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RESEARCH ARTICLE

Impact of Maternal Nutrient Consumption on Human Milk Macro Nutrient Composition: A Cross-Sectional Study

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ABSTRACT

Objective: To increase the production of human milk, mothers must have an adequate, balanced, and healthy diet. This study investigated the effect of maternal food consumption on the macronutrient composition of breast milk.

Methods: This cross-sectional descriptive study included 46 mothers. Food consumption and breast milk content of mothers were analysed on postnatal days 1, 5, and 15. Macro and micronutrient values consumed by the mothers were evaluated using the BeBis programme. Breast milk was analysed with Miris HMATM device.

Results: In repeated measurements until mature milk was secreted (days 1st, 5th and 15th), the amount of carbohydrates and fat in breast milk gradually increased, whereas the amount of protein decreased. A significant negative correlation was observed between the amount of carbohydrates and energy consumed by mothers on the 5th day and the amount of breast milk proteins. There was a significant positive correlation between the amount of carbohydrates in the mothers' food consumption on the 15th day and the amount of carbohydrates in their breast milk.

Conclusions: The effect of nutrient consumption of the mothers in the study group in the last 24 h on the macronutrient levels of breast milk was evaluated. It was observed that maternal food consumption affected the macronutrient composition of breast milk during the three follow-ups. In repeated measurements, the nutrients consumed by the mothers affected the breast milk (transitional milk, and mature milk) content.

Keywords: Nutritional Consumption, Human Milk, Macronutrient, Composition

INTRODUCTION

With human milk, the most natural food for infants, all the nutrients needed by infants in the first months of life are met, almost half of them are met in the following six months, and nearly one-third of them are met until the age of two years (1). It is known that human milk differs in terms of its macro and micronutrient content; each mother's human milk is unique to her infant, and its content changes according to the infant's needs (2,3).

Changes in the content, structure, and amount of human milk, especially in the first two weeks after birth. The amount of colostrum secreted within the first 5 days after birth is less than that of mature milk, but it differs in terms of its richness in immunological compounds and proteins (4-7). Human milk contains many bioactive compounds and micronutrients (vitamins, minerals, and trace elements) necessary for infant growth and development (2,3). The composition and amount of human milk are affected by factors such as the lactation period, maternal nutrition, and genetic characteristics, duration and frequency of human feeding, the time between two human feeding sessions, human feeding technique, and the gestational and postnatal age of the infant (8-11).

A mother should have an adequate, balanced, and healthy diet to increase milk production (12,13). The nutrients that mothers consume change human milk production and composition (13,14).Nutritional patterns of mothers during the postpartum period vary in different geographies and countries. Furthermore, the socioeconomic status variable also showed differences in increasing the consumption of basic nutrients, especially during the postpartum period. Purchasing power and cultural differences can cause changes in the most consumed

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foods. Some studies have indicated that the nutritional content of human milk is affected by many factors (2-5,10-12). There are only a few studies in the literature that investigated the impact of maternal nutritional status on human milk content. The aim of this study was to examine the impact of maternal nutritional status on the content of human milk.

MATERIAL AND METHODS

Study Design

This cross-sectional descriptive study was conducted in the neonatal unit of a university hospital in Istanbul. This study aimed to examine the relationship between newborn characteristics and human milk nutritional content. The STROBE Statement was used in the design, planning, implementation, and reporting of the cross-sectional, descriptive study.

Sample size and inclusion criteria

The study population consisted of mothers who gave birth in the hospital where the data were collected, and the sample consisted of 46 mothers who met the selection criteria. The minimum sample size required for the study was calculated via power analysis. In this context, the required minimum sample size was found to be 34 under the assumption of a 5% first-type error margin, one-to-one group distribution rate, 80% study power, and therefore a 20% second-type error, and an effect size of 0.50 according to a double-sided hypothesis and Cohen's standard effect sizes. To increase the study power, it was planned to include 50 mothers in the sample. When the data collection process was terminated, four mothers were excluded from the sample because there were missing data, and 46 mothers comprised the study sample.

