

Undernutrition and associated factors among lactating mothers in Dehradun, Uttarakhand, India

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Abstract

Undernutrition was one of the most widespread public health problems that affected both developed and developing countries. In India, it was one of the factors which lead to unacceptably high morbidity and mortality among women. However, little was documented on undernutrition among lactating women, particularly in the urban community. This study aimed to evaluate the nutritional status and its related factors among lactating mothers in the urban areas of the Dehradun region, Uttarakhand, India. A structured, pre-tested, and validated questionnaire was used to capture the socio-demographic information including the economical and medical conditions of 150 lactating women in Dehradun, India. Pearson correlation coefficient and association of various factors determined that 31.33% of women were in the age bracket of 20-25 years and the low-income group (72%). The prevalence of underweight was 7.33%, and the mean and standard deviation of the body mass index of mothers were 20.59 ± 2.96 and 21.70 ± 3.18 for sedentary and moderate workers respectively. There were significant correlations found between BMI, energy, carbohydrates, and fat intake ($p < 0.05$). A multivariate regression model was used to associate the nutritional status of the participant's income group, education, type of work, age of mothers, and frequency of meals. Based on the results, intervention programs for dietary correction and the effect of nutrition on the body were emphasized to lactating mothers for better health and nutritional outcomes.

1. Introduction

Undernutrition refers to inadequate food consumption and/or poor absorption and/or poor natural use of nutrients consumed. Based on certain studies, 9.7% of women are underweight globally (Di Cesare *et al.*, 2016). While obesity is on the rise, the persistence of being underweight in South Asian countries and some parts of Africa remains a serious concern and unacceptably high. The highest burden of the underweight is observed among the poorest women in poor countries, largely due to several disparities observed within the region or country itself (Reyes Matos *et al.*, 2020). Maternal underweight is likewise associated with offspring growth and development, including increased risk for PTB, low birth weight (LBW), under-five mortality, and poor mental and physical development (Black *et al.*, 2013).

The maternal mortality ratio (MMR) is defined as the number of maternal deaths during a given period per

100,000 live births during the same period. For 2010–12, India's MMR was estimated at 178 maternal deaths per 100,000 live births. In 2010, 19% of the 287,000 maternal deaths estimated worldwide took place in India (William *et al.*, 2015). According to the nutritional profile of African and Asian countries, food insecurity, hunger, and malnutrition are prominent issues; the poor nutritional status of women and children has been a consistent problem in several countries which causes about 27% of women of reproductive age to be undernourished, leaving their children predisposed to low birth weight, short stature, lower resistance to infections, and higher risk of disease and death (Global Health, 2017)

Undernutrition takes place when the body is not provided with the required nutrition (United Nations Global Nutrition Agenda, 2015). A malnourished person is deprived of the essential nutrients that are necessary for health maintenance. This is caused either by famine

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or poor dietary habits (Kavle *et al.*, 2018). Globally every year, an estimated 14 million adolescent girls enter lactation from which more than 90% live in developing countries (Hundera *et al.*, 2015). Women in developing countries with underweight have a threat of mortality and morbidity, and it affects the quality and volume of milk produced; undernourished women produce a lower quantum of breast milk than well-nourished woman (Alemayehu *et al.*, 2015). Evidence indicated that women with a body mass index (BMI) ≤ 18.5 kg/m² are at increased risk of illness and mortality rate (Mtumwa *et al.*, 2016).

The first six months of exclusive breastfeeding increase women's need for energy requirements by 30% or 1260 kJ/day above the gestation energy demand, and the breast milk product has a total energy value that requires an average diurnal energy cost of breastfeeding of roughly 2.9 MJ/day. The energy, protein, and other nutrients in bone milk come from the women's diet or her body's stores.

There are numerous contributing factors to undernutrition including poverty, poor hygiene, lack of nutritive knowledge and application of health services, and older practices or discriminative social structure which frequently happen together, and lead to an environment of malnutrition and vulnerability to contagious diseases (Fanzo, 2012), the vulnerability of lactating women is high due to considerable elevation of nutrient conditions during lactation than in any other stage of a woman's reproductive life due to physiological change (Beck, 2012), and it imposes high metabolic demand on the women to nourish their children with bone milk of good attention of important nutrients (Bhutta, 2013).

