



FACTOR AFFECTING MATERNAL DIETARY PROTEIN INTAKE DURING PREGNANCY AND ASSOCIATION OF INADEQUATE PROTEIN INTAKE AND VARIOUS PREGNANCY OUTCOMES: THE OBSERVATIONAL CROSS-SECTIONAL STUDY

Obstetrics & Gynaecology

Dr Pallavi Gurav Assistant Professor, Department of OBGY, MGM MCH, Aurangabad.

Dr Swati Shiradkar Professor and Head of Unit, Department of OBGY, MGM MCH, Aurangabad.

Dr Suresh Rawate Associate Professor, Department of OBGY, MGM MCH, Aurangabad.

Dr Shilpi Verma Assistant Professor, Department of OBGY, Government Cancer Hospital, Aurangabad.

ABSTRACT

Background: Nutrition in pregnancy refers to the nutrient intake and dietary planning that is undertaken before, during and after pregnancy. Adequate protein intake is very important for the intrauterine growth of the foetus and the future wellbeing of the baby. **Methods:** This observational cross-sectional study involves 500 patients who delivered at MGM Medical College and Hospital Aurangabad. A pre-designed structured questionnaire was used in the form of one to one interview from which their protein and calorie intake was noted in structured format. Pregnancy outcome was noted. **Results:** Out of 500 women, 30.6% patients had inadequate protein intake and 69.4% patients had adequate protein intake. Formal education improves protein intake. Urban slum is having maximum number of patients with protein inadequacy. Vegetarian diet is significantly associated with inadequate protein intake. Inadequate protein intake and calorie intake is associated with preeclampsia, abruption, FGR, intrauterine foetal demise and anaemia and is statistically significant. **Conclusion:** Adequate protein intake in diet is modifiable risk factor of public health importance to prevent adverse birth outcomes.

KEYWORDS

Protein intake, Anaemia, Preeclampsia, FGR, Antenatal care

INTRODUCTION

We are what we eat, is a famous quote that holds more relevance than being just a quote. Protein forms an essential component of healthy diet to support both growth and maintenance. Protein in body plays structural (Keratin collagen) and functional (enzymes, transport protein, hormones) roles¹. Low maternal dietary protein can cause embryonic losses, Fetal growth restriction and reduced postnatal growth due to deficiency in specific amino acids that are important for cell metabolism and function².

The world Health Organization (WHO) guidelines on antenatal care (ANC) recommends balanced energy and protein supplementation for pregnant women to reduce the risk of still births and small for gestational age neonates³. We embarked this study to assess adequacy of protein intake during pregnancy, find out association of anemia and other complications with inadequate protein intake during pregnancy and to study factors affecting protein intake during pregnancy in an attempt to develop possible nutritional interventions to improve maternal and fetal outcome and long-term quality of life.

MATERIALS AND METHODS:

Study Design: This was observational cross-sectional study.

Study site and study Population:

This study was conducted at MGM Medical College and Hospital Aurangabad. The study included 500 pregnant women who delivered at MGM Hospital Aurangabad during the period of October 2015 to October 2017.

Inclusion Criteria: ANC patients visiting MGM hospital on IPD basis

Exclusion Criteria: Patients having known medical disorders with diet restrictions were excluded from study.

This study was approved by the institutional ethics committee.

Data collection:

Patients were informed about the purpose of the study and written, well informed and valid consent was taken.

A pre-designed structured questionnaire was used in the form of one to one interview. Patients were asked about the average daily diet they have consumed during pregnancy, from which their protein and calorie intake was noted in structured format. Data collection for each case included patient characteristic like education, area of stay, socioeconomic status, type of diet, antenatal care, diet counselling and

pregnancy outcomes including anemia, low birth weight, preeclampsia, placental abruption, intrauterine fetal demise.

Statistical analysis:

Descriptive statistics were used to describe the data. For categorical variables frequencies and percentages were reported differences between groups were analyzed using Pearsons Chi-squared test. P value less than 0.05 was significant.

OBSERVATIONS:

Factors associated with protein intake in pregnancy (Table 1)

This study enrolled 500 pregnant women who delivered at MGM Hospital out of whom 347 (69.4%) women were having adequate protein intake while 150(30.6%) were having inadequate protein. Calorie intake was found to be adequate in 309(61.8%) patients while it was inadequate in 191(38.2%) patients.

