

Dietary intake of Croatian lactating women

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Summary

Nutritional inadequacies during lactation may affect the well-being of both the mother and the infant. For this reason, breast-feeding women usually pay attention to their dietary practice during the breast-feeding period. The aim of this study was to examine changes in dietary intake of Croatian lactating women during six months postpartum. The study sample consisted of 83 lactating women whose diet records were collected at three measurements rounds: at 1 ± 0.25 , 3 ± 0.25 and 6 ± 0.25 months postpartum. The mothers' diets were investigated using two consecutive 24-hour dietary recalls. Energy and nutrient intakes were estimated using a nutritional database. The obtained results have shown that the diet of Croatian lactating women is hypocaloric (65.73 – 79.52 % DRI, $p < 0.001$) and deficient in magnesium, zinc, vitamins A, B1, B6, D and folate. Also evident was a moderate imbalance in the distribution of energy percentages from macronutrients. During six months postpartum, lactating women continuously decreased food intake resulting in a gradual decrease in energy intake ($p < 0.001$) and in the intake of all micronutrients. However, during six months postpartum, lactating women increased the share of total fat in energy intake ($p = 0.006$) and the share of saturated fatty acids ($p = 0.048$), while the share of monounsaturated fatty acids in total energy intake decreased ($p = 0.004$). It could be concluded that it is worthwhile to further study the nutritional status of Croatian lactating women during this vulnerable period especially regarding their micronutrients intake in order to achieve the recommended dietary requirements.

Keywords: lactating women, macronutrients, micronutrients, nutrient intakes, 24-hour recall

Introduction

Breast-feeding is known to have multiple health benefits for both mother and infant. Infants who are exclusively breast-fed are protected from many illnesses, while at the same time, breast-feeding is a cheap and time-saving method for mothers, which helps mothers to develop a unique bonds with their infants. Because of the benefits of breast-feeding, it is recommended to exclusively breastfeed the newborn for the first six months of life.

Encouraging breast-feeding is also a priority public health concern in Croatia. However, the rate of breast-feeding in Croatia is low, with the average duration of breast-feeding being 3.4 ± 2.9 months. Only 36.6 % of Croatian mothers exclusively breast-feed for longer than three months (Zakanj et al., 2000).

Dietary practices of lactating women may have a significant effect on the well-being of mothers and infants. In fact, the proportion of ingested nutrients portioned from milk biosynthesis may depend on maternal nutrient stores. These stores may be

mobilized to contribute to the nutrient availability for milk biosynthesis, and it is likely that the extent of nutrient mobilization is conditioned upon dietary intake (Rasmussen, 1992). The effect of the nutrition of mothers on the quality and quantity of their milk is a frequent topic of discussion. Studies conducted on lactating women have shown that a mother's nutrition has a greater impact on her long-term health than on the quality and quantity of her milk (Carmo et al., 2001). This makes lactating women an extremely vulnerable population worth studying. It is important to determine the usual dietary intake of lactating women, because it is a major determinant of nutritional status and because most interventions designed to improve nutritional status try to improve dietary intake. As in the case during pregnancy, one cannot assume *a priori* that dietary intake remains static during lactation. In fact, there are good reasons to assume that dietary intake changes because of various cultural beliefs, advice from health-care providers, and changing energy requirements and appetite (related in part to the changing needs of the

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infant and changes in activity pattern) during postpartum period.

The majority of researches in developed industrialised countries are concerned with the dietary intake of lactating women from parturition to three months of lactation (Giammarioli et al., 2002; Lyu et al., 2009; Sabel et al., 2009). To the best of our knowledge, no reports have appeared concerning Croatian women.

Given the importance of nutritional intake during lactation and given the absence of literature data, our objective is to examine energy, macronutrients and micronutrients intakes in a group of Croatian lactating women. Obtained results should be a significant contribution in the future designing of national dietary guidelines for this population.

Materials and methods

Subjects

In this prospective study, we enrolled and monitored for six months postpartum 83 lactating Croatian women in Primorsko-Goranska County. Data collection lasted 12 months, from January 2009 to January 2010. The study sample was recruited on the basis of criteria listed below. Women who gave birth to healthy, full term infants with birth weight > 2500 g, with time elapsed since parturition of one month (± 0.25) were eligible for entry into the study. Women were healthy volunteers recruited in paediatric clinics via word of mouth, with the help of their health workers during routine physical examination of their children. Women suffering from any metabolic disorders were excluded.