Sample selection criteria

a) Singleton pregnancy b) the infant's gestational age is >35 weeks

Exclusion criteria

b) The presence of a congenital anomaly in the newborn that will prevent the infant's sucking (cleft palate, cleft lip, etc.) b) the presence of a disease in the mother that may affect human milk content (diabetes, hypertension, hypothyroidism, etc.) c) The presence of an infectious disease in the mother, such as HIV, hepatitis B, hepatitis C, etc., known to be transmitted through human milk d) the mother's not coming to the 5th-day and 15th-day postpartum controls.

Data collection tools

The data were obtained using a data collection form (including socio-demographic and obstetric characteristics of mothers and infants, nutritional habits of the mother) prepared by the researchers as a result of the literature review (14,15). The mothers were asked to record the nutrients they consumed in the last 24 h on the day they came for control. The BeBis programme (16) was used to calculate the mothers' nutritional consumption. Human milk content was analysed using a Miris HMATM device. Human milk samples for analysis were obtained using the hand-express method. Samples were taken as foremilk before the human feeding session.

BeBis Programme: The programme analyzes macro and micronutrients when the nutritional consumption during the day and their amounts are entered into the programme. A researcher entered the nutrients into the BeBis programme.

Miris HMATM (Uppsala, Sweden): The energy and macronutrients (protein, fat, and carbohydrate) in human milk were analysed using the Miris HMATM device. The Miris HMATM device was certified by the International Organisation for Standardisation (ISO 9622: 1999). The Miris HMATM analyzes 2 mL of human milk in approximately 2 min. Milk was taken from the mother's wand into a syringe and analysed using the Miris HMATM device. The Miris HMATM device calibration and cleaning were performed as recommended by the researcher on the day of data collection.

Intervention and data collection

Mothers who gave vaginal birth and their infants are discharged after 24 h if there are no health problems, and those born by caesarean section are discharged after 48 h. The initial control of newborns after discharge is performed within 72 h, according to the requirements. A researcher filled out the data collection form by conducting face-to-face interviews with the mothers.

Mothers who met the selection criteria were included in the study. 2 ml milk samples were collected from the right human at least 2 h after human feeding within the first 24 h after delivery, on the 5^{th} and 15^{th} days after delivery, analysed with Miris HTAM. Macronutrient content values were obtained approximately 3 min after the human milk sample was placed into the analyser. The mothers recorded the nutrients and amounts consumed within 24 h and brought the records with them when arriving at control.

Data analysis

The data obtained from the study were evaluated in the SPSS 21.0 package using parametric and nonparametric descriptive statistical analyses. The conformity of variables to the normal distribution was investigated using histograms and the Kolmogorov-Smirnov test. When presenting descriptive statistics, mean, standard deviation, and median values were used. Pearson's correlation analysis was conducted to determine the relationship between quantitative variables. Statistical significance was set as $p<0.05$.

Ethical considerations

Voluntary consent was obtained from all participants. The study was approved by the ethics committee (XXX University XXX Faculty of Medicine Clinical Research Ethics Committee; Date:09.08.2019;No:991). All participants provided informed consent before answering the questionnaire.

RESULTS

The mean age of the mothers in the study group was 28.6±5.5 years, 95.7% were unemployed, 60.8% gave birth by caesarean section, the mean pre-pregnancy body weight was 67.8±9.9 kg, the average weight gain during pregnancy was 12.7±5.4 kg, and the mean weight on day 1st postpartum was 73.3±10.3 kg (Table 1).

It was found that 65.2% of the infants were male, the mean gestational age was 38.9±1.1 weeks, the mean birth weight was 3389±406 g, and 82.6% of the infants weighed appropriate for gestational age (AGA), according to the Lubchenco curve (Table 2).

The carbohydrate content of colostrum, transitional milk, and mature milk increased as 4.7 g/100 mL, 5.6 g/100 mL, and 6.5 g/100 mL, respectively; the fat content increased as 2.2 g/100 mL, 3.3 g/100 mL, and 3.5 g/100 mL; protein values decreased as 4.1 g/100 mL, 1.97 g/100 mL, and 1 g/100 mL; and calories as 68.50 kcal/100 mL, 67.4 kcal/100mL, and 68.4 kcal/100 mL, respectively. The mothers' nutritional consumption within the last 24 hours were determined on days 1, 5, and 15 postpartum in the following manner: carbohydrate 150.1±107.7 g, 251.2±90.2 g, 251.5±91 g, protein 23.7±19.6 g, 75.5±57.7 g, 78.7±46.7 g, and fat 28.4±26.7 g, 80.5±36.4 g, 79.1±34.5 g. Likewise, the number of calories consumed increased as 969.3±721.7 kcal, 2050.4±640.2 kcal, and 2148.5±591.3 kcal, respectively (Table 3).