The health and nutritional status of women are highly linked with the overall health and nutritional status of the population (Khan and Khan, 2012). Since women in middle- and low-income countries are nutritionally vulnerable groups to the increased nutritional demand of lactation, developing countries including India give a special focus to appropriate nutrition during lactation. The objectives of this study are the nutritional status and its related factors among lactating mothers in the urban areas of the Dehradun region, Uttarakhand, India.

2. Materials and methods

2.1 Study area

The study was conducted in the Dehradun city of Uttarakhand, India. Dehradun is the capital of Uttarakhand with an area of over 3,088 km². The population of Dehradun as per the population census of

2011 was estimated to be over 1.7 million. As per 2017 statistics, the infant mortality rate per 1000 live Births in Dehradun was 27. Dehradun is known for its mix of the population coming from different parts of the country, cultures, languages, and backgrounds. The city has an 11 -poverty rate as per the economic survey of 2011-12. The Health and Family Welfare Department of Uttarakhand manages the health care responsibilities. Thousands of clinics, nursing homes, and various private and government hospitals are managing the birth facilities for pregnant women in the city.

2.2 Study design

The study was performed in the urban areas of the Doiwala district of Dehradun, India, in the year 2017-2019.

2.3 Sampling procedure

The participants of the study included the lactating mother with their infants who were visiting various clinics, and hospitals in Dehradun city, India. To maintain the purposive sampling technique, the participants were picked up with an unknown background, and later, the questionnaire was filled out by interview method. The informed consent form was filled out by every participant. Each participant was allocated a unique identification number. The names and contact details of the participants were kept confidential and anonymous.

2.4 Sample size determination

The target population was identified based on the parameters such as socio-demographic area and socio-economic group. The socio-demographic area covers the urban areas of Dehradun, Uttarakhand, India and the socio-economic group covers the low-Income group (annual salary between 1 lakh/annum to 2 lakh/ annum) population as per Ministry of Housing and Urban Poverty Alleviation, Government of India. A purposive sampling technique was used for the sample size determination. The simple formula (Daniel and Cross, 2018) was used for sample size calculation as below:

$$N = Z^2 \times P(1-P) / D^2$$

Where N is the sample size, Z value = 1.96 for 95% confidence limits and P = Estimated prevalence (0.55 for 55%).

The study was conducted on 150 participants of 20-30 years old mothers of lactation period 0-6 months

2.5 Data collection

The data was collected by the researcher herself who

was trained in survey administration. A pilot study was also done with a pre-testing questionnaire after that post questionnaire was formed with modifications based on the feedback. The questionnaire was prepared in the local language (Hindi and English) for easy understanding. The researcher was trained on how to perform anthropometric measurements and measuring instruments to estimate the number of foods consumed by lactating mothers.

A pre-testing questionnaire was prepared and based on the feedback, the questionnaire was corrected and revalidated to arrive at the draft version of the questionnaire. A pre-test was carried out in Dehradun city. The mothers who participated in this test were no longer used in the final study. The updated draft questionnaire was further scrutinized by the faculty at the Amity Institute of Food Technology, Amity University, Noida, U.P, India. The suggestion and recommendations of the faculty were incorporated into the final version of the questionnaire.

2.7 Socio-demographic characteristics

A questionnaire was prepared to capture the socio-demographic information of the subjects like age, religion, education, employment status, type of occupation, monthly income, the number of children, marital status, and the type of delivery.

2.8 Anthropometric measurements

The subjects were asked to remove the shoes and weight measurement was taken using a portable bathroom scale. The subjects were standing in an erect position while the measurement. Readings were taken up to the nearest 1 decimal place (0.1 kg). Height was measured by asking the subjects to stand straight next to a wall (without any shoes) and then measuring the height using a height-measuring scale. Measurements were taken to the nearest 0.1 cm. BMI was calculated as weight (kg) divided by height (m²) for each subject. All measurements were taken and recorded in duplicate using Standard Operating Procedures (Hurria et al., 2010).

2.9 Dietary intake assessment

The dietary intake of the subjects was assessed using a validated 24-hour recall. The subjects were asked to recall all foods and beverages consumed during the past 24 hrs. The information shared by subjects was used in the 24-hour recall. The commonly available household utensils were used to determine the portion size, and to aid the women to estimate the amount of food they consumed. The quantity was further converted to grams using household measures. For any commercially

prepared food, an equivalent packet was used to determine the quantity and then converted to grams. The nutritional facts on the packets were used to determine food information. The average nutrient intake was calculated for every respondent using the Food composition table (Oguntona and Akinyele, 1995). The food frequency questionnaire was used to ascertain the frequency of consumption of certain foods in the list on a daily, weekly, or monthly basis.