Women were considered to be lactating if they reported breast-feeding their infant at least three times a day. The criteria for defining lactating participants are customary for this kind of research (Dufour et al., 2002).

All women signed informed consent after being thoroughly informed of the purpose, requirements and procedure of the study. The research protocol was approved by the Ethic Committee of the Faculty of Food Technology, University of Osijek.

Study design and data collection

Lactating women were studied at three times referred to as three measurement rounds: 1 ± 0.25 month postpartum, 3 ± 0.25 months postpartum and 6 ± 0.25 months postpartum. The fieldwork was carried out by a trained researcher, and in each round, data on dietary intake were collected in the mothers' households. The study sample included lactating

women ($n = 83$) for whom we had three rounds of data for all the variables measured.

Dietary evaluation

Dietary evaluation was based on two consecutive 24-hour recalls from each woman for every measurement round. Assessment of the amounts consumed was aided by the use of household measures and models of portion sizes. With the aim of obtaining reliable data, the researcher conducted a multi-pass protocol for 24-hour recall (Johnson et al., 2008). In this protocol first, respondents provides a list of all foods eaten on the previous day using any recall strategy they desired (i.e. not necessarily in chronological order). The interviewer then obtains a more detailed list by probing for additions to these foods and by giving respondents an opportunity to recall food items initially omitted from the list. Finally, the interviewer reviews the occasions to be added if appropriate.

Types and quantities of consumed foods were entered into a computer program on the basis of which daily intakes of energy and macronutrients were calculated. The programme is based mainly upon the Croatian Food Composition Tables (Kaić-Rak & Antonić, 1990) containing data for the nutritional composition of 580 items, and partly upon the data of some other food tables. In addition to the nutritional composition of foods, the computer program enables entering recipes for composite meals. The results are expressed as two-day averages. Average nutrient intakes were compared to the Dietary Reference Intakes (DRI) and Acceptable Macronutrient Distribution Ranges for lactating women (Institute of Medicine, 2002).

Statistical analysis

The normality of the data distribution was tested with the Kolmogorov-Smirnov test, and descriptive statistics are presented as means \pm standard deviations. Mean differences in dietary intakes through six months postpartum were evaluated in the time dimension. For this purpose, a one-way analysis of variance (ANOVA) was conducted followed by *post hoc* Scheffe test. For statistical analysis, we used software Statistica 8.1 (StatSoft., Inc. Tulsa, OK, USA). Testing for variables was reported to be statistically significant by using $p < 0.05$.

Results and discussion

The results obtained in this sample of lactating women seem to point to a low energy intake,

associated with higher intake of fat. The intakes of all vitamins and some minerals (namely zinc and magnesium) were below recommendations. A gradual decrease of energy intake, accompanied with a decrease of intake of all macronutrients and micronutrients, during six months postpartum has been demonstrated.

The study sample included in this research consisted of 83 lactating women from Primorsko-Goranska County in Croatia whose demographic and socio-economic characteristics are summarized in Table 1. Among the women invited to participate in this research, the highest response was among older (65.06 %) and more educated participants (almost 94 % of the study sample have completed high

school or earned a university degree). In about 80 % of participants' households both spouses were employed and about 50 % of all participants had households income greater than Croatian average (*data not shown*). About 13 % of participants could be considered deprived and receive some kind of social welfare. The majority of participants were primiparous, what could explain the greater interest they showed in taking part in this kind of research. The characteristics of the study sample corresponded with the results of a questionnaire survey which showed that Croatian mothers who were more likely to breast-feed are older, better educated and primiparous (Berović, 2003).

Table 1. Demographic and socio-economic characteristics of the study sample (n = 83)

Parameter	Number of participants (n)	Percentage of study sample (%)
Age (years)		
19-30	29	34.94
31-40	54	65.06
Education		
primary school	5	6.04
high school	41	49.38
university education	37	44.58
Marital status		
married	80	96.39
single	3	3.61
Number of pregnancies		
1	52	62.65
2	22	26.51
3	8	9.63
4 and more	1	1.21
Employment		
only women	3	3.62
only men	13	15.66
both	67	80.72
Receipt of any kind of social welfare		
Yes	11	13.25
No	72	86.97

Adequate composition of human milk, which is necessary for the growth and development of the newborn, could be achieved by well-balanced dietary intake of lactating women. Consequently, the dietary intake of lactating women could significantly influence the nutritional status, either of the children or the mothers themselves. Nutritional requirements of lactating women are highly differentiated. The basic requirement is an energetically balanced diet containing all the indispensable nutritional components. Appropriate dietary intake through postpartum period determines the nutritional status of mother and of infant (Dewey et al., 2001).