From our study it is noted that formal education improves protein intake. Protein intake was found to be inadequate in 45.50% of illiterate women while it was 30.3% in literate women. Urban slum is having maximum number of patients with protein inadequacy (44.90%). Protein intake was slightly lower in lower (36.80%) and upper (31%) socioeconomic status than middle (27.7%) socioeconomic strata but the difference is not statistically significant. In this study it was noted that Vegetarian diet was significantly associated with inadequate protein intake (39.40%) against with mixed diet inadequate protein intake (23%).

Regular antenatal care improves protein intake. Lack of antenatal care (35.80%) or no antenatal care (44.70%) was associated with significant inadequate protein intake. Protein intake was affected positively with doctor's advice. Amongst women who received diet counselling from doctor, 82.50% had adequate protein intake.

Table 1 : Factors associate with protein intake in pregnancy

Characteristics	Protein		x2-value	p-value
	Inadequate	Adequate		
Education				
Illiterate	5(45.50%)	6(54.50%)	1.169	P- 0.025 Significant p<0.05
Literate	148(30.30%)	341(69.7%)		
Area of stay				
Rural	19 (25.70%)	55 (74.30%)	29.446	0.000 Significant p<0.05
Urban Slum	84(44.90%)	103 (55.10%)		
Urban	50 (44.90%)	189(79.10%)		

Socioeconomic status				
Lower	49(36.80%)	84(63.20%)	3.615	0.164 Not Significant
Middle	82(27.70%)	214(72.30 %)		p>0.05
Upper	22(31.00%)	49(69%)		
Diet				
Vegetarian	91(39.40%)	140(60.60%)	15.636	0.000 Significant
Mixed	62(23%)	207(77%)		p<0.05
Antenatal care				
No Antenatal Care	24(35.82%)	43(64.10%)	46.52	0.000 Significant
Inadequate antenatal care	97(44.7%)	120(55.29%)		p<0.05
Adequate antenatal care	32(14.8%)	184(85.15%)		
Dietary Counselling				
None	46(43.80%)	59(56.19%)	26.639	0.000 Significant
From a Non Medical person	83(33.87%)	162(66.12%)		p<0.05
From a Paramedic	0%	13(100%)		
From a doctor	24(17.5%)	113(82.48%)		

Protein intake in pregnancy and pregnancy outcomes (Table 2):

Inadequate protein intake is associated with Anaemia and is statistically significant. Out of 153 women with inadequate protein intake 45.8% women had Anaemia. Amongst 347 women with adequate protein intake 31.4% were having Anaemia. Protein intake affects positively on birth weight. Low birth weight was noted in 101(68.71%) patients with inadequate protein intake. Inadequate protein intake is associated with preeclampsia and is statistically significant. With adequate protein intake 39.50% women had preeclampsia but with inadequate protein intake 60.50% women developed preeclampsia.

Less protein intake is associated with abortion and is statistically significant(p=0.000). Inadequate protein intake is associated with increased risk for intrauterine foetal demise and is statistically significant. Out of 34 patients who had intrauterine foetal demise 21 (61.80%) had inadequate protein intake.

Table 2: Protein intake in pregnancy and pregnancy outcomes

Characteristics	Protein Inadequate	Adequate	x2-value	p-value
Anaemia				
Present	70 (39.1%)	109(60.90%)	9.5	0.002 Significant
Absent	83(25.9%)	238(74.1%)		p<0.05
Low Birth Weight				
Present	101(68.71%)	46(31.29%)	142.381	0.000 Significant
Absent	52(14.73%)	301(85.27%)		p<0.05
Pre-eclampsia				
Present	52(60.50%)	34(39.50%)	43.623	0.000 Significant
Absent	101(24.40%)	313(75.60%)		p<0.05
Abortion				
Present	13(72.2%)	5(27.80%)	15.232	0.000 Significant
Absent	140(29.00%)	342(71.0%)		p<0.05
IUFD				
Present	21 (61.80%)	13 (38.20%)	16.684	0.000 Significant
Absent	132(28.30%)	334(71.70%)		p<0.05