2.10 Statistical analysis

Statistical analysis was carried out using IBM SPSS Software v 28.0. Results were expressed as means and standard deviations, frequencies, and percentages. Average nutrient intakes were compared to RDA (ICMR -NIN, 2020) and FAO/WHO (FAO (Food and Agriculture Organization) and WHO (World Health Organization), 2001). Reference values for lactating women and therefore the percentages of recommended intake met by the mothers were estimated.

To determine the association of independent variables with the dependent variable, multivariable logistic regression analysis was used. Variables with $p < 0.05$ in the bivariable analysis were entered into multivariable analysis to identify independent predictors of undernutrition. A p-value of less than 0.05 was considered statistically significant. Pearson correlation and regression were used to determine the relationship between the anthropometric measurements and nutrient intake.

3. Results

This study provides information on the socio-economic, demographic profile, nutritional status, and nutrient intake of lactating mothers in Dehradun, India. Out of 150 women, 103 (68.67%) women are in the range of 25 or more years of age which is considered good age for motherhood as shown in Table 1

Table 1 shows the socio-demographic characteristics of lactating women. Most mothers (96%) were non-graduate or almost illiterate. 58.67% of women were moderate workers but has a family monthly income of less than INR 16,000.00 (almost two-thirds of 72% of the total population). As shown in Table 3, 46% had 1 child while a high percentage of the women was married.

Table 2 shows that the anthropometric measurements for moderate working women had a mean height, weight, and BMI of 158.17±6.19 cm, 54.14±7.6 kg, 21.70±3.18 kg/m², respectively. For sedentary working, women had a mean height, weight, and BMI of 156.91±5.0 cm, 50.72±8.02 kg, and 20.59±2.96 kg/m², respectively. About 7.33% of overall women were underweight.

The mean BMI for sedentary ($20.59 \pm 2.96 \text{ kg/m}^2$) and Moderate worker ($21.70 \pm 3.18 \text{ kg/m}^2$) working women indicate the normal category of the BMI scale.

Table 1. Socio-demographic characteristics of the lactating women

Socio-demographic variables	n	%
Mean maternal age in years		
Age groups		
≤ 25 years	47	31.33
> 25 years	103	68.67
Maternal educational status		
Non graduate	144	96.00
Graduate	6	4.00
Maternal religion		
Hindu	134	89.33
Muslim	16	10.67
Maternal type of occupation		
Non-Working	52	34.67
Working	98	65.33
Maternal Physical activity Pattern		
Sedentary	62	41.33
Moderate	88	58.67
Maternal family monthly income		
< 16000 INR	108	72.00
≥ 16000 INR	42	28.00

Table 3 shows the maternal health and feeding statistics of lactating mothers. About 7.33% of women were undernourished and were taking less than 2 meals/day. This in turn affects the lactation capacity of the mother especially when they have more than 1 child. The majority (50.67%) of mothers were vegetarians. Approximately 54% of mothers had a child of more than 4 months old.

The multivariate analysis results showed that there was a significant association between baby age, monthly salary, the number of meals per day, maternal type of occupation and maternal physical activity pattern ($p < 0.05$). The result of multivariable logistic regression analysis revealed that were significantly associated with undernutrition ($p < 0.05$).

The frequency of meals in a day had a major

association with the nutritional status (BMI) of the lactating mothers, i.e., women who had less than 2 meals had an odds ratio of 3.2099 times (AOR: 0.6015, 95% CI: 17.1282) than those who had more than 2 meals in a day. Similarly, non-graduate women have an odds ratio of 0.3731 times (AOR: 0.0397, 95% CI: 3.5089) than those who were graduates. Women with more than 2 children were likely to be undernourished as compared to one-child mothers.

Table 3. Maternal health and feeding practices of participants

Maternal characteristics	n	%
Age of baby		
< 4 months	69	46.00
≥ 4 months	81	54.00
Number of children		
One	60	40.00
More than one	90	60.00
Delivery Type		
Normal	93	62.00
C-Section	57	38.00
Type of food consumption		
Vegetarian	76	50.67
Non-Vegetarian	74	49.33
Meals in a day		
≤ 2	11	7.33
> 2	139	92.67

Table 4 represents the average energy against the selected nutrients for sedentary and moderate worker women. It indicated that women are taking almost 75% of the RDA recommended calories and average quantities of carbohydrates, iron, calcium, Vitamin A, and Vitamin C.