Table 1: Sociodemographic characteristics of the mothers (N=46)

Characteristics		n (%)
Education	Literate	16 (34.7)
	Primary education	17 (36.9)
	Secondary education	13 (28.4)
Employment status	Employed	2 (4.3)
	Unemployed	44 (95.7)
Income status	Income more than expenses	2 (4.4)
	Income equals expenses	28 (60.8)
	Income less than expenses	16 (34.8)
Family type	Nuclear	19 (41.3)
	Extended	27 (58.7)
Mode of delivery	Vaginal	18 (39.2)
	Caesarean section	28 (60.8)
Continuous medication administration	No	43 (93.5)
	Yes	3 (6.5)

	Mean±SD	Median
Maternal age (years)	28.6±5.5	27.5
Pre-pregnancy weight (kg)	67.8±9.9	68.0
Total weight gain during pregnancy (kg)	12.7±5.4	11.0
Weight on day 1 postpartum (kg)	73.3±10.3	71.8
Maternal height (cm)	159.3±6.0	160.0
Number of living children	2.7±1.1	3.0

Table 2: Infant characteristics (N=46)

Sex	Female	16 (34.7)
	Male	30 (65.3)
Birth weight according to gestational age	*AGA	38 (82.6)
	**SGA	8 (17.4)

	Mean±SD	Median
Gestational age (weeks)	38.9±1.1	39.0
Birth weight (g)	3389±406	3335
Birth length (cm)	51.5±1.9	51.0

*AGA: Appropriate Gestational Age **SGA: Small gestational age.

According to the results of the BeBis programme, upon examining the correlation between the nutritional consumption by the mothers during the 24-hour period on days 1st , 15th, and 15th, postpartum and human milk macronutrient levels, there was no significant correlation between the nutritional consumption by the mothers on the first day and human milk macronutrient levels. There was a significant negative correlation between the energy and carbohydrate content of the nutritional consumption by the mothers on day 5th postpartum and the levels of human milk proteins. A significant positive correlation was detected between the amount of carbohydrate in the mothers' nutritional consumption on day 15th postpartum and the carbohydrate levels in the human milk (Table 4).

DISCUSSION

It is known that maternal nutrition influences the composition of human milk, and the macro- and micronutrient content of human milk should be sufficient for the healthy nutrition, growth, and development of infants (14,15). This study was conducted to examine the effects of maternal nutrition on the human milk content.

The daily protein requirement of feeding mothers increases for the synthesis of milk proteins and cell regeneration. It is recommended that a woman of childbearing age should consume an average of 0.8 g/kg protein per day, and it is recommended to add 19 g of protein daily to her diet during pregnancy and lactation (16). The average daily protein consumption by mothers in our study group was 23.7 g on day 1 postpartum, 75.5 g on day 5th postpartum, and 78.7 g on day 15th postpartum. When the recommended amount of protein (0.8 g/kg) in the literature was calculated according to the mothers' average weight (73.3 kg), the required daily average protein intake was 58.6 g/day, and the required average protein intake was 77.6 g/day when adding 19 g that should be consumed additionally by human-feeding mothers in the postpartum period. The amount of protein consumed by the mothers daily was similar to the recommendations. There was no significant correlation between the amount of protein consumed by the mothers daily (days 1st , 15th, and 15th, postpartum) and human milk protein and other macronutrients. Likewise, a study conducted with 117 mothers in Italy found no significant correlation between the amount of

Table 3: Distribution of the nutrients in human milk and nutritional consumption by the mothers (N=46)