DISCUSSION:**Protein intake during pregnancy:**

The additional protein requirement during pregnancy is measured as the mean of the requirement observed in healthy, well-nourished, pregnant women. This is called the Estimated Average Requirement (EAR). The EAR of protein during pregnancy is 0.88g/kg/day during 1st trimester and 1.1g/kg/day during 2nd and 3rd trimester⁴. Out of 500 women in our study, protein intake was found to be adequate in

347(69.4%) and inadequate in 153 (30.6%) cases, these findings were comparable with study by Phuong Hong Nguyen et al⁷ where inadequate protein intake was noted in 35.7% study participants.

Factors affecting protein intake during pregnancy:**Education:**

In this study, it was found 69.70% women with formal education were having adequate protein intake. Literacy for women is necessary for understanding and so that they can have control over social, personal and economic conditions. These findings were consistent with study done by Nguyen PH et al⁵ it was noted that educated patients seek advice more from doctors and also, compliance of the patient improves with education. Another study by Unisa S et al⁶ it was documented that education for at least 6 years has positive association with food diversity.

Area of stay:

In study at our institute, patients belonging to urban slum areas had inadequate protein intake as compared to urban and rural areas probably because this population has limited access to high quality food. This population needs to be targeted the most. A cross sectional study in urban slums of New Delhi by Suparna Ghosh – Jerath et al (2015)⁷ reported suboptimal intake of proteins and micronutrients in urban slum and need for strengthening nutritional counselling services.

Socioeconomic status:

Protein intake was slightly less in lower and middle socioeconomic status but is not statistically significant, as we had less patients from low socioeconomic status. These findings were similar to study conducted by Rajeev Singh Dhakad et al (2019)⁸. A study conducted by Shobha Rao⁹ noted 50% inadequacy of protein intake in lower socioeconomic strata.

Type of diet:

In this study, vegetarian diet significantly lacks adequate protein intake and maximum protein intake was seen with mixed diet. One has to be more careful in planning the diet.

Antenatal care:

In Our study, patients visiting for regular antenatal care were seen to have adequate protein intake. It suggests that regular antenatal care improves nutrition study by Suparna Ghosh Jerath et al⁷ where its noted protein intake was suboptimal in women who didn't avail ANC. The Cochrane database of systematic review by Erika Otis et al¹⁰ noted Protein intake increased significantly (three trials, 632 women) (protein intake: MD +6.99 g/day, 95% CI 3.02 to 10.97) with antenatal dietary education.

Diet counselling:

Protein and calorie intake was seen more when doctors had given advice. If the patients had followed the suggested dietary advice. Results are comparable to study by Khlood Bookari et al (2017)¹¹

A systematic review by Omar Dewidar et al¹² nutritional counselling during pregnancy may improve protein intake during pregnancy. (MD: 10.44 g, 95% CI, 1.83-19.05, two RCTs; $I^2 = 95\%$; high certainty of evidence using GRADE assessment)

Protein intake in pregnancy and pregnancy outcomes:

Anemia is associated with inadequate protein intake in study by Rian Diana et al¹³ findings were pregnant women with moderate anemia had a higher proportion of inadequate nutrient intake than mildly anemic pregnant. The majority of anemic pregnant women had <70% energy adequacy level and <90% protein adequacy level. Study results by Mira Triharini et al¹⁴ emphasized on significant association between the perceived benefits and the intake of protein and iron to prevent iron deficiency anemia.

In this study, it was found that adequate protein intake affects positively on birth weight. A systematic review and meta-analysis by Briony Stevens et al¹⁵ reported balanced protein energy supplementation significantly improved birthweight (seven randomized controlled trials, $n=2367$; $d=0.20$, 95% confidence interval, 0.03–0.38, $P=0.02$). review article by Cassandra M Herring et al² has stated that maternal protein nutrition has a pronounced impact on fetal programming and alters the expression of genes in the fetal genome and dietary Arginine supplementation during pregnancy

improved embryonic survival and growth by increasing placental angiogenesis and blood flow, as well as promoting embryonic protein synthesis.