The changes in the intake of energy and macronutrients through six months postpartum in a sample of Croatian lactating women is shown in Table 2. During six months postpartum, a significant decrease could be seen in intake of energy ($p < 0.001$), protein ($p < 0.001$), carbohydrate ($p < 0.001$), total fat ($p = 0.023$), saturated fatty acids ($p = 0.018$) and monounsaturated fatty acids ($p = 0.048$). The diets of women included in this study have shown that moderate caloric deficit occurred throughout the entire study time. Compared with recommendations, the fulfilment of energy requirements decreased from 79.52 % DRI (after one month) to 65.73 % DRI (after six months) (Table 2). Recommendations for energy

intake during lactation are based on the assumption that mothers' diets are adequate providing the result is the optimum growth and development of their children. Most of the recommended intakes are based on knowledge of the amount of milk produced during lactation, its energy and nutrient contents, and amounts of maternal energy and nutrient reserves. The recommended energy needs during the first six months of lactation is an additional 500 kcal assuming that 170 kcal/day will be mobilized from energy stores accumulated in pregnancy. The recommended energy intake after six months is reduced to an additional 400 kcal/day as milk rate production decreases from 760 ml/day to 600 ml/day (Institute of Medicine, 2002). At the beginning of the study, 19.32 % of participants had an energy intake greater than 100 % DRI, while after six months of continuous caloric reduction, only 4.85 % of participants had an energy intake higher than recommended (*data not shown*). However, there is

no cause for concern, as today's experts agree that recommendations for energy intake during lactation are set too high, and that women who follow these recommendations lose less weight in postpartum (Panel of Macronutrients, 2005). Additionally, it was shown that women, due to the adaptive mechanism, could successfully breast-feed their infants under moderate hypocaloric intake (Mohammad et al., 2009). This was confirmed in our study as well, since breast-feeding was successful for all participants.

When we analysed the share of macronutrients in total energy intake, it could be seen that during postpartum a decrease of energy intake was accompanied by changes in the share of macronutrients in total energy intake. The share of total fat in energy intake increased ($p = 0.006$), such as the share of saturated ($p = 0.048$) and monounsaturated fatty acids ($p = 0.004$) (Table 2).

Table 2. Daily energy and macronutrient intake (mean \pm SD) of lactating ($n = 83$) women during six months postpartum

Parameter		Time since parturition (months)			p - value in time dimension		
		1	3	6	1-3	1-6	3-6
Energy	kJ	9529.58 \pm 2725.08	9193.86 \pm 2387.73	7797.75 \pm 2253.43	ns	< 0.001	0.001
	% DRI	79.52 \pm 22.70	77.01 \pm 19.88	65.73 \pm 19.25	ns	< 0.001	0.002
Protein	g	85.56 \pm 24.32	81.41 \pm 25.54	70.73 \pm 22.53	ns	< 0.001	0.018
	% kJ	15.73 \pm 2.86	14.50 \pm 2.93	11.22 \pm 4.58	ns	ns	ns
Carbohydrate	g	228.44 \pm 60.86	266.46 \pm 74.98	286.76 \pm 92.27	ns	< 0.001	0.007
	% kJ	49.40 \pm 6.74	50.41 \pm 6.99	52.15 \pm 6.11	ns	ns	ns
Fat	g	83.56 \pm 23.58	81.27 \pm 21.67	75.00 \pm 22.61	ns	0.023	0.006
	% kJ	34.87 \pm 6.25	35.10 \pm 6.48	38.06 \pm 6.56	ns	0.006	0.013
Saturated fatty acids	g	33.51 \pm 9.39	32.05 \pm 8.75	29.51 \pm 9.00	ns	0.018	0.048
	% kJ	12.02 \pm 2.82	13.88 \pm 1.84	16.02 \pm 2.97	0.038	0.048	0.034
Monounsaturated fatty acids	g	33.82 \pm 9.78	33.17 \pm 9.01	31.54 \pm 10.01	0.908	0.048	ns
	% kJ	16.29 \pm 3.41	14.46 \pm 3.55	15.00 \pm 3.91	0.042	0.004	ns
Polyunsaturated fatty acids	g	15.88 \pm 8.03	16.05 \pm 8.24	14.30 \pm 8.27	ns	ns	ns
	% kJ	6.44 \pm 2.67	6.76 \pm 2.84	7.04 \pm 2.96	ns	ns	ns

