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Original Research Article

Maternal milk intake and the foetus growth: A bio-cultural study in Pune

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ABSTRACT

Background/Introduction: The relationship between maternal diet and foetal parameters has been a matter of debate because of the number of parameters and various dimensions associated with it. The study has gained attraction because of its importance despite of uncertainty and controversy in it.
Aim & Objectives: The objective of this study was to investigate the relationship between maternal milk consumption and fetal growth as well as the birth weight of the newborn. To achieve this objective, dietary information was collected using a 24-hour diet recall survey, and protein intake was evaluated based on dietary intake.
Materials and Methods: A total of 455 ultrasound observations from 229 respondents were collected by using a Prospective Observational Cohort Mixed Longitudinal study design in the second and last trimester of pregnancy from one private and two government hospitals in Pune, India where direct interviews were taken. Dietary data were collected using 24-hour diet recall. Food Frequency questionnaire was administered to understand the dietary habits and preferences.
Results: The average protein intake was 77.33g/day. Birth weight and Protein intake of mother do not show statistically significant linear relationship (p=0.605) The descriptive test shows that the majority of respondents had tendency to consume less than one cup (155.64 mL) of milk per day. The study shows better tendency of foetal growth in BPD, HC, AC, FL, FW, Weight at birth in the group of the respondent consuming milk more than 4 cups (>717mL) per day. This growth might be due to the micronutrient intake of mother.
Conclusion: There is no association between maternal milk intake and the fetus growth.

1. Introduction

The relationship between the diet of the mother and the wellbeing of the fetus and infant continues to be a matter of great importance, uncertainty and controversy. A great deal of information has become available since the RCOG study group on nutrition during pregnancy.[1,2] Andreasyan et al. investigated the association between maternal nutrition and birth anthropometry.[3] A study conducted among rats examined the influence of a high- protein diet during pregnancy and lactation on the renal, hemodynamic, and metabolic phenotype of the F1 generation.[4] Nutrition supply to the fetus is a key factor in the regulation of fetal growth however the direct supply of nutrients to provide building blocks of tissue growth is likely to be only minor component of this regulation.[5] The phenomenon of "foetal programming" which constitutes of the impact of maternal nutrition in intrauterine environment and its effect on foetal genome can exert lifelong consequences. This phenomenon have led to the recent theory of " Foetal origins of adult diseases" The alterations in foetal nutrition and endocrine status may result in development adaptations

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which permanently change the structure, physiology and metabolism of the offspring resulting into the metabolic, endocrine and cardiovascular diseases in adult life.[2,4,6] Milk is also an efficient food for the delivery of many nutrients (proteins, minerals, vitamins, or combination of these) essential for foetal development and, therefore, of potential importance for linear foetal growth. Milk intake in pregnancy was associated with higher birth weight for gestational age, lower risk of SGA, and higher risk of LGA.[7] South African outpatient clinics. Studies showed that intrauterine malnutrition have more serious consequences for children than postnatal malnutrition. Under-nutrition, as well as over-nutrition during pregnancy, was associated with adverse pregnancy outcomes.[8] In developing countries, Maternal under-nutrition is a major factor contributing to adverse pregnancy outcomes whereas in developed countries prevalence of high calorie diets resulting in adverse metabolic outcomes in offspring in their later life.[9]

2. Materials and Methods

2.1. Ethics

The study protocol was approved by the Institutional Ethical Committee of Deenanath Mangeshkar Hospital & Research Center (IHR_2018_ruL_AK_271), Savitribai Phule Pune University (SPPU), Pune (SPPU/IEC/2019/45) and Pune Municipal Corporation (HO/1166). As per the guidelines and suggestions given by Institutional Ethical Committee of Savitribai Phule Pune University, Deenanath Mangeshkar Hospital and Research Center and Pune Municipal Corporation, the theme of the research topic is well conveyed to all the subjects in all the three hospitals prior to data collection in details. Anthropometric measurements especially of neonates and that to the new born in NICU are taken in presence of hospital authorities. All the data is collected with written consent and by sharing information sheet to the respondents or the relative of the respondents. When the respondent or her relative were convinced, then only actual procedure of data collection used to begin.