There is statistically significant association between inadequate protein intake and development of Preeclampsia and Abruption too. In a study conducted by Punyatoya Bej et al¹⁶ factors, less protein intake was found to be significant predictor of risk for development of preeclampsia and eclampsia.

In this study inadequate protein intake was associated with intrauterine fetal demise, these findings were supported by review article by M S Krammer et al¹⁷ who reviewed trials in Cochrane database noted balanced energy protein supplementation is associated with significant reduction in risk of stillbirth. The Cochrane database of systematic review by Erika Otis et al¹⁰ reported there is significant reduction in risk of still birth with balanced energy protein supplementation.

CONCLUSIONS:

Adequate protein intake in diet is modifiable risk factor of public health importance to prevent adverse birth outcomes. Literacy and socioeconomic status has impact on protein intake during pregnancy. Regular antenatal care plays a great role. But there is a scope for proactive diet counselling of the pregnant lady and overall diet awareness in general population. There is need for empowering paramedical staff for correct diet counselling. There is still research gap, limited evidence available and more studies are warranted for forming recommendations about balanced protein energy supplementation in Indian population.

Financial Support and Sponsorship

Nil

Conflicts Of Interest

There are no conflicts of interest

Acknowledgements

We wish to thank the Department of OBGY, MGM Medical College and Hospital, Aurangabad for their assistance in conducting this study. We thank all the participants who gave consent to take part in this study.