ns-non significant

Generally speaking, the percentages of energy obtained from macronutrient sources were in agreement with the Acceptable Macronutrient Distribution Range (AMDR) for protein (10 - 35 % kJ) and carbohydrate (45 - 65 % kJ) but were higher than the AMDR of 20 - 35 % kJ for fat (Whitney & Rolfes, 2005). The results of average energy and macronutrients intake are similar to the results of dietary intakes of well-nourished lactating women in developed countries (Patterson et al., 2001; Giammarioli et al., 2002; Mannion et al., 2007; Lyu et al., 2009; Sabel et al., 2009).

As a consequence of a decrease in food intake during postpartum, a decrease in the intake of all selected minerals could be noticed. Lactating women during postpartum significantly decreased their intake of calcium ($p < 0.001$), phosphorus ($p < 0.001$), iron ($p = 0.012$) and zinc ($p = 0.008$) (Table 3). During the research period, average intakes of phosphorus, iron and selenium were higher than intake recommendations, while average intakes of magnesium and zinc were below recommendations (Table 3).

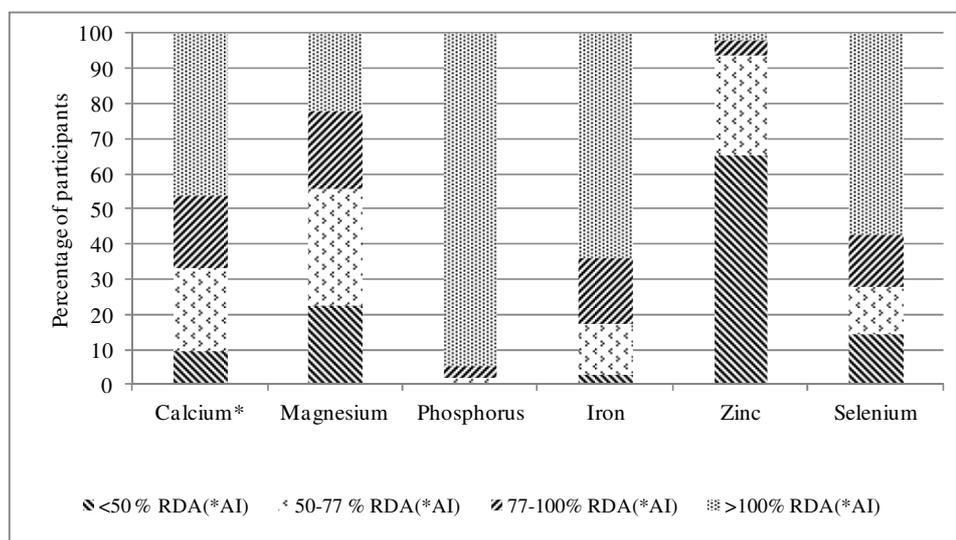
Table 3. Daily intake of minerals and fulfilment of dietary recommendations (mean \pm SD) of lactating (n = 83) women during six months postpartum

Parameter		Time since parturition (months)			p - value in time dimension		
		1	3	6	1-3	1-6	3-6
Calcium	mg	1093.79 \pm 340.90	1027.62 \pm 342.77	860.79 \pm 335.95	ns	< 0.001	0.007
	% AI	109.38 \pm 34.09	102.76 \pm 34.28	86.08 \pm 33.59	ns	< 0.001	0.007
Magnesium	mg	260.29 \pm 89.11	239.59 \pm 80.55	217.94 \pm 80.45	ns	ns	0.005
	% RDA	83.93 \pm 28.75	77.29 \pm 25.98	70.30 \pm 25.95	ns	ns	0.005
Phosphorus	mg	1594.11 \pm 469.58	1506.16 \pm 468.24	1293.68 \pm 409.34	ns	< 0.001	0.016
	% RDA	227.73 \pm 67.08	215.17 \pm 66.89	184.81 \pm 58.48	ns	< 0.001	0.016
Iron	mg	13.24 \pm 5.87	11.92 \pm 4.32	10.92 \pm 4.68	ns	0.012	ns
	% RDA	147.08 \pm 65.26	132.41 \pm 47.95	121.34 \pm 51.96	ns	0.012	ns
Zinc	mg	5.80 \pm 2.45	5.19 \pm 1.97	4.73 \pm 2.14	ns	0.008	ns
	% RDA	48.32 \pm 20.45	43.29 \pm 16.43	39.40 \pm 17.82	ns	0.008	0.004
Selenium	μ g	87.78 \pm 38.93	86.47 \pm 36.47	79.11 \pm 38.67	ns	ns	ns
	% RDA	125.40 \pm 55.61	123.53 \pm 52.10	113.02 \pm 55.24	ns	ns	ns