Lactating mothers consume a variety of food ranging from cereals, legumes, fruits, and vegetables. However, the primary source of their diet is carbohydrate-based and low in fruits/fibre. The mean intake of energy is approximately 700 Kcal lesser than what has been recommended by RDA (ICMR-NIN, 2020). More than 92% had a normal BMI as per Table 2. This normal BMI is an indication of the weight gained during the pregnancy and is considered good for health.

Table 2. Anthropometric characteristics of the lactating women

Anthropometric variables	n	%	Sedentary	Moderate
			Mean (\pm SD)	
Maternal height				
≤ 160 cm	111	74.00	156.91 \pm 5.0	158.17 \pm 6.19
> 160 cm	39	26.00		
Maternal weight				
≤ 55 kg	112	74.67	50.72 \pm 8.02	54.14 \pm 7.6
> 55 kg	38	25.33		
Maternal BMI				
< 18 (underweight)	11	7.33	20.59 \pm 2.96	21.70 \pm 3.18
≥ 18 (Normal)	139	92.67		

Table 4. Average energy and selected nutrient intake of lactating women

Nutrients	Sedentary			Moderate		
	Mean Intake	RDA**	%RDA	Mean Intake	RDA**	%RDA
Calories (kcal)	1717.11±250.14	2260	75.97832	1735.56±265.46	2730	63.5736
Carbs (g)	196.15±44.37	285	68.8	203.2±49.17	334.5	60.7
Fat (g)	40.02±10.79	30	133.4	41.08±10.92	30	136.933
Protein (g)	43.76±6.89	49.6	88.22581	44.85±7.38	49.6	90.4234
Iron (%)	25.5±27.18	16	159.375	24.73±22.35	16	154.563
Calcium (mg)	516.77±245.2	1000	51.677	549.32±269.46	1000	54.932
Cholesterol (mg)	19.39±47.76	-	-	22.08±52.89	-	-
Sodium (mg)	773.95±310.8	2000	38.6975	761.34±267.54	2000	38.067
Sugars (g)	53.58±18.71	-	-	52.81±18.95	-	-
Fibre (g)	19.52±5.091	25	78.08	20.17±5.14	32	63.0313
Vitamin A (µg)	12.95±8.4	950	1.363158	13.43±8.18	950	1.41368
Vitamin C (mg)	93.95±53.56	115	81.69565	98.99±51.13	115	86.0783

** Recommended Dietary Allowances (RDA) for Indian lactating mothers (0-6 months) as sedentary and moderate activity per NIN ICMR-2020

Table 5. Correlation and Regression analysis

Parameters	Energy	Protein	Fat	Carbohydrate
Height	-0.20(0.008)	-0.08 (0.30**)	-0.18 (0.01)	-0.22 (0.005)
Weight	0.088 (0.48**)	-0.009 (0.96**)	0.35 (1.80E-05)	0.21 (0.01)
BMI	0.22 (0.006)	0.059 (0.42**)	0.47 (3.80E-09)	0.35(1.54E-05)

** not significant as $p > 0.05$, Figures in parentheses are level of significance

Correlation and regression analysis in Table 5 showed a significant positive relationship between Energy, Fat, and Carbohydrate intake with Weight and BMI respectively. Although in the case of protein, there is no significant relationship observed for height, weight, or BMI since p-value is greater than 0.05.

4. Discussion

The data obtained through the survey indicates that most of the women had a low literacy rate, low family income, and moderate occupational work. Many studies across and within the countries suggest the strong and significant association of malnutrition with economic factors. While a limited number of studies use income as an economic measure, many studies used consumption expenditure and asset-based index (henceforth refer as wealth index) in explaining malnutrition (Panda *et al.*, 2020).

India is a developing country, and hence, the low-income group of people has limited access to quality food during lactation. Post-delivery, most of the women are confined within the house and are taken care of by their husbands or other relatives. This leads to a better opportunity for mothers to feed their infants and reduce their activity level (Ukegbu and Uwaegbute, 2012).

