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Energy, Fluids Intake and Beverages Consumption Pattern among Lactating Women in Tabriz, Iran

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Abstract: In current study, we determined daily mean intake of energy and fluids and also beverages consumption pattern in lactating mothers and the possible effects of some maternal factors on infants' weight. Information on food and fluid intake was collected from 182 mothers. Weight and height of mothers and infants were measured and the body mass index (BMI) and weight for age Z-score (WAZ) were calculated. The mean energy and total fluid intake were compared by recommended values. Furthermore, the possible effects of some maternal factors on infants' weight were evaluated. The mean daily energy intake (2390 ± 405 kcal) was lower than the mean calculated energy values (2458 ± 258 kcal) and RDA (2733 kcal). Daily mean fluid intake (3050 ± 540 ml) was approximately similar to the recommended values. Also a significant association between the WAZ of children and maternal BMI ($B = 0.36$, $p < 0.001$) and weight ($B = 0.15$, $p < 0.042$) persisted. With regards to the effect of maternal nutritional status on weight of infants, appropriate nutritional educations and interventions are suggested for lactating women.

Key words: Lactating women, infant, energy, beverages, fluid

Introduction

The effect of the nutrition of mothers on the quality and quantity of their milk is a frequent topic of discussion. However, the diets that are recommended to lactating mothers generally provide for an increase in all nutritional elements by a specific amount (Picciano, 2003). The energy cost of human lactation is generally considered to represent a substantial drain on maternal nutritional metabolism (Lunn, 2004). Lactation is a high energy demanding phase of the human reproductive cycle entailing an increase of 25% in energy cost above the non-lactating requirement (Lunn, 2004). An energy deficit may be met by an increase in energy intake (EI), a mobilization of body fat reserves, a reduction in total energy expenditure (TEE) or an increase in metabolic efficiency. In developing countries, the extra energy cost of lactation is imposed upon a limited food supply and lactating women may not have the possibility of increasing their energy intake very much (Vinoy *et al.*, 2000).

Maternal diet and nutritional status have been found to influence both the quantity and quality of milk (Miranda *et al.*, 1983). Malnourished mothers often produce milk which is suboptimal in quantity and quality, with deficiencies in water-soluble vitamins, protein, calcium and fat. Dietary supplementation of such mothers seems to lead to increased milk output and improved milk quality (Miranda *et al.*, 1983).

A lactating woman's need for water also increases-theoretically by an additional 600-700 ml/day because of the large amount required for milk production (Charney, 2008).

Also milk production is most affected by the frequency of sucking; the volume can be affected by maternal hydration and inadequate maternal fluid intake affects milk volume (Charney, 2008). In addition, the type of fluid consumed by individuals should also have received attention. In fact, the required water of body could be supplied with various beverages including water, milk, tea, fruit juices, coffee and soft drinks but regarding their nutritional value and also their effect on health, it is necessary to have a healthy drinking pattern (Jacqueline *et al.*, 2002; Rodgers, 1999).

This study aimed to, assess the intakes of energy and macronutrient, also evaluated the amounts and sources of fluids consumed by healthy lactating mothers in Tabriz, one of the five principal cities in the country and the most developed city in the North West of Iran. Also the possible effects of some maternal factors on infants' weight have been investigated.

Materials and Methods

In this descriptive study, A 9% random sample of 182 lactating women were recruited by randomized clustered sampling method from health centers of urban and health houses of suburb areas of Tabriz city in April 2007.

Including criteria for mothers were: Having infants with this characteristics: exclusively breast feed infant aged 90-120 days, infant with normal birth weight, full term infant and infant with no chronic disease.

Height of subjects was measured with barefoot and using amounted tape with the subject's arm hanging freely at their sides and recorded to the nearest 0.5 cm.

Body weight of subjects was measured with barefoot and light clothing to the nearest 0.1 kg with a Seca scale. The body mass index (BMI) was calculated as weight (kg) by height (m^2).

Infants' body weight was measured using accurately calibrated instrument (electronic scales: Soehnle, max wt 20 kg, accurate to 10 g).

Weight for age Z-score (WAZ) was calculated according to the median value of the international reference population recommended by National Center for Health Statistics (NCHS)/World Health Organization (WHO, 1986).

Information on food and fluid intake was collected by using 24 h recall method of 3 days (one week end day included). Dietary intake of subjects was analyzed by Nutritionist III software program. The mean energy intake of mothers compared with both RDA and calculated energy values adjusted to height, weight and physical activity levels (Carol, 2008).

The mean total fluid intake (drinking fluid values merged with data on the water content of foods) and also the rate of metabolic water were figured out.