Human milk nutrients (in 100 mL)	Day 1		Day 5		Day 15	
	Mean±SD	Median	Mean±SD	Median	Mean±SD	Median
Carbohydrate (g)	4.7±1.2	4.6	5.6±1.2	5.9	6.5±0.8	6.6
Fat (g)	2.2±0.9	2.1	3.3±0.6	3.1	3.5±0.8	3.4
Protein (g)	4.1±1.6	4.4	2.0±1.0	1.7	1.0±0.3	1.0
Energy, kcal	68.5±16.3	62.5	67.4±10.4	68.0	68.4±9.5	68.5
Nutritional consumption by the mother (per day)	**Day 1**		**Day 5**		**Day 15**	
	Mean±SD	**Median**	**Mean±SD**	**Median**	**Mean±SD**	**Median**
Carbohydrate (g)	150.1±107.7	145.6	251.2±90.2	239.9	251.5±91.0	246.4
Protein (g)	23.7±19.6	13.9	75.5±57.7	64.8	78.7±46.7	74.7
Fat (g)	28.4±26.7	20.9	80.5±36,4	73.1	79.1±34.5	74.0
Energy (kcal)	969.3±721.7	800.5	2050.4±640.2	1911.0	2148.5±591.3	2132.6

protein consumed by mothers daily and the levels of human milk protein (17).

The mother's nutritional status and content can affect the composition of human milk and thus the infant's nutrient intake (15). Nutritional requirements are higher in infancy than in other age periods. The composition of human milk changes over time according to infants' changing needs (2,3,18). There was a negative correlation between the carbohydrates consumed by the mothers and the energy they received and the human milk protein in our study group on day 5th postpartum. There was a positive correlation between the amount of carbohydrates consumed by the mothers on day 15th postpartum and the carbohydrate content of human milk. The amount and quality of protein in human milk are not affected by the mother's diet. However, providing protein support to the mother increases the protein concentration and free amino acid content of the milk (18). Hascoët et al. (19) revealed a positive correlation between the carbohydrate consumption of the mother and the levels of human milk protein, carbohydrates, and lipids. Bzikowska et al. (20) investigated the impacts of maternal and infant factors on human milk content and found that maternal nutrition affected the amount of human milk carbohydrates. Magnel et al. (21) reported no correlation between maternal nutrition and the amount of human milk carbohydrates. More research using larger samples is needed in this area because the literature on maternal nutrition and breast milk content is scarce, and there is no consistent evidence.

No correlation was detected between the amount of fat consumed by the mothers in our study group and human milk macronutrient levels. Maternal fatty acid intake affects the fatty acid profile of human milk (1). Samur et al. (22) examined the mothers' nutritional consumption for three days using the BeBis programme and revealed that Turkish women frequently consumed flour products, margarine and desserts, and trans fats, and there was a significant correlation between human milk fatty acids and trans fats consumed by mothers. The research results and the literature differ, which may be related to the foods consumed by the mothers participating in the study within the last 24 h. A systematic review by Keikha et al. (23) evaluated 43 studies on human milk composition and maternal nutrition. There was no correlation between maternal nutrition and macronutrient levels in the human milk composition, but there was a correlation with micronutrients. Likewise, Fouani and Mahmoudi (24) stated that maternal nutritional status affects micronutrients rather than macronutrients in human milk. Rakıcıoğlu et al. (25) investigated changes in human milk content when fasting mothers in Turkey did not consume water and other foods for approximately 8-10 hours per day. It was determined that the intake of all nutrients of the fasting mothers decreased, but it did not significantly affect the growth of human milk macronutrients or infants. The energy of human milk is provided by macronutrients such as fat and carbohydrates (22). The approximate daily caloric intake of the mothers in our study group was 969, 2050, and 2148 kcal on day 1 postpartum, day 5 postpartum, and 2148 kcal on day 15th postpartum. It is recommended that mothers should consume 2300-2500 kcal of energy daily during human feeding (16,26). It was observed that mothers consumed fewer calories than recommended. It has been reported that the macronutrient content of human milk is high in different cultures and age groups, regardless of the number of pregnancies, despite changes in maternal nutritional status (27,28).

