Bulletin of Pure and Applied Sciences
Zoology (Animal Science), Vol.42A, No.1,
January-June 2023: P.64-86

Print version ISSN 0970 0765
Online version ISSN 2320 3188
DOI: 10.48165/bpas.2023.42A.1.7

Original Research Article *Content Available online at: https://www.bpasjournals.com/zoology*

Comparison of the Nutritional Health Profile of the Pregnant Women and its Association in Developing Anemia: A Progressive Study of the Rich and Poor Pregnant Women of the Ajmer City

[1,2]Swapana John* and [1]Dr. Prakash C Sharma

Author's Affiliation:
[1]Department of Zoology, S.P.C Government College, Beawar Road, Ajmer, Rajasthan 305001, India
[2]Department of Zoology, Sophia Girls' College (Autonomous), Ajmer, Rajasthan 335001, India

***Corresponding author:**
Swapana John,
Assistant Professor, Department of Zoology, Sophia Girls' College (Autonomous), Ajmer, Rajasthan 335001, India
E-mail: swapna4christ@gmail.com

Article Info:
Received on 23.11.2022
Revised on 20.01.2023
Approved on 15.05.2023
Accepted on 24.05.2023
Published on 16.06.2023

ABSTRACT:
Introduction- Anemia in pregnancy is one of the gravest world health crises affecting one fourth of the world population, mainly children and women of the reproductive age. The onset of anemia is attributed to two major classifications being 'Nutritional'-meaning deficiency of minerals and vitamins, and 'Non-nutritional' corresponding to infection and hemoglobinopathies. The only micronutrient mandatorily required supplementing to fill the gap between the dietary intake and the demand is iron. Micronutrient's iron, folate, and vitamins are very vital for the proper growth of the fetus during pregnancy. The diverse consequences of nutritional anemia are recurrent abortion, recurrent fetal loss, congenital abnormalities, preterm labour, reduced birth weight and neonatal and maternal mortalities. **Methodology-** It's an empirical, longitudinal, prospective, and comparative study using a structured questionnaire on the target group of the urban population in the city of Ajmer city. **Results and Conclusion-** Assessing BMI, there were 51.61% of anemic rich pregnant women who were considered malnourished as they belonged to the group with BMI < 18.4 kg/m^2 whereas among the poor anemic pregnant women it was 75.87% women under this BMI. Evaluating the poor non-anemic pregnant women, nearly 16.98% of women belonged to BMI < 18.4 kg/m^2 category and 8.95% of the rich non-anemic women who had their BMI < 18.4 kg/m^2. Among the rich non-anemic pregnant women, there were 37.74% who came under the category of overweight having BMI >23kg/m^2 and only 3.77% of poor non-anemic women grouped under over weight. The mean$\pm$SD of Hb at third trimester of the rich and poor pregnant women was 10.4$\pm$1.02 and 9.0$\pm$0.02 respectively.

Keywords: Anemia, Reproductive Health, Nutrition, Pregnant Women.

How to cite this article: John S. and Sharma P.C. (2023). Comparison of the Nutritional Health Profile of the Pregnant Women and its Association in Developing Anemia: A Progressive Study of the Rich and Poor Pregnant Women of the Ajmer City. *Bulletin of Pure and Applied Sciences-Zoology*, 42A (1), 64-86.

INTRODUCTION

Anemia in pregnancy is one of the gravest world health crises affecting one fourth of the world population, mainly children and women of the reproductive age. It is a major crisis having long-term and short-term outcomes during pregnancy and even beyond. According to WHO approximation, globally more than half of the pregnant women have hemoglobin level less than 11.0gm/dl. Worldwide, the number of people affected by anemia according to WHO is approximated to be about 2 billion and nearly 50% of all instances can be ascribed to IDA (WHO, 2001). Over 115,000 maternal deaths and 591,000 perinatal deaths occur globally due to anemia, the largely affected continents being Africa and Asia (Ezzati, M. *et al*., 2004).In developing countries 58% women are anemic and 20% of all maternal deaths are due to anemia. In terms of the attributable disease burden, anemia is considered as one of the ten leading global risk factors (McLean, E. *et al*., 2007). Anemia also affects the social and economic progress drastically. It is a major factor for global Disability-Adjusted Life Years (DALYs) in women between the age of 15–49 years. Nearly 3.4% of DALYs is caused due to anemia (Rahman, M. M. *et al*; 2016).