2.2. Study design

This mixed longitudinal study was carried out in one private and two government hospitals in Pune, Maharashtra, India. All singleton mothers (n=229) with 455 ultrasound measurements of abdomen-circumference (AC), head circumference (HC), Biparietal diameter (BPD), and femur length (FL) from 28^{th} to 38^{th} weeks of gestation were documented through antenatal clinics of one private and two government hospitals during August 2018 to March 2020. The respondents were approached total 4 times during the study. The first interaction used to take place at the time of anomaly scan report in their hand to confirm singleton pregnancy without anomaly in the 5^{th} week of gestation. In the second trimester, during 28^{th} to 32^{nd} week of gestation, again same respondent used to be chassed for getting filled the 24-hour diet recall and during third trimester (34^{th} to 38^{th} weeks of gestation) food frequency questionnaire used to get filled for cross verifying the dietary data. The Sonography reports were obtained during second and third trimester visits to document the foetal anthropometry. Mothers were not aware about the gender of the foetus during gestation.

The participants were drawn from middle to affluent socio-economic background from private hospital and below poverty level background from government hospitals.[1] All singleton pregnant women with at least one Sonography (19 to 20 weeks) report, irrespective of Socio-economic background, within 18 to 40 years age group and those who have enrolled for institutional delivery in the hospital and willing to participate were enrolled for the study. Following were the limitations of the study; (i) Genetical factors were not considered in study; (ii) Biochemical tests were not conducted due to shortage of funds; (iii) chances of drop outs due to migration which were considered as an error.

The research questionnaire was constructed with three sections; (i) demographic profile, (ii) maternal gestational status, medical history of mother, (iii) dietary data

The actual number of deliveries at private hospital was used for calculation of sample size. The final sample was calculated using Cochran's sample size formula which came about minimum sample size for the study to be 226 with 95% level of confidence. The questionnaire was pretested in a pilot study among 54 respondents from the sample based on milk consumption; Cronbach's alpha used in evaluating the validity of the questionnaire (Cronbach's alpha=0.76) which indicated adequate consistency. The demographic background of mothers including information on religion, caste (in private hospital), place of residency, maternal age, family type, educational status (both mother and father), family income, occupation were recorded. In addition to that, gestational weight gain, parity, self-reported pre-pregnancy weight and height were also recorded. Body mass index was calculated using formula (weight in kg/ height in meter square).

2.3. Dietary assessment

Maternal dietary record was obtained by filling 24-hour diet recall method and food frequency questionnaire during second trimester to understand their dietary practices. 24-HR diet recall was handed over to the respondents to be filled at home to avoid the mistakes and errors through the reliance on memory and creating unnecessary stress on the respondent. Respondents were asked to note down all main daily food items including snacks, beverages, meals, munchies, milk etc. that were consumed during