An inadequate number of micronutrients is one of the main causes of maternal malnutrition in low-income countries – essentially due to the lack of resources. On

the other hand, cultural factors, and myths regarding the mother's diet during the lactation period are another cause of nutrient restriction (Hailelassie *et al.*, 2013). The nutritional status (Table 3) of study participants according to BMI classification had no significant association with religion or type of food consumption. Strong associations were identified between BMI and Maternal occupation type, Family monthly income, education, and age of the mother as per Table 6.

The food-based on plants contains some micronutrients with low bioavailability. This is often actually because of the presence of some nutrients which might limit the absorption of positive little nutrients (Chen *et al.*, 2012). Thus, the continuous dependence of lactating mothers on plant-based food may lead to deficiencies. Intake of some required micronutrients was below recommendation. This is evident in calcium, where a recommended dose of 1200 mg/day was not followed by the lactating mothers. This is much lesser when compared to developed countries like Australia and the USA. In Asian countries, women have insufficient calcium in their diets during lactation (around 300-600 mg/ day)

Due to continuous efforts of the government of India programs for pregnant women, we observed a high intake of Iron content in lactating mothers. Absorption of iron has been noted to be increased once consumed with ascorbic acid-made foods within the diet. The ascorbic acid intake of the ladies was primarily from citrus fruits.

Table 6. Association of BMI vs other variables

Socio-demographic characteristics	Under Weight (BMI<18)	Normal (BMI≥18)	OR
	n (%)	n (%)	
Age groups			
≤ 25 years	1(0.67)	45(30)	0.4642(0.0963,2.2376)
> 25 years	10(6.67)	94(62.67)	
Maternal educational status			
Nongraduate	10(6.67)	134(89.33)	0.3731(0.0397,3.5089)
Graduate	1(0.67)	5(3.33)	
Maternal religion			
Hindu	7(4.67)	127(84.67)	0.1654(0.0423,0.6466)
Muslim	4(2.67)	12(8)	
Maternal type of occupation			
Non-Working	6(4)	46(30.67)	2.4261(0.7033,8.3693)
Working	5(3.33)	93(62)	
Maternal Physical activity pattern			
Sedentary	6(4)	56(37.33)	1.7786(0.5176,6.1109)
Moderate	5(3.33)	83(55.33)	
Maternal family monthly income			
< 16000 INR	10(6.67)	98(65.33)	4.1837(0.5189,33.733)
≥ 16000 INR	1(0.67)	41(27.33)	
Age of baby			
< 4 months	7(4.67)	62(41.33)	2.1734(0.6084,7.7638)
≥ 4 months	4(2.67)	77(51.33)	
Number of children			
One	5(3.33)	55(36.67)	1.2727(0.3703,4.3741)
More than one	6(4)	84(56)	
Delivery Type			
Normal	8(5.33)	85(56.67)	1.6941(0.4305,6.6672)
C-Section	3(2)	54(36)	
Type of food consumption			
Vegetarian	2(1.33)	74(49.33)	0.1952(0.0407,0.9361)
Non-Vegetarian	9(6)	65(43.33)	
Meals in a day			
≤ 2	2(1.33)	9(6)	3.2099(0.6015,17.1282)
> 2	9(6)	130(86.67)	1

The adequate ascorbic acid intake might in all probability have increased the iron within the diet of the ladies. The lactating women in this study (Table 5) met their vitamin A requirement by 1.3%. The main sources of vitamin A for the women were edible cooking oil, dark and ccoloured leafy vegetables as well as fruits.

Similar studies were reported among lactating women in African communities (Kobati *et al.*, 2012). The frequency of food consumption revealed that Ghee and edible oils were consumed daily. There were several homemade traditional food items consumed by lactating mothers which have rich vitamin A and in turn improve the presence in lactating mothers. The details of the p-value can be referred to in Table 6 which showed a significant positive relationship between Energy, Fat, and Carbohydrate intake with Weight and BMI

respectively.

5. Conclusion

The influence of the socio-demographic factors on maternal health and diet patterns was observed. Maternal family income, type of occupation, education and frequency of meal has a greater impact on the BMI of lactating mothers. Most of the respondents had low consumption of food components as compared to recommended values of RDA, Indian Council of Medical Research. Cereals and legumes were the main food consumed by lactating mothers leading to declining required micronutrients, especially calcium in their bodies. In light of the study, mindful intervention programs are required to educate lactating mothers on food supplementation and the nutritional needs of the

body. It's recommended to work on further study parameters that will help lactating mothers with better diet and health.

Conflict of interest

The authors declare no conflict of interest.

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