ns-non significant

The share of participants whose daily intake met the recommended 77 - 100 % RDA for calcium, magnesium, zinc, iron, and selenium was 20.68 %, 22.08 %, 4.41 %, 18.47 % and 15.06 %, respectively (Fig. 1). The value of 77 % of recommendations was used as a cut-off point, because this would be adequate for one half of the persons, assuming that the requirements are distributed normally (Mackey et al., 1998). The lowest fulfilment of recommendations

is obvious in the intake of zinc, while lactating women fulfil only between 39.40 % and 48.32 % RDA. Only two women (2.5 % of total participants) had zinc intake higher than recommended. Inadequate zinc intake is common among lactating women (Mannion et al., 2007; Dufour et al., 2002), and during assessment of intake, the bioavailability of zinc from different sources should be taken into consideration.

**Fig. 1.** Relative average distributions for lactating women (n=83) meeting dietary standards for selected minerals during six months postpartum

The intakes of all selected vitamins were below the recommendations with evident significant decrease in intakes of vitamin A ($p = 0.042$) and vitamin B6 ($p = 0.038$). The intake of other vitamins did not change significantly during postpartum (Table 4).

The lowest percentage in the fulfilment of dietary needs is evident in the case of folate intake (20.93 - 21.32 % RDA). Only 7 % of participants had folate intake in the range of 77 - 100 %, while as many as 71 % of participants had folate intake below 50 % RDA.

Insufficient intakes of calcium, folate, vitamin E and vitamin D were reported among lactating women in Italy and Spain (Savino et al., 2001; Sanchez et al., 2008). The daily intake of vitamin A (expressed as retinol equivalent-RE) could fulfil, on average, 62.12 – 79.56 % RDA (Table 4). According to the average intake, only 15.7 % of participants had an intake of vitamin A in the range of 77 - 100 % of recommendations (Fig. 2). Vitamins A and E are commonly noted as being deficient, even in a well-balanced nutrition of lactating women (Caire-Juvera et al., 2007). The change in dietary intake should include a higher consumption of plant origin products (such as plant oils, vegetables and fruits), but also some food of animal origin which is a source of vitamin A (i.e. liver, egg yolk, milk, cheese etc.). The intake of vitamin D among lactating women is also below recommendations (29.94 – 33.75 % RDA)

(Table 4). According to the average intake of vitamin D, only 7.2 % of study participants had an intake higher than recommended (Fig. 2). A low intake of vitamin D among the population of lactating women is reported also in Australia, Canada and USA (Allgrove, 2004; Hollis & Wagner, 2004; Pettifor, 2004). However, since sun exposure can also contribute to the vitamin D supply (Glerup et al., 2000), it could be assumed that, considering the place where they live (i.e. coastal part of Croatia which has plenty of sunny days per year), the participants would be able to fulfil the daily requirements for vitamin D. The share of lactating women whose daily intake of vitamin D could be considered adequate gradually decreases during postpartum. The share of participants whose daily intake met the recommended 77 - 100 % for vitamin B1 and vitamin B6 was: 18.10 % and 10.93 % (Fig. 2).