Daily fluid requirements of subjects were estimated by reasonable allowance based on recommended caloric intake (1 ml/kcal) by an additional 600-700 ml/day and also body weight (35 ml/kg of usual body weight in adults) by an additional 600-700 ml/day. It has been reported that, the oxidation of foods in the body produces metabolic water as an end product. The oxidation of 100 g fat, carbohydrate and protein yields 107, 55 and 41 g of water, respectively for approximately 200-300 ml/day (Charney, 2008). So the rate of metabolic water in lactating women was also figured out.

Ethics: The study was approved by the Ethics Committee of the Tabriz Medical University. All subjects were made aware of the content of the study and if they agreed to participate, a written informed consent was obtained.

Statistical analysis: Statistical analysis was performed with SPSS version 11.5 software and included means and SDs. Comparisons of the results with recommended dietary values were made using Students T-test method. Multiple regression analysis was performed taking maternal age, energy intake, BMI and weight, infants' birth weight, maternal total fluid intake, beverages consumption and water from food as independent variables and weight for age of the children as the dependent variable. Results were considered statistically significant at the 95% of confidence interval.

Results

The average age, weight and height of participants was 26.5 ± 6 (Y), 65.5 ± 12 (kg) and 156.5 ± 6 (cm). The average BMI of lactating mothers was in over weight range

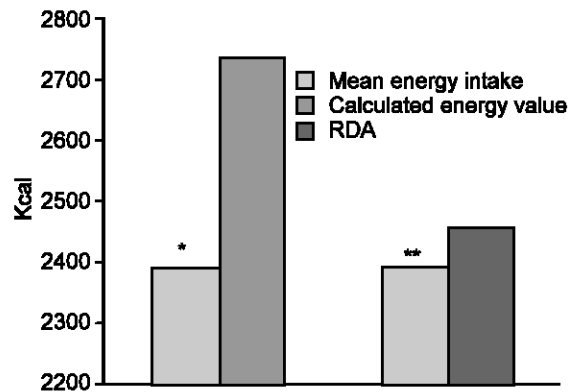


Fig. 1: The comparison of the mean daily intake of energy with recommended values in lactating mothers.

*The difference between mean energy intake of mothers and RDA recommendation for energy was significant ($p < 0.01$).

**The difference between mean energy intake of mothers and the mean calculated energy values was significant ($p < 0.03$).

(26.79 ± 4). Of the groups of 182 mothers, 34.56, 23.8 and 1.64% were over weight, obese and underweight, respectively. However, about 40% of participants were in the normal BMI range. The mean WAZ of infants (0.72 ± 1.2) was in the normal range.

Figure 1 shows the comparison of the mean daily intake of energy with recommended values in lactating mothers. Comparison of calculated energy values adjusted to height, weight and physical activity levels (2458 ± 258 kcal) with the mean energy intakes (2390 ± 405 kcal/d) showed significant difference ($p < 0.03$). Also the mean energy intakes were significantly less ($p < 0.01$) than RDA recommendation (2733 kcal/d). The percentage of energy from carbohydrate, protein and lipid was 59.4 ± 7 , 13.6 ± 2 , 26.9 ± 6 , respectively.

Daily total mean of fluid intake (3050 ± 540 ml) reflect the sum of beverages (2224 ± 366 ml, 73%) and food water (824 ± 187 ml, 27%). Daily means intake of total various beverages have been shown in Table 1. In our subjects the differences between the total mean of fluid intake (3050 ± 540 ml) and both reasonable allowance based on recommended caloric intake (2990 ± 274 ml) and also body weight (2894 ± 263 ml) were not significant. Tea was the most consumed beverages in lactating women (60.4%). The calculated mean metabolic water (304.7 ± 165 ml) was approximately in the normal range. Table 2 shows the association of different maternal factors with infants' WAZ. After adjusting for maternal age, energy intake, BMI and weight and infants' birth weight, a significant association between the WAZ of children and maternal BMI ($B = 0.36$, $p < 0.001$) and weight ($B = 0.15$, $p < 0.042$) persisted.

Table 1: Daily mean intake of total various beverages in study subjects (n = 182)

Beverages	Mean (SD)	Percent
Total beverages intake	2224±366 ml	
-water	551±251 ml	(24.7%)
-Tea	1344±273 ml	(60.4%)
-Milk	198.1±65 ml	(9%)
-Soft drinks	42.1±8 ml	(1.9%)
-Yoghurt drinks	71.7±12 ml	(3.2%)
-Fruit juices	18.9±4 ml	(0.8%)

Table 2: The association of factors with infants' WAZ

The association of factors			
With infants' WAZ	β	p-value	SEM*
Daily energy intake	0.14	0.430	0.09
Maternal BMI	0.36	0.001	0.13
Birth weight	0.41	0.090	0.18
Maternal weight	0.15	0.042	0.09
Maternal age	-0.12	0.070	0.06

Multiple $R^2_{WAZ} = 0.64$, *Standard error mean

Table 3: The association of maternal fluid intake with infants' WAZ

The association of factors			
With infants' WAZ	β	p-value	SEM*
Total fluid intake	0.58	0.17	0.10
Beverages intake	0.31	0.20	0.13
Food water	0.50	0.14	0.03

Multiple $R^2_{WAZ} = 0.11$, *Standard Error Mean

The association of maternal fluid intake with infants' WAZ was shown in Table 3. After adjusting for maternal total fluid intake, beverages consumption and water from food, no significant association performed between the WAZ of children and independent variables.