past 24 hours Food frequency questionnaire was obtained while respondent used to wait for her turn to visit doctor in OPD. The portion size and the quantity were filled by researcher. FFQ was documented to understand the meal pattern and dietary habits of the respondent. For documenting dietary patterns measuring cups were used. Respondents were asked to report the actual portion of meals through measuring cups. For documenting chapatti or *Bhakri*, card board models of three sizes (small, medium, big) were shown to understand the actual size of the stuff. Ethnic recipes were documented to understand the ingredients, raw quantity, cooked quantity and the amount of ingredients in it. The food frequency questionnaire was formulated according to the Indian foodstuffs. The main food items were divided into following categories (Cereals Grains Products; pulses and legume; Milk And Milk Products; leafy vegetables; Roots And Tubers, Nuts & Oil Seeds, Condiments and Spices, other vegetables; fruits; Fishes And Other Sea Foods, Meat And Poultry, Fats And Edible Oils Sugars, and others which were already available on Nutrition Society of India (NSI) Diet Calculator developed by Dr Raja Sriswan Mamidi, National Institution of Nutrition, Hyderabad. In this programme raw value, cooked value and the intake are to be filled. The values for various nutrients are calculated for 100 grams of edible portion and the units are as follows , energy (kcal), protein (g), fat (g), Minerals (g), Crude fiber (g), carbohydrates (g), calcium (mg), Phosphorus (mg), Iron (mg), vitamin A (mcg), thiamine (mg), riboflavin (mg), niacin (mg), B6 (mg), folic acid and free folic acid (mcg), vitamin c (mg), choline (mg), magnesium (mg), sodium (mg), potassium (mg), copper (mg), manganese (mg), molybdenum (mg), zinc (mg), chromium (mg), sulfur (mg) an chlorine (mg). The formula used to calculate intake for individual item is (Intake (g) * Raw quantity (g))/ (cooked quantity (g))*100. Food frequency questionnaires were asked to confirm the dietary pattern and consumption practice of the respondent. Each category of foodstuff was attributed to frequency of intake varying from daily, weekly, monthly, rarely, never and also to the different portion-sizes (small, medium, and large).

2.4. Statistics

The information was compiled using Microsoft Excel Version 10 and IBM SPSS Statistics Data Editor Version 29.0.0.0(241). Statistical analysis comprising descriptive and inferential statistics were carried out. At commencement, descriptive analysis was done to express mean, standard deviation, standard error of mean, and the minimum and maximum of continuous variables that consisted of maternal intake of micronutrient and macronutrients and percentage of energy derived from macronutrient intake. Descriptive and Inference Statistical analysis comparison were carried out. Descriptive test was accomplished to express mean, standard deviation, standard error of mean and minimum, maximum of continuous variables that consisted of; maternal milk intake and foetal growth parameters. In the present study mean and standard deviations for above mentioned continuous variables were calculated. The data analysis for this research was performed into two parts. The first part of analysis was conducted to decipher the relationship between independent and dependent variables. This analysis was applied to the type of data means, ANOVA for quantitative. Quantitative is based on the measurement of quantity or amount, which is applicable to the phenomenon that can be expressed in the terms of quantity whereas qualitative is concerned with qualitative phenomenon i.e., phenomenon relating to or involving quality or kind. The examples of categorical variables in this study are daily milk consumption. Quantitative variables include anthropometric measurements of the foetus growth parameters, and dietary data with regard to 24-hours diet recall. The data analysis was performed into two parts. The first part of analysis was conducted to uncover the relationship between independent and dependent variables i.e., to express mean, standard deviation, standard error of mean, and the minimum and maximum of continuous variables that consisted of: maternal milk intake and its association with foetal growth. This analysis was coincided to the type of data means. For Independent sample t-test, multiple linear regression model and ANOVA for quantitative were used. P value < 0.05 shows the level of significance.

3. Results

The mean age of the respondents was 25.03 years. Majority of women were Hindu 78.16% whereas 20.52% women were from Muslim families. The educational background of the respondents shows that there are 2.7% respondents who are illiterate, 0.9% can read and write, 19.5% have studied till 4^{th} standard, 23.1% respondents have studied up to 10^{th} standard, 23.5% respondents have studied up to 12^{th} standard, 2.3% respondents have done diploma courses, 20.8% respondents are graduate, 6.3% respondents have completed their post- graduation and 0.9% respondents have perused their education above post-graduation. The data show that 28.9% families have single earning member, 23.1% families have 2 earning members, 17.8% families have 3 earning members, in 11.6% families 4 members are earning so as in 5.8% families there are 5 earning members whereas 12.9% families have more than 5 earning members.