LITERATURE REVIEW

The onset of anemia is attributed to two major classifications being 'Nutritional'-meaning deficiency of minerals and vitamins, and 'Non-nutritional' corresponding to infection and hemoglobinopathies. The important role is, however, played by iron deficiency. It goes without mentioning that the importance of iron in human body significantly acts as the oxygen transporter. Incidentally, there is a low availability of iron in the diets to a major population of the entire global population. Considering the staple food consumed, the average daily absorption of iron from Indian diet ranges from 0.8 mg/day to 4.5 mg/day, while that of a Western diet lies between 1–5 mg/day. The inadequate diet and not having prenatal iron and folate supplement are the main reasonsfor the nutritional anemia in pregnant women.

In the book Nutrition during Pregnancy, the authors Kim, I. *et al*., (1992), observe that the only micronutrient mandatorily required supplementing to fill the gap between the dietary intake and the demand is iron. Pregnant women are particularly at a higher risk of nutritional IDA. Micronutrient's iron, folate, and vitamins are very vital for the proper growth of the fetus during pregnancy. Anemia resulting from ID leads to a condition in which the RBC become microcytic and hypochromic (Urrechaga, E.*et al*., 2015). People with low socio-economic status and having a low body weight have constantly higher prevalence of developing anemia and so are women who have recently delivered (Bentley, M. E., & Griffiths, P. L., 2003). Socio-economic factors may be an additional factor associated with maternal nutritional status and thus leading to anemia. In the low socio-economic communities, the adolescent girls enter pregnancy with a very low nutrient store and are therefore at a higher risk of nutritional inadequacies. Psychological, socio-economic and demographic status, and cultural food taboos are all directly or indirectly associated with nutritional factors leading to anemia.

Non-nutritional factors leading to anemia are difficult to identify. There can be a misinterpretation of trends, if focused only on the nutritional aspect of the causation of anemia (Stoltzfus, R. J., 1997). It is indeed a challenge to examine anemia, which concurrently requires knowledge of the epidemiology of its fundamental and primary grounds of origin. Considering the high-risk population, estimates propose that the occurrence of anemia can be as high as 50% - 80% of which moderate to severe anemia can be accounted to 10% - 20% respectively (World Health Organization., 1992). Infections, multiple pregnancies and hemoglobinopathies are all non-nutritional factors leading to the occurrence of anemia.

There are diverse consequences of nutritional anemia like recurrent abortion, recurrent fetal loss, congenital abnormalities, and neonatal and maternal mortalities (Haas, J. D., & Fairchild, M. W., 1989). Mental and motor formation related

issues are seen in children (McCann, J. C., & Ames, B. N., 2007). Preterm labour, reduced birth weight (Rasmussen, K. M., 2001), increased child and maternal mortality (Brabin, B. J., Premji, Z., & Verhoeff, F., 2001) are linked with anemia, especially acute cases. Small gestational age babies, pre-term babies increase along with perinatal mortality for those mothers who are anemic. Mean weight, Apgar score, hemoglobin level after 3 months and birth weight are also significantly affected. Anemia in pregnancy eventually accelerates the rate of both maternal and neonatal mortality (Balarajan, Y. *et al*., 2011).

MATERIALS AND METHOD

The present empirical, longitudinal, prospective, and comparative study was conducted on the rich and poor pregnant women of the urban population in the city of Ajmer to determine the nutritional status and its impact on developing anemia in pregnant women.

It was a an empirical, longitudinal, prospective, and comparative study of the pregnant women using a structured questionnaire to analyse the various nutritional causes leading to the prevalence of anemia among the pregnant women for the rich and poor urban population in the city of Ajmer.