There was a significant negative correlation between the amount of energy consumed by the mothers and the human milk proteins on day 5th postpartum, but there was no correlation in the measurements performed on days 1st and 15th postpartum. Minato et al. (29) also demonstrated that the amount of energy that the mother received from her food did not affect the amount of energy in her milk. Yang et al. (30) did not find a correlation between maternal macronutrient consumption within the last 24 h and macronutrient concentrations in human milk. The fact that the human milk content did not change, despite the low amount of nutrients and energy taken by the mothers, was associated with fat burning. The results obtained with repeated measurements in our study group can be considered parallel to those obtained by Yang et al. and Minato et al.

Table 4: Correlation between maternal daily nutritional consumption and human milk nutrients (N=46)

Nutritional consumption by the mother		Human milk nutrients			
		Day 1			
		Carbohydrate	**Fat**	**Protein**	**Energy**
Energy	r	0.181	-0.189	-0.205	-0.189
	p	0.228	0.208	0.172	0.207
Water	r	0.228	-0.032	-0.213	-0.128
	p	0.128	0.831	0.156	0.395
Protein	r	0.161	-0.110	-0.077	-0.026
	p	0.284	0.468	0.612	0.864
Fat	r	0.157	-0.129	-0.182	-0.168
	p	0.298	0.394	0.226	0.263
Carbohydrate	r	0.162	-0.218	-0.273	-0.236
	p	0.282	0.146	0.067	0.114
		Day 5			
Energy	r	0.129	-0.132	-0.359	-0.258
	p	0.391	0.380	**0.014**	0.083
Water	r	-0.231	-0.026	-0.137	-0.007
	p	0.122	0.863	0.362	0.966
Protein	r	-0.035	0.028	-0.267	-0.193
	p	0.819	0.852	0.072	0.198
Fat	r	-0.020	-0.027	-0.116	-0.060
	p	0.894	0.857	0.441	0.690
Carbohydrate	r	0.242	-0.139	-0.348	-0.230
	p	0.105	0.357	**0.018**	0.124
		Day 15			
Energy	r	0.208	-0.205	0.094	-0.105
	p	0.165	0.172	0.535	0.488
Water	r	0.265	0.004	-0.010	-0.022
	p	0.075	0.981	0.945	0.883
Protein	r	0.232	0.119	0.210	0.001
	p	0.121	0.430	0.161	0.993
Fat	r	0.162	-0.116	0.043	-0.064
	p	0.281	0.444	0.778	0.672
Carbohydrate	r	0.377	-0.057	0.178	0.009
	p	**0.010**	0.706	0.237	0.952

*Spearman's Correlation Test

Unlike other studies, it was observed that maternal nutrition (especially carbohydrate consumption) affected the macronutrient (protein, carbohydrate) content of human milk in repeated measurements performed at different times in our study group. There was a positive correlation between the carbohydrate content of maternal nutrition on day 15t[h] postpartum and the carbohydrate value of human milk on day 15[th], but the amount of fat and protein consumed by the mothers did not affect human milk content. The difference of our study from other research may be related to the data collection method, nutritional culture, and the time of human milk examination. Further studies examining maternal nutrition and human milk content in different cultures are recommended.

Limitations

The results obtained from this study are limited to women with similar socioeconomic characteristics who gave birth at a university hospital.

CONCLUSION

Repeated measurements (days 1st, 5th, and 15th postpartum) revealed that the amount of carbohydrates and fat in human milk gradually increased while the amount of protein decreased. There was a significant negative correlation between energy and carbohydrate content in the nutritional consumption by mothers on day 5 postpartum and the levels of human milk proteins. Additionally, there was a significant positive correlation between the carbohydrates consumed by the mothers on day 15th postpartum and human milk. The maternal nutritional consumption affects the human milk (transitional milk and mature milk) content. These results may not show a direct causal relationship. Further studies are required.

Adequate and balanced nutrition during the preconception, pregnancy, and human feeding periods is important for mother and baby health. Optimal nutrition provided in the first 1000 days of life, during which neurodevelopment is rapid, affects healthy growth and development. Support mother and baby nutrition through counselling, guidance, and training for physicians, midwives, and mothers who have important roles in mother and child health services during the first thousand days of life. Midwives should determine deficiencies in nutritional information and provide trainings in line with current and evidence-based information starting from the preconception period onward to expectant mothers.