REFERENCES

- 1) Elango R, Ball RO. Protein and Amino Acid Requirements during Pregnancy. *Adv Nutr*. 2016 Jul 15;7(4):839S-44S. doi: 10.3945/an.115.011817. PMID: 27422521; PMCID: PMC4942872.
- 2) Herring CM, Bazer FW, Johnson GA, Wu G. Impacts of maternal dietary protein intake on fetal survival, growth, and development. *Exp Biol Med* (Maywood). 2018 Mar;243(6):525-533. doi: 10.1177/1535370218758275. Epub 2018 Feb 22. PMID: 29466875; PMCID: PMC5882021.
- 3) WHO. *WHO Recommendations on Antenatal Care for a Positive Pregnancy Experience*. World Health Organization; Geneva, Switzerland: 2016. [Google Scholar]
- 4) Institute of Medicine. *Dietary Reference Intakes for Energy, Carbohydrates, Fiber, Fat, Fatty Acids, Cholesterol, Protein and Amino Acids*. National Academy Press; Washington, DC, USA: 2005. [Google Scholar]
- 5) Nguyen PH, Kachwaha S, Tran LM, Sanghvi T, Ghosh S, Kulkarni B, Beesabathuni K, Menon P, Sethi V. Maternal Diets in India: Gaps, Barriers, and Opportunities. *Nutrients*. 2021 Oct 9;13(10):3534. doi: 10.3390/nu13103534. PMID: 34684535; PMCID: PMC8540854.
- 6) Unisa S, Saraswat A, Bhanot A, et al. Predictors of the diets consumed by adolescent girls, pregnant women and mothers with children under age two years in rural eastern India. *Journal of Biosocial Science*. 2021;53(5):663-682. doi:10.1017/S0021932020000462
- 7) Ghosh-Jerath S, Devasenapathy N, Singh A, Shankar A, Zodpey S. Ante natal care (ANC) utilization, dietary practices and nutritional outcomes in pregnant and recently delivered women in urban slums of Delhi, India: an exploratory cross-sectional study. *Reprod Health*. 2015 Mar 20;12:20. doi: 10.1186/s12978-015-0008-9. PMID: 25889714; PMCID: PMC4396888.
- 8) Rajeev Singh Dhakad, and Abhishek Kumar. (2019). "NUTRITIONAL HEALTH STATUS WITH DIFFERENT ASPECT OF TARGET GROUP (PREGNANT AND LACTATING WOMEN): A LITERATURE REVIEW." *International Journal of Research - Granthaalayah*, 7(5), 38-48. <https://doi.org/10.5281/zenodo.3234662>.
- 9) Rao, Shobha. (2015). Swati Raje and Shobha Rao. Maternal Food consumption patterns and risk of low birth weight among poor communities in rural Maharashtra. (Accepted) *Indian Journal of Nutrition and Dietetics*. 2015. The Indian journal of nutrition and dietetics.
- 10) Ota E, Hori H, Mori R, Tobe Gai R, Farrar D. Antenatal dietary education and supplementation to increase energy and protein intake. *Cochrane Database of Systematic Reviews* 2015, Issue 6. Art. No.: CD000032. DOI: 10.1002/14651858.CD000032.pub3. Accessed 30 December 2023.
- 11) Bookari K, Yeatman H, Williamson M. Informing Nutrition Care in the Antenatal Period: Pregnant Women's Experiences and Need for Support. *Biomed Res Int*. 2017;2017:4856527. doi: 10.1155/2017/4856527. Epub 2017 Aug 14. PMID: 28890896; PMCID: PMC5584352.
- 12) Dewidar O, John J, Baqar A, Madani MT, Saad A, Riddle A, Ota E, Kung'u JK, Arabi M, Raut MK, Klobodu SS, Rowe S, Hatchard J, Busch-Hallen J, Jalal C, Wuchler S, Welch V. Effectiveness of nutrition counseling for pregnant women in low- and middle-income countries to improve maternal and infant behavioral, nutritional, and health outcomes: A systematic review. *Campbell Syst Rev*. 2023 Nov 29;19(4):e1361. doi: 10.1002/cl2.1361. PMID: 38034903; PMCID: PMC10687348.
- 13) Diana R, Khomsan A, Anwar F, Christianti DF, Kusuma R, Rachmayanti RD. Dietary Quantity and Diversity among Anemic Pregnant Women in Madura Island, Indonesia. *J Nutr Metab*. 2019 Sep 30;2019:2647230. doi: 10.1155/2019/2647230. PMID: 31662905; PMCID: PMC6791205.
- 14) Triharini, M., Nursalam, N., Sulistyono, A., Adriani, M., & Hsieh, P.L. (2018). Perceived Benefits and Intakes of Protein, Vitamin C and Iron in Preventing Anemia among Pregnant Women. *Jurnal Ners*, 13(2), 156-161. doi:<http://dx.doi.org/10.20473/jn.v13i2.7>
- 15) Stevens B, Buettner P, Watt K, Clough A, Brimblecombe J, Judd J. The effect of balanced protein energy supplementation in undernourished pregnant women and child physical growth in low- and middle-income countries: a systematic review and meta-analysis. *Matern Child Nutr*. 2015 Oct;11(4):415-32. doi: 10.1111/mcn.12183. Epub 2015 Apr 7. PMID: 25857334; PMCID: PMC6860195.
- 16) Bej P, Chhabra P, Sharma AK, Guleria K. Determination of Risk Factors for Preeclampsia and Eclampsia in a Tertiary Hospital of India: A Case Control Study. *J Family Med Prim Care*. 2013 Oct-Dec;2(4):371-5. doi: 10.4103/2249-4863.123924. PMID: 26664844; PMCID: PMC4649887.
- 17) Kramer MS, Kakuma R. Energy and protein intake in pregnancy. *Cochrane Database Syst Rev*. 2003;(4):CD000032. doi: 10.1002/14651858.CD000032. Update in: *Cochrane Database Syst Rev*. 2012;9:CD000032. PMID: 14583907.
- 18) Girard AW, Olude O. Nutrition education and counselling provided during pregnancy: effects on maternal, neonatal and child health outcomes. *Paediatr Perinat Epidemiol*. 2012 Jul;26 Suppl 1:191-204. doi: 10.1111/j.1365-3016.2012.01278.x. PMID: 22742611.
- 19) Mulyantoro, Donny & Kusriani, Ina. (2021). Protein Energy Deficiency Increases the Risk of Anemia in Pregnant Women. *IOP Conference Series: Earth and Environmental Science*. 810. 012043. 10.1088/1755-1315/810/1/012043.
- 20) Demilew, Y.M., Alene, G.D. & Belachew, T. Effect of guided counseling on nutritional status of pregnant women in West Gojjam zone, Ethiopia: a cluster-randomized controlled trial. *Nutr J* 19, 38 (2020). <https://doi.org/10.1186/s12937-020-00536-w>