The four hospitals of the city were targeted for the sample collection. Asha sahyoginis working at different PHC's within the Ajmer city were also sought to monitor and maintain contacts with the pregnant women. However, all the deliveries occurred in the given two government hospitals and two private hospitals which are as follows:

Table 1: List of Hospitals

S. No.	Name of the Hospital	Type of Hospital	Location
1.	St. Francis Hospital	Private	Beawar Road
2.	Holy Family Hospital	Private	Bhatta
3.	Janana Hospital	Government	Pushkar Road
4.	Satellite Hospital	Government	Adarsh Nagar

The Research design for the present study was carried out in a longitudinal, descriptive, and progressive way to identify the role of various independent variables such as psychological, socio-economical, demographical and nutritional factors leading to anemia and the impact of anemia on pregnancy outcomes. The data for the present empirical study is primary and secondary in nature. The primary data is collected using a structured questionnaire schedule. The pregnant woman was monitored specifically from her second trimester till delivery. The independent and dependent variables, also classified into primary and secondary data that were used in the research were designed meticulously, considering every aspect of the research work. The independent variables were:

1. Specific Information of the Pregnant Woman with Respect to Dietary and Nutritional Variable: anthropometric measurement of the pregnant woman consisting of her height, weight at first and last trimester, BMI and total weight gained. Clinical assessment with respect to breathlessness, weakness, dizziness/fatigue and pale conjunctivitis of the eyes. Biochemical investigation involving the level of hemoglobin before pregnancy and during the second and third trimester, number of hospital visits, number of iron and folic acid consumed. Dietary survey pertaining to eating habits, number of meals per day, number of coffee and tea and total intake of nutrition value based on a 24-hour recall method for 3 consecutive days.

The dependent variables are:

Secondary Data

Prevalence and Frequency of Anemia: Frequency of mild, moderate, and severe anemia in both the study group.

2. Phase I: Nutritional Status Index:

a. Anthropometric Measurements:

The physical growth of the pregnant women was judged based on their height, weight at 1st and 3rd trimester and weight gained and BMI.

Height: The height of the woman was measured on the first visit with the help of a narrow flexible and a non-stretchable tape. Subjects were instructed to remove their shoes and stand with their middle of the back touching the scale with their feet parallel and their heels touching the ground. Their thighs, back and shoulders were also touching the scale; the head was comfortably held upright. During the measurement, the scale gently lowered, crushing the hair on the head to provide an accurate measurement of the height. The height was converted in feet (ft) as the arms hung naturally at the sides.

Weight: The weight of the subject is a vital part of anthropometric measurement. A platform weighing balance was used to measure weight and calibrated before each measurement. The woman stood barefoot on the centre of the platform, wearing a minimum amount of clothing, looking straight ahead, without touching anything else, and weighed themselves in kilograms up to 0.1kg accuracy (Jelliffe, D. B., & World Health Organization., 1966); (Sheth, T. N. *et al*., 1997).

Body Mass Index (BMI): Calculating the BMI was done using the woman's weight at last trimesters (34-37 weeks) respectively. Any value of BMI < 18.5kg/m^2 was an indicator of undernourishment. The Rosso and Mardones defines categories of maternal nutritional status according to mother's weight and height category. It is calculated by the following formula-

Weight in kg / Height in m^2= kg / m^2

Table 2: BMI for Indian Women

BMI Class (kg / m^2)	Category
< 18.4	Underweight
18.5 – 22.9	Normal
23 – 24.9	Overweight
> 25	Obese

Weight gain: Weight gain during pregnancy is yet another tool for assessing the maternal nutritional status. It is taken as an important way to assess the well-being of the mother and the child. Pregnant women gain approximately 11-16 kg on average. In the first trimester, the weight is distributed evenly between 1-2 kg; in the second and third trimesters, the weight is distributed at a linear rate of 0.4 kg/week (Rao, B. M., & Reddy, P. N., 1996). Subtracting the weight gained during the third trimester from the weight gained during the first trimester allows the estimation of weight gain.

b. Clinical Evaluation:

The clinical signs present in the women were noted as relevant clinical indicators which should be considered when assessing nutritional status.