Ethics Committee Approval: This study was approved by the ethics committee of İstanbul University Faculty of Medicine Clinical Research Ethics Committee; (Date:09.08.2019;No:991).

Informed Consent: Written consent was obtained from the participants.

Peer Review: Externally peer-reviewed.

Author Contributions: Conception/Design of Study- F.Ş.B., G.B., E.A.Ç.; Data Acquisition- F.Ş.B., G.B., E.A.Ç.; Data Analysis/Interpretation- F.Ş.B., G.B., E.A.Ç.; Drafting Manuscript- F.Ş.B.; Critical Revision of Manuscript- G.B., E.A.Ç.; Final Approval and Accountability- F.Ş.B., G.B., E.A.Ç.

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REFERENCES

1. World Health Organisation (WHO). Breastfeeding. 2017. https://www.who.int/nutrition/topics/exclusive_humanfeeding/en (Accessed Oct 23, 2022).
2. Isaacs EB, Fischl BR, Quinn BT, Chong WK, Gadian DG, Lucas A. Impact of human milk on intelligence quotient, brain size, and white matter development. Paediatric research 2010; 67:357-62. https://doi.org/10.1203/PDR.0b013e3181d026da
3. Fujita M, Roth E, Lo YJ. In poor families, mothers' milk is richer for daughters than sons: A test of the Trivers–Willard hypothesis in agropastoral settlements in Northern Kenya. American Journal of Physical Anthropology.2012;149(1):52-59. https://doi.org/10.1002/ajpa.22092
4. Pang, W.W., Hartmann, P.E. Initiation of human lactation: secretory differentiation and secretory activation. Journal of Mammary Gland Biology and Neoplasia. 2007;12:211-21. DOI 10.1007/s10911-007-9054-4
5. Yurtsal Z.B. and Kocoglu G. The effects of antenatal parental human-feeding education and counselling on the duration of human feeding and maternal and paternal attachment. Integrative Food Nutrition and Metabolism 2015; 2(4):222-30. 10.15761/IFNM.1000134
6. Dahl L. Clinicians' guide to human feeding. Evidenced-based Evaluation and Management 2015;22. https://doi.org/10.1007/978-3-319-18194-3
7. Valentine CJ, Morrow G, Pennell M. Randomised controlled trial of docosahexaenoic acid supplementation in midwestern US human milk donors. Humanfeeding Medicine 2013;8(1):86-91. https://doi.org/10.1089/bfm.2011.0126
8. Morrow AL, Ruiz-Palacios GM, Altaye M. Human milk oligosaccharides are associated with protection against diarrhoea in human-feed infants. The Journal of Paediatrics 2004;145(3):297-303. https://doi.org/10.1016/j.jpeds.2004.04.054
9. Hinde K, German JB. Food in an evolutionary context: insights from mother's milk. Journal of the Science of Food and Agriculture 2012;92(11):2219-23. https://doi.org/10.1002/jsfa.5720
10. Bravi F, Wiens F, Decarli A. Impact of maternal nutrition on human milk composition: a systematic review. American Journal of Clinical Nutrition 2013;104(3):646-62. https://doi.org/10.3945/ajcn.115.120881
11. American Academy of Paediatrics (AAP). New Mother's Guide to Humanfeeding, 2nd Edition; 2011. https://www.aap.org/en/search/?context=Healthy%20Children&k=New%20Mother%27s%20Guide%20to%20Humanfeeding&lang . Accessed on November 23, 2023.
12. Butts C, Hedderley D, Herath T. Human milk composition and dietary intakes of human-feeding women of different ethnicity from the manawatu-wanganui region of New Zealand. Nutrients.2018;10(9):1231, https://doi.org/10.3390/nu10091231
13. Bzikowska A, Czerwonogrodzka-Senczyna A, Weker H. Correlation between human milk composition and maternal nutritional status. Roczniki Państwowego Zakładu Higieny 2018;69(4):363-7. DOI: 10.32394/rpzh.2018.0041
14. Phattraprayoon N, Kraisonsin N, Kanjanapattanakul W. Comparison of human milk compositions among mothers delivering small-for-gestational age, appropriate-for-gestational age, and large-for-gestational age infants. Humanfeeding Medicine 2018;13(9):627-30. https://doi.org/10.1089/bfm.2018.0043
15. Quinn E.A., Largado F.E., Power M., Kuzawa C.W. Predictors of human milk macronutrient composition in Filipino mothers. American Journal of Human Biology 2012;24(4):533-40. https://doi.org/10.1002/ajhb.22266
16. Pekcan AG, Şanlıer N, Baş M. Turkey Dietary Guidelines. Ankara Kayhan Agency; 2015, p.29-45,102-105 https://dosyasb.saglik.gov.tr/Eklenti/10915,tuber-turkiye-beslenme-rehberipdf.pdf (Accessed Feb 23, 2020).