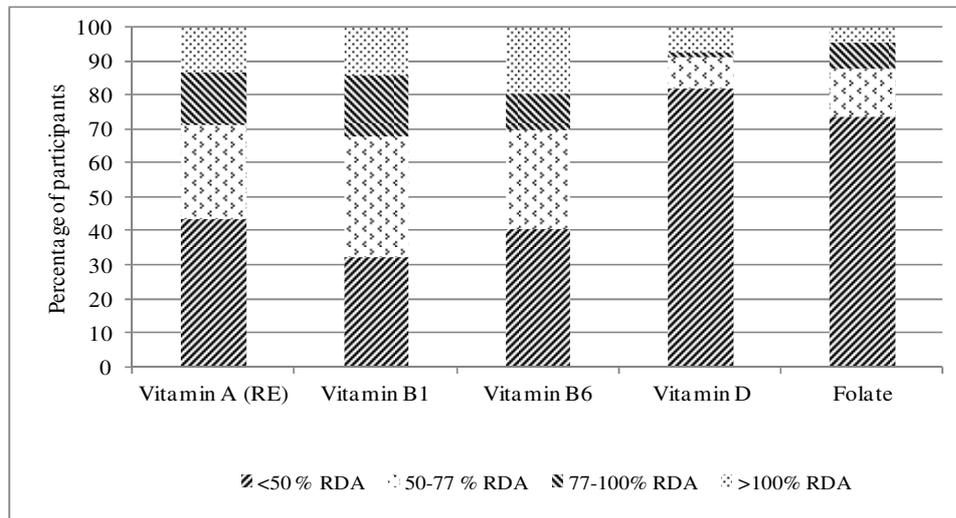


Fig. 2. Relative average distributions for lactating women (n = 83) meeting dietary standards for selected vitamins during six months postpartum

As shown by the data concerning minerals and vitamins intake the obtained values are vary considerably, which is confirmed by high values of standard deviations. We have made efforts to reduce variance by using multi-pass protocol and by multiple recalls. However, remarkable differences in the intake by one person during the successive days of dietary recalls as well as interpersonal differences which are usually obtained by 24-hour recall method can significantly affect the final results obtained.

There appears to be a number of reasons for the low intakes observed in our study sample. First, there can be an overestimation of energy requirements for

lactating women as previously discussed. Another possible explanation is that our participants were underreporting their intakes of energy or were trying to restrict their energy intakes in order to lose weight. However, these low intakes are associated with successful lactation. Bearing in mind the moderate imbalance in nutrients in the diet, it should be recommended that women decrease their fat and increase their carbohydrate intakes in order to achieve the recommended proportion of macronutrients, so long as protein, essential fatty acids, and energy are consumed in adequate amounts.

The limitation of this study is the small number of participants which does not make this sample large

enough to be representative of this population group. As a further limitation could be considered that our study participants were well educated, highly motivated and consequently belonged to the well-to-do fraction of population. In order to supplement the findings of our study it will be valuable to monitor some biochemical parameters of

study sample (i.e. blood sample) but unfortunately, we did not have capacities to do this. In view of the above, additional studies would be needed to provide a more comprehensive evaluation of the adequacy of dietary intakes of Croatian women during lactation.

Table 4. Daily intake of vitamins and fulfilment of dietary recommendations (mean \pm SD) of lactating (n = 83) women during six months postpartum

Parameter	Time since parturition (months)			p - value in time dimension			
	1	3	6	1-3	1-6	3-6	
Vitamin A (RE)	μg	1034.23 \pm 1220.28	851.99 \pm 499.10	807.55 \pm 588.78	ns	0.042	ns
	% RDA	79.56 \pm 93.87	65.54 \pm 38.39	62.12 \pm 45.29	ns	0.042	ns
Vitamin B1	mg	1.11 \pm 0.88	1.13 \pm 1.06	1.14 \pm 1.30	ns	ns	ns
	% RDA	79.33 \pm 63.00	80.44 \pm 76.56	81.22 \pm 93.18	ns	ns	ns
Vitamin B6	mg	1.33 \pm 1.00	1.74 \pm 2.40	1.64 \pm 1.77	ns	0.038	ns
	% RDA	66.54 \pm 50.04	87.01 \pm 120.09	82.06 \pm 88.63	ns	0.038	ns
Vitamin D	μg	1.50 \pm 2.31	1.52 \pm 2.59	1.69 \pm 3.13	ns	ns	ns
	% AI	29.94 \pm 46.21	30.31 \pm 51.87	33.75 \pm 62.57	ns	ns	ns
Folate	μg	106.59 \pm 42.14	104.45 \pm 33.84	104.65 \pm 40.52	ns	ns	ns
	% RDA	21.32 \pm 8.43	20.89 \pm 6.77	20.93 \pm 8.10	ns	ns	ns

ns-non significant

Conclusions

Dietary intake of the selected population of Croatian lactating women is characterised by energy intake lower than recommended, together with higher daily intake of fat. The intake of selected vitamins (A, B1, B6, D and folate) and selected minerals (zinc and magnesium) were below the recommended values for the majority of participants. During the postpartum period, lactating women continuously decreased their energy intake. Meanwhile, there was an obvious decrease in the share of total fat and saturated fatty acids during the six months postpartum period. This decrease was significant in the period of three to six months postpartum.

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