Breathlessness: If the woman experienced difficulty in breathing.

Weakness: Lack of interest in daily chores. Unhealthy and inadequate diet may result in weakness. Incessant weakness can be serious and may be an alarming sign for anemia.

Dizziness / fatigue: Fatigue results in weakness and reduced work efficiency. Dizziness / fatigue can be due to lack of food or consumption of low nutritive food. Persistent dizziness or fatigue will again eventually lead to anemia.

Conjunctivitis of the eyes: Eyes being the most customary sign, which clinically assess anemia. Lack of nutritive diet results in pale conjunctivitis of the eyes.

c. Dietary Survey:

Type of food consumed: If the lady was on vegetarian or on non-vegetarian diet. Non-vegetarian includes meat, fish and egg.

Pattern of Meal: The pattern of eating meals by the pregnant women in each semester was taken into consideration. If the woman consumed

meal < 4 times, 4-5 times,6-7 times, or >7 times a day.

d. Nutritional Survey:

A diet intake in 24-hour recall method for three consecutive days was used to calculate the nutrition value, as this is a best method wherever a regular meal pattern is followed (Thimmayamma, B. V. S., & Parvathi, R., 2009). The information thus acquired was used to calculate the daily intake of food. The diet was categorised as cereals, pulses, milk and milk products, green leafy vegetables, other vegetables, roots and tubers, sugar and jaggery, egg and meat. The amount of raw food and cooked food items used by the pregnant woman for all meals were recorded according to household measures like bowls, cups, and consistency. Household measures were standardized to determine the quality of the food consumed. Data thus procured was further furnished by translating into average intake of food. This was then converted into grams of raw food, as the value taken was in grams. The intake in terms of raw amounts was calculated by the following formula:

$$\text{Raw amount of food item (gm)} = \frac{Total\ raw\ quantity\ used\ in\ preparation\ (gm)}{Total\ cooked\ quantity\ of\ food\ after\ preparation\ (gm)} \times$$

e. Nutritional Assessment:

The average daily consumption of various foodstuffs was calculated and was compared with the suggested Recommended Dietary Allowances (RDA). The important nutrients that were calculated were energy in (kcal); protein (gm); calcium (mg); iron (mg) and fat (gm). A comparison was made between the mean nutrient intakes for three consecutive days with Recommended Dietary Allowances (NIN, N., 2010). The mean nutrient intake was tabulated and compared with the RDA values given by ICMR to assess the nutrient adequacy of their present diets (Gopalan, C. *et al*., 2000). The Recommended Dietary Intake (RDI) recommendation for adequacy of food intake for moderate women as per National Institute of Nutrition (NIN) 2010 was used as the benchmark to analyse the percent adequacy of food intake.

3. Phase II Maternal Anemia (Secondary Data):

The mothers were assessed for the prevalence of mild, moderate and severe anemia in their second and third trimester associating it with the various psychological, socio-economic, demographic, and nutritive factors.

a. Biochemical Investigation: Prior to any clinical symptoms to occur due to the deficiency diseases; the first to manifest are the biochemical changes. Biochemical tests conducted on body fluids such as blood and urine etc. help to diagnose the disease at the sub-clinical stage, and confirm clinical diagnosis at the disease stage as mostly the clinical signs and symptoms are non-specific (Bamji, M. S., 1999). For the present study the hemoglobin level of the pregnant women in their second and third trimester was taken for the biochemical estimation. Biochemical analysis for hemoglobin in gm/dl was assessed as the secondary data. Clinical signs and symptoms and the biochemical analysis report on the level of hemoglobin were taken into consideration for the research. As per the WHO definitions and guidelines, level of hemoglobin is the primary exposure for the pregnant women and it is categorised as severe, mild and moderate as follows:

b. Hemoglobin level: The normal level of hemoglobin is 11 gm/dl. A value <11gm/dl in the first trimester, <10.5 in the second trimester and Hb <11gm/dl in the third trimester is considered as anemic (AAP, C., & American Academy of Pediatrics., 1993) (Table 3 and 4).