17. Boniglia Carratù C, Giammarioli S. Influence of maternal protein intake on nitrogen fractions of human milk. *International* Journal for Vitamin and Nutrition Research 2013;73(6):447-52. Doi:https://doi.org/10.1024/0300-9831.73.6.447
18. Gerçek Öter E. Nutrition of the human feeding mother. Özsoy S, ed. Counselling/Current Approaches in Humanfeeding and Humanfeeding. 1st Ed. Ankara: Turkey Clinics; 2021, p.66-76.
19. Hascoët JM, Chauvin M, Pierret C. Impact of maternal nutrition and perinatal factors on human milk composition after premature delivery. Nutrients 2019; 11(2):366. https://doi.org/10.3390/nu11020366
20. Bzikowska-Jura A, Sobieraj P, Szostak-Węgierek D, Wesołowska A. Impact of infant and maternal factors on energy and macronutrient composition of human milk. Nutrients 2020;12(9):2591. https://doi.org/10.3390/nu12092591
21. Mangel L, Mimouni FB, Feinstein-Goren, N. The effect of maternal habitus on the macronutrient content of human milk colostrum. Journal of Perinatology 2017; 37(7):818-21. DOI: https://doi.org/10.1038/jp.2017.51
22. Samur G, Topcu A, Turan S. Trans-fatty acid composition of mature human milk in Turkic women and its association with maternal diet's. Lipids 2009;44(5):405-13. https://doi.org/10.1007/s11745-009-3293-7
23. Keikha M, Bahreynian M, Saleki M, Kelishad R. Macro- and micronutrients of human milk composition: Are they related to maternal diet? A comprehensive systematic review. Humanfeeding Medicine 2017;12(9);517-27. https://doi.org/10.1089/bfm.2017.0048
24. Fouani FZ, Mahmoudi M. Maternal Nutrition, Child Development, and Immunity. In: Mahmoudi M., & Rezaei, N. Eds. (1986). Nutrition and Immunity. Springer, Cham; 2019. https://doi.org/10.1007/978-3-030-16073-9_11
25. Rakıcıoğlu N, Samur G, Topcu A. The effect of Ramadan on maternal nutrition and composition of human milk. Paediatrics international 2006;48(3):278-283. https://doi.org/10.1111/j.1442-200X.2006.02204.x
26. Segura SA, Ansótegui JA, Díaz-Gómez, N.M. The importance of maternal nutrition during human feeding: do human feeding mothers need nutritional supplements? Anales de Pediatría 2016;84(6):347-e1. https://doi.org/10.1016/j.anpede.2015.07.035
27. Hennet T, Weiss A, Borsig L. Decoding human milk oligosaccharides. Swiss Med Wkly. *2014;19:144. doi: 10.4414/smw.2014.13927*
28. Kilci Erciyas Ş. Content of human milk. Özsoy S, Ed. Counselling/Current Approaches in Humanfeeding and Humanfeeding. 1st Ed. Ankara Turkey Clinics; 2021, p.32-9
29. Minato T, Nomura K, Asakura H. Maternal undernutrition and human milk macronutrient content are not associated with weight in humanised infants at 1 and 3 months after delivery. International Journal of Environmental Research and Public Health 2019; 16:3315. https://doi.org/10.3390/ijerph16183315
30. Yang T, Zhang Y, Ning Y. Human milk macronutrient composition and associated factors among urban Chinese mothers. Chinese Medical Journal 2014;127(9):1721-5. doi: 10.3760/cma.j.issn.0366-6999.20133260.