3.1. Maternal dietary intake

The average protein intake when calculated in NSI diet calculator was 77.33g/day (Table 4) which is fair enough to satisfy the recommended protein requirement during pregnancy as per ICMR which is 65 g/day.(Srilakshmi B,

Table 1: Descriptive test for milk intake and foetus growth

Descriptive					
		N	**Mean (cm)**	**Std. Deviation**	**Std. Error**
BPD	None	11	18.88	9.85	2.97
	<155.64 mL	34	17.84	8.70	1.49
	155.65 to 465.17 mL	27	13.97	6.31	1.21
	>465.17 to 717 mL	27	17.82	9.70	1.87
	>717 mL	4	22.98	11.08	5.54
	Total	103	17.13	8.74	0.86
HC	None	11	64.06	28.23	8.51
	<155.64 mL	34	61.40	70.45	12.08
	155.65 to 465.17 mL	27	52.62	52.64	10.13
	>465.17 to 717 mL	27	57.51	34.54	6.65
	>717 mL	4	80.30	52.27	26.14
	Total	103	59.10	53.00	5.22
AC	None	11	93.61	57.33	17.28
	<155.64 mL	34	70.65	66.84	11.46
	155.65 to 465.17 mL	27	66.93	52.11	10.03
	>465.17 to 717 mL	27	66.27	60.89	11.72
	>717 mL	4	114.43	69.58	34.79
	Total	103	72.68	60.69	5.98
FL	None	11	18.38	7.55	2.28
	<155.64 mL	34	19.60	66.78	11.45
	155.65 to 465.17 mL	27	13.03	5.05	0.97
	>465.17 to 717 mL	27	38.38	116.52	22.42
	>717 mL	4	21.43	12.97	6.49
	Total	103	22.74	70.82	6.98
FW	None	11	1594.82	483.98	145.92
	<155.64 mL	34	1447.68	525.37	90.10
	155.65 to 465.17 mL	27	1268.93	466.85	89.85
	>465.17 to 717 mL	27	1417.11	557.43	107.28
	>717 mL	4	1681.75	687.16	343.58
	Total	103	1417.61	522.67	51.50
Weight at birth				0.90	0.27
	<155.64 mL	34	2.73	0.48	0.08
	155.65 to 465.17 mL	27	2.87	0.42	0.08
	>465.17 to 717 mL	27	2.85	0.39	0.08
	>717 mL	4	3.01	0.72	0.36
	Total	103	2.79	0.51	0.05

2002). The mean maternal energy intake of the respondents under study is 2199.87 kcal/day which is complying the requirements as per ICMR for an Indian pregnant woman doing the sedentary work (1,875+300=2,175 kcal/day).

Table 1 shows the Descriptive test for milk intake and foetus growth. Out of 103 respondents 11 respondents were not habitual to consume milk at all. 34 respondents drink one cup milk daily either through tea, coffee or plain milk. 27 respondents reported to consume more than one cup to 2 cups of milk, 27 respondents reported to drink more than 2 cups to cups of milk in either form, through tea, coffee, cornflakes, or plain milk. Only 4 respondents reported to have more than 4 cups of milk. Maternal milk consumption is classified according to average milk intake and the standard deviation. The descriptive test shows that the majority of respondents had tendency to consume less than 155.64 mL of milk everyday which comes to less than one cup of milk per day. The study shows better tendency of foetal growth in certain measurements like (BPD, HC, AC,FL,FW, Weight at birth) in the last group i.e., the respondent consuming milk more than 4 cups (>717mL) per day (Table 1) shows increase in the measurements of the foetus as well as the weight at birth. The relation between milk intake and foetal growth measurements and neonatal weight as seen from the study may be are due to supply of micronutrients. No significant difference was seen among maternal milk intake and protein consumption and foetal growth pattern (p=0.605) (Table 4) in this table the birth weight and Protein intake of mother do not show statistically significant linear relationship (p=0.605) which confirms that