Table 3: Cut-off Values for IDA in Children, Women of Child-bearing Age, and Pregnant Women

Group and Age (years)	Concentration of Hemoglobin (gm/dl)	Hematocrit value (%)
Children (>years)		
0.5-4.9	11.0	33
5.0-11.9	11.5	35
Women		
Non-pregnant	12.0	36
Pregnant, first trimester	11.0	33
Pregnant, second trimester	10.5	32
Pregnant, third trimester	11.5	34

Sources: CDC (1989); AAP, CON (1993).

Table 4: Grades of Anemia According to the Hemoglobin Level

S. No	Grades of Anemia	Level of Hb (gm/dl)
1.	Severe Anemia	<7gm / dl
2.	Moderate Anemia	7 - 10gm / dl
3.	Mild Anemia	>10 - <11gm / dl
4.	Normal	>11gm / dl

Source: Murphy, J. F., (2011)

Hemoglobin values are rounded off to the nearest 0.5 gm / dl, and hematocrit is rounded off to the nearest percent.

OBSERVATIONS AND RESULTS

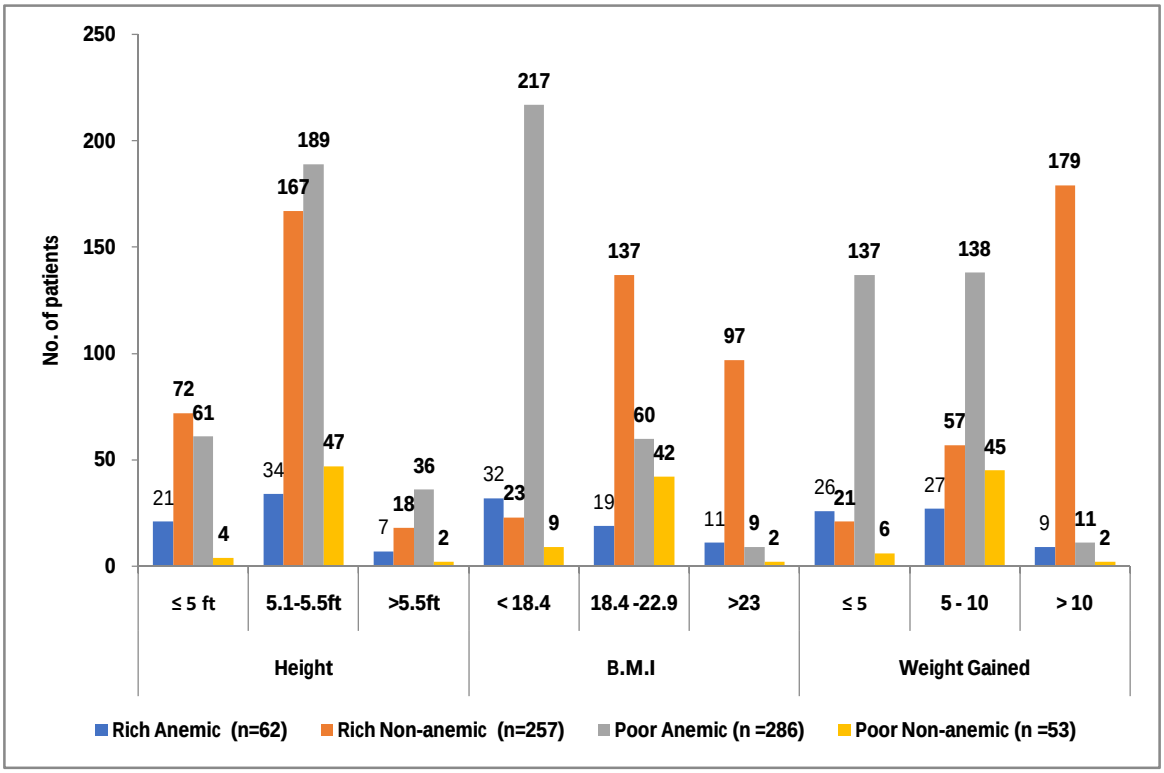
1. Specific Information with Respect to Nutritional Profile and its Association with Anemia in the Study Groups:

The given table 5 depicts a comparative observation of nutritional profile and its association with anemia among the study group, the first criteria under it being height. There were 33.87% rich anemic pregnant women who had their height less than 5ft., while for the poor anemic pregnant women with height less than 5ft. was 21.33%. However, 28.02% of non-anemic rich pregnant women had their height less than 5ft., while 7.55% of the poor non-anemic pregnant women whose height was less than 5ft. Another important criterion was assessing BMI, there were 51.61% of anemic rich pregnant women who were considered malnourished as they belonged to the group with BMI < 18.4 kg/m^2 whereas among the poor anemic pregnant women it was 75.87% women under this BMI. Evaluating the poor non-anemic pregnant women, it was surveyed that nearly 16.98% of women belonged to BMI < 18.4 kg/m^2 category and 8.95% of the rich non-anemic women who had their BMI < 18.4 kg/m^2. Among the rich non-anemic pregnant women, there were 37.74% who came under the category of overweight having BMI >23kg/m^2 and only 3.77% of poor non-anemic women grouped under over weight.

Considering the rich anemic pregnant women, it was found that 41.94% of women gained ≤ 5kg during their period of pregnancy and only 14.52% women gained more than 10 kgs. In relation to the poor anemic pregnant women, it was found that only 3.85% pregnant women gained more than 10 kg while 48.25% of them gained between 5 - 10 kg and 47.90% of them gained ≤ 5 kg. Contrasting this observation with that of the poor non-anemic pregnant women, it was noticed that 84.91% of women gained 5 - 10 kg and only 3.77% of them gained more than 10 kg during their gestation. With regard to the non-anemic rich pregnant women, there were only 8.17% of them who gained ≤ 5 kg and 69.65% of them gained more than 10 kg.

Table 5: Specific Information with Respect to Nutritional Profile and its Association with Anemia in the Study Groups

Anthropometric Measurement	Rich (Total= 319)				Poor (Total= 339)			
	Anemic (n=62)		Non-anemic (n=257)		Anemic (n =286)		Non-anemic (n =53)	
	Number	%	Number	%	Number	%	Number	%
Height								
≤5ft	21	33.87	72	28.02	61	21.33	4	7.55
5.1-5.5ft	34	54.84	167	64.98	189	66.08	47	88.68
>5.5ft	7	11.29	18	7.00	36	12.59	2	3.77
B.M.I (kg/m²)								
< 18.4	32	51.61	23	8.95	217	75.87	9	16.98
18.4 -22.9	19	30.65	137	53.31	60	20.98	42	79.25
>23	11	17.74	97	37.74	9	3.15	2	3.77
Weight Gained (kg)								
≤ 5	26	41.94	21	8.17	137	47.90	6	11.32
5 - 10	27	43.55	57	22.18	138	48.25	45	84.91
> 10	9	14.52	179	69.65	11	3.85	2	3.77



