord 2002; 1(3): 15-29.
21. Rodríguez JM. The origin of human milk bacteria: is there a bacterial entero-mammary pathway during late pregnancy and lactation? Adv Nutr 2014; 5(6): 779-784.
22. de Andrés J, Jiménez E, Chico-Calero I, et al. Physiological translocation of lactic acid bacteria during pregnancy contributes to the composition of the milk microbiota in mice. Nutrients 2017; 10(1): 14.
23. Knowles SR, Nelson EA, Palombo EA. Investigating the role of perceived stress on bacterial flora activity and salivary cortisol secretion: a possible mechanism underlying susceptibility to illness. Biol Psychol 2008; 77(2): 132-137.
24. Cerdá B, Pérez M, Pérez-Santiago JD, et al. Gut microbiota modification: another piece in the puzzle of the benefits of physical exercise in health?. Front Physiol 2016; 7: 51.
25. Borgo F, Riva A, Benetti A, et al. Microbiota in anorexia nervosa: the triangle between bacterial species, metabolites and psychological tests. PLoS One 2017; 12(6): e0179739.
26. Hechler C, Borewicz K, Beijers R, et al. Association between psychosocial stress and fecal microbiota in pregnant women. Sci Rep 2019; 9(1): 4463.
27. Keith DR, Weaver BS, Vogel RL. The effect of music-based listening interventions on the volume, fat content, and caloric content of breast milk-produced by mothers of premature and critically ill infants. Adv Neonatal Care 2012; 12(2): 112-119.
28. Kumar H, du Toit E, Kulkarni A, et al. Distinct patterns in human milk microbiota and fatty acid profiles across specific geographic locations. Front Microbiol 2016; 7: 1619.
29. Lau C, Hurst NM, Smith EO, Schanler RJ. Ethnic/racial diversity, maternal stress, lactation and very low birth weight infants. J Perinatol 2007; 27(7): 399-408.

AUTHORS' CONTRIBUTIONS

ADP took part in preparing the concept of the article; ADP, AC collected data; ADP, AC, GG analysed data; ADP, AC, GG wrote the article; ADP, GG, MK critically revised and finally approved it.

.