Table 2: ANOVA-to test the association between milk intake and foetus growth

ANOVA						
		Sum of Squares	**df**	**Mean Square**	**F**	**P value**
BPD	Between Groups	470.226	4	117.557	1.575	.187
	Within Groups	7314.166	98	74.634		
	Total	7784.392	102			
HC	Between Groups	3451.978	4	862.994	.299	.878
	Within Groups	283045.444	98	2888.219		
	Total	286497.421	102			
AC	Between Groups	13932.206	4	3483.051	.943	.442
	Within Groups	361817.712	98	3692.017		
	Total	375749.918	102			
FL	Between Groups	9698.894	4	2424.723	.473	.755
	Within Groups	501897.113	98	5121.399		
	Total	511596.007	102			
FW	Between Groups	1252140.120	4	313035.030	1.153	.337
	Within Groups	26612986.346	98	271561.085		
	Total	27865126.466	102			
Weight at birth	Between Groups	1.138	4	.285	1.081	.370
	Within Groups	25.808	98	.263		
	Total	26.946	102			

Table 3: Descriptive statistics for birth weight and maternal protein intake (from 24-Hour Diet recall method)

Descriptive Statistics			
	Mean	**Std. Deviation**	
birth weight(kg)	2.8214	.42723	219
Protein(g/day)	77.3316	24.70233	221

Table 4: Pearson correlation between maternal protein intake and neonatal birth weight

Correlations			
		birth weight(kg)	**Protein**
birth weight(kg)	Pearson Correlation	1	.035
	Sig. (2-tailed)		.605
		219	217
Protein(g/day)	Pearson Correlation	.035	1
	Sig. (2-tailed)	.605	
		217	221

maternal protein intake does not show any association ship with neonatal birth weight.

The major findings of the study through descriptive and ANOVA test reveal no association between maternal milk intake and the foetus growth. Most of the respondents belong to the second category of the intake of the milk i.e. <155.64 mL which is < or equal to 1 cup of milk daily.

4. Discussion

A comparative study conducted by Yajnik et al. among Pune and Southampton babies shows Indian mothers were younger, lighter, shorter and have lower BMI than Southampton mothers; Also the babies born to Indian mothers are smallest in abdominal circumference, mid arm circumference, but preserve body fat during intrauterine development.[10] A study of children from four chronically malnourished Guatemalan villages has demonstrated a significant association between food supplementation during Pregnancy and lower prevalence of growth retardation and infant mortality. Supplementation of the children's diets was also correlated with better performance and psychological tests.[11] An article on milk consumption practices during pregnancy provides literature evidence and evidence derived from translational research that milk consumption during pregnancy increases gestational, placental, and foetal and birth weight.[12] Another study shows association of milk consumption during pregnancy with greater fetal weight gain.[13] A study in Pune among affluent women showed that the rate of growth was highly influenced by maternal milk and protein intake which suggest that contribution of common nutrients or other nutritional factors present in milk and protein promote the growth of foetus[14] A study shows significant

negative association between milk intake in well-nourished group and sub scapular skin fold thickness of the newborns at birth. Similarly, consumption of milk in undernourished mothers was found to be associated negatively with mid upper arm circumference of the newborns ($p<0.05$).[2,11] A study conducted to determine the effect of maternal nutrition on birth parameters reveals positive contribution between percent of energy derived from protein and birth weight and negative association between energy intake with birth weight, birth length and maternal carbohydrate intake. The study supports that the maternal dietary composition has an effect on foetal growth and pregnancy outcome.[14]

The present study reveals no association ship of maternal milk or protein intake with foetal growth and neonatal birth weight. The study reveals that the Foetus Growth does not differ due to the consumption of milk by mother.

5. Conclusion

The present study shows that the foetus growth does not differ significantly due to milk intake.

6. Abbreviations

BPD- Biparietal Diameter, HC- Head Circumference, AC- Abdominal Circumference, EDD- Estimated Date of delivery, FL- Femur Length, FW- Foetal Weight, BMI- Body Mass Index, NICU- Body Mass Index.

7. Source of Funding

None.

8. Conflict of Interest

None.

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