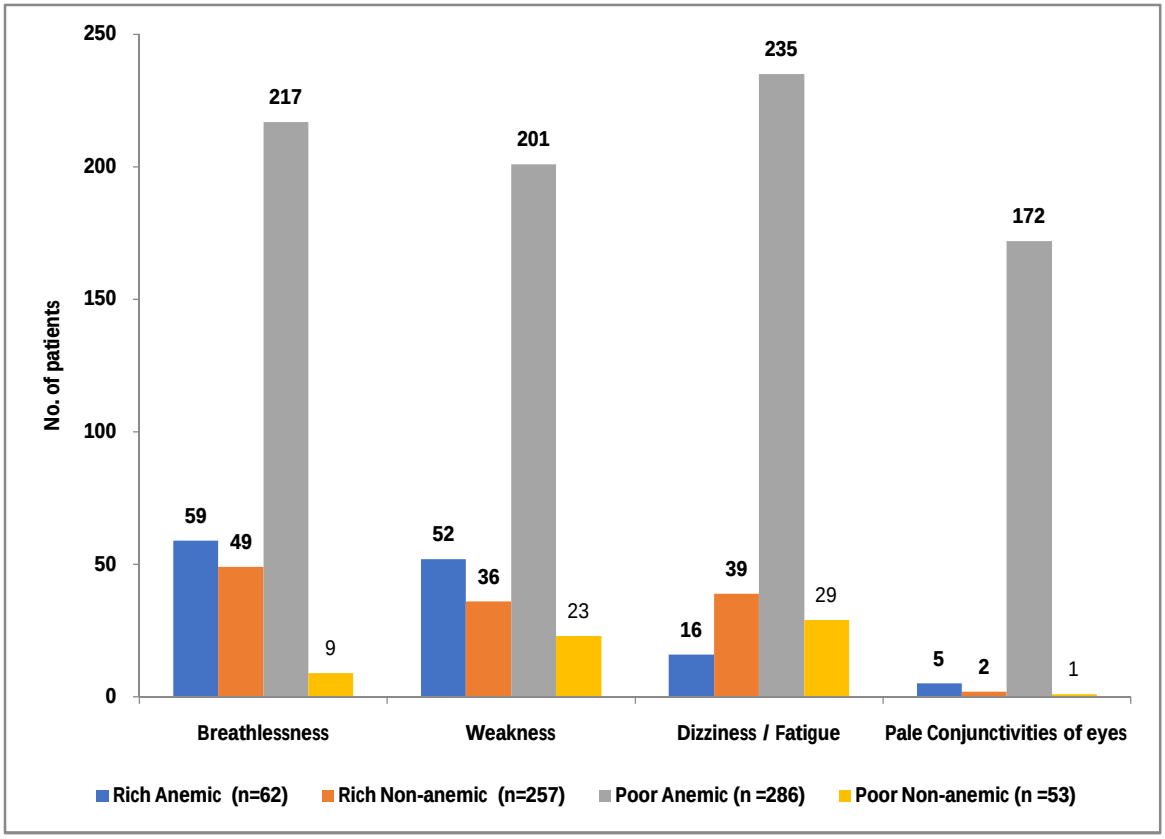
Graph 1: Specific Information with Respect to Nutritional Profile and its Association with Anemia in the Study Groups

2. Comparison of the Deficiency Signs and Symptoms among the Study Groups:

The given table 6 illustrates the comparison of the deficiency signs and symptoms among the study group. There were 95.16% of rich anemic pregnant women who suffered from breathlessness, 83.87% of women complained of weakness and 25.81% experienced dizziness/ fatigue and 8.06% of women had pale conjunctivitis of the eyes. Considering the poor anemic pregnant women, it was seen that were 75.87% of them who complained of breathlessness, 70.28% of them experienced weakness and 82.17% of them endured dizziness /fatigue and 60.14% of them had from pale conjunctivitis of the eyes. Comparing these criteria with that of the poor non-anemic pregnant women, it was found that there were 16.98% of them who suffered with breathlessness, 43.40% of them complained of weakness and 54.72% of them experienced dizziness/fatigue and 1.89% had pale conjunctivitis of the eyes. However, for the non-anemic rich pregnant women, 19.07% of them complained of breathlessness, 14.01% of them experienced weakness, 15.18% of them endured dizziness/fatigue and only 0.78% of women suffered from pale conjunctivitis of the eyes.

Table 6: Comparison of the Deficiency Signs and Symptoms among the Study Groups

Clinical Signs	Rich (Total= 319)				Poor (Total= 339)			
	Anemic (n=62)		Non-anemic (n=257)		Anemic (n =286)		Non-anemic (n =53)	
	Number	%	Number	%	Number	%	Number	%
Breathlessness	59	95.16	49	19.07	217	75.87	9	16.98
Weakness	52	83.87	36	14.01	201	70.28	23	43.40
Dizziness / Fatigue	16	25.81	39	15.18	235	82.17	29	54.72
Pale Conjunctivitis of eyes	5	8.06	2	0.78	172	60.14	1	1.89