Discussion

Compared to developing countries, the mean energy intake (2398±405 kcal) in our lactating mothers was higher than the reported mean energy intake (2200 kcal) for Shiraz-Iran (Ayatollahi, 2004), 1600-1750 kcal for Gambia (Prentice, 1980), 1800 kcal for Bangladesh (Alam *et al.*, 2003) and 1816 kcal for Brazil (Cunha *et al.*, 2005). In comparison with similar studies on lactating mothers in industrialized countries, the mean energy intake in women of this study was slightly lower than mean energy intake (2716 kcal) for Scotland (Thomson *et al.*, 1970) and 2728 kcal for London, UK (Whichelow, 1976) but higher than mean energy intake (2083 kcal) reported for Newland (McLachlan *et al.*, 2004), 2124 kcal reported for USA (Sims, 1978) and 2295 kcal for Cambridge UK (Whitehead, 1981). Although the mean energy intake of mothers was significantly less (60 kcal) than calculated energy values, the difference was enormous (335 kcal) in comparison with the average RDA estimate of needs in a lactating woman. Despite this difference, the mean of maternal BMI and infants' weight was in the normal range. Then similar to other reports which found that the RDA estimate of needs for

energy in lactating women was higher than their needs (Chou *et al.*, 1999; Crowell, 1995), we can conclude that the RDA recommendation for energy maybe high for our lactating mothers. Also some other investigators found that the RDA estimate of needs for energy in lactating women was higher than their needs.

By providing population-based estimates of total water intake by lactating women, our study addresses a nearly complete lack of information on this topic.

The lactating women in our study had an average total water intake per unit of energy (1.27 g/kcal/day) similar to that reported by lactating women in the Iowa (Stumbo *et al.*, 1985) study (1.4 g/kcal/day) and USDA (Abby *et al.*, 1991) Survey (1.3 g/kcal/day). As expected, our larger sample of lactating women had a wider range of total water intake values (1506-4982 ml/day), which completely encompassed the range for the 26 Iowa participants (1920-3957 ml/day). Our study found the highest level of total liquid intake to be approximately 5 liters per day that was 4 liters per day in Iowa. Also similar to USA report (Stumbo *et al.*, 1985), total water intake of these 182 lactating mothers was not significantly correlated with WAZ of their infants.

Total mean drinking fluid intake (3050±540 ml) in our study was higher than the total mean of fluid consumption in USA (Stumbo *et al.*, 1985) lactating woman (2860 ml) and USDA (Abby *et al.*, 1991) survey (2242 ml). Although, the Iowa study revealed that fluid intake by lactating women was minimally affected by season (Stumbo *et al.*, 1985), the cause of high fluid consumption in the current study might be concerned with the season. Since current study was conducted in spring, it could be assumed that the high climatic temperature of this season contributed to high consumption of fluids.

In this study, the most consumed beverages were tea 60.4%, water 24.7% and milk and milk drinks 12.2%, respectively whilst in USDA report the most intake beverages were water 30%, milk and milk drinks (13.6%) and tea (11%).

Our literature review showed that relationship between the nutritional status of the lactating mothers and that of the child has not been precisely defined.

The results of this study showed that infants' weight was positively and significantly associated with maternal weight and BMI. The similar results were found in Bangladesh which showed that mothers with higher values of BMI had better nourished children than those with lower values (Rahman *et al.*, 1993).

Also studies conducted in Gambia (Prentice *et al.*, 1981), Honduras (Peaez-Escamilla *et al.*, 1995) and Mexico (Villalpando *et al.*, 1992) showed that maternal BMI had significant affects on breast milk fat content and so on lactation performance. Because fat is the main source of energy in human milk. Also among the Otomi Indians of Mexico, lactation performance was reported to

be significantly correlated with maternal body size and composition (Ettyang *et al.*, 2005).

With regards to the effect of maternal nutritional status on weight of infants and because the mean energy intake of mothers was less than RDA estimate of needs for energy and calculated energy intake, appropriate nutritional educations and interventions are suggested for lactating women. Also, we concluded that RDA estimate of needs for energy was higher than the requirements of lactating mothers in our population. Although the average daily intakes of fluids in lactating mothers were approximately similar to the recommended values, the pattern of fluids consumed was inappropriate. Unnecessary recommendations to consume "lots of fluids" might inspire some women to replace nutritionally valuable solid foods with water or other nutrient free beverages such as tea.

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