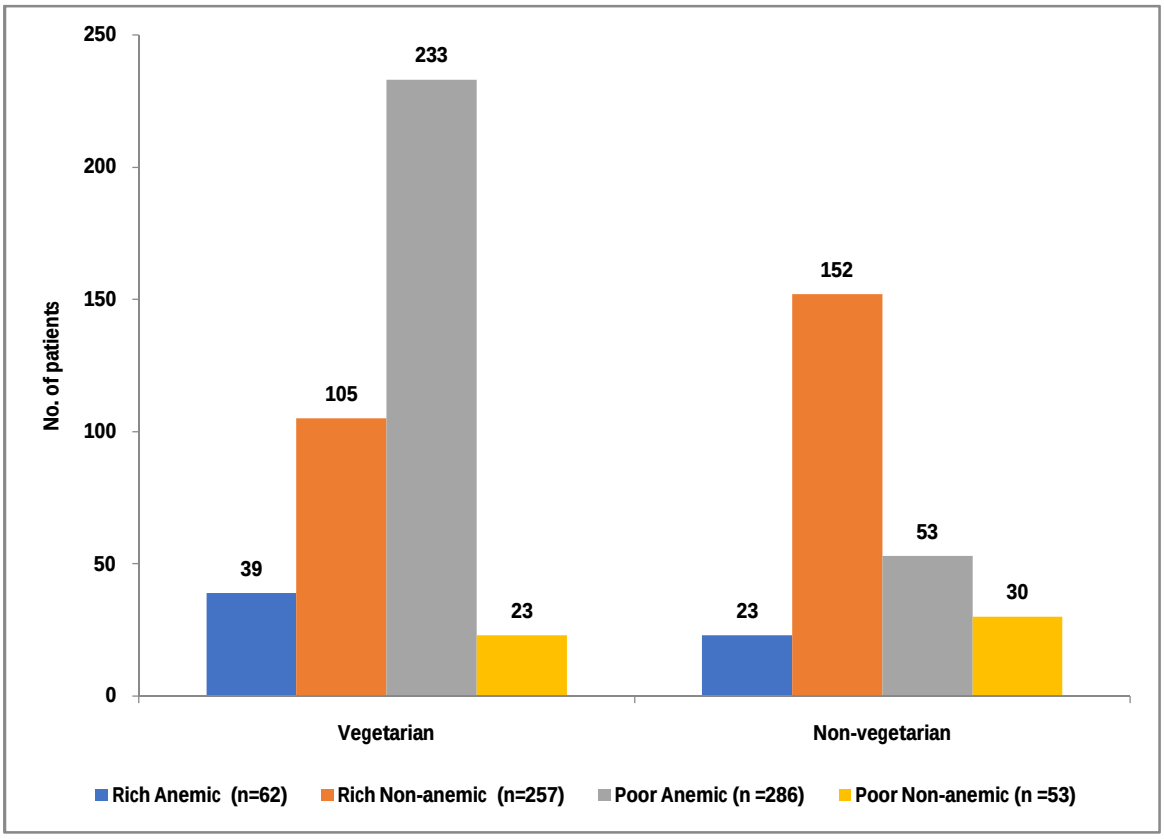
Graph 2: Comparison of the Deficiency Signs and Symptoms among the Study Groups

3. Comparison of Dietary Habits and its Association with Anemia among the Study Groups:

The given table 7 presents comparative information of dietary habits and its association with anemia. It was observed among the rich section that 62.90% of women who were strictly vegetarian and were anemic and 59.14% were non-vegetarian among the non-anemic rich pregnant women. Comparing them with the poor anemic section, it was noticed that 81.47% of women who were vegetarian were anemic and 56.60% non-anemic were on a non-vegetarian diet.

Table 7: Comparison of Dietary Habits and its Association with Anemia among the Study Groups

Dietary Habit	Rich (Total= 319)				Poor (Total= 339)			
	Anemic (n=62)		Non-anemic (n=257)		Anemic (n =286)		Non-anemic (n =53)	
	Number	%	Number	%	Number	%	Number	%
Vegetarian	39	62.90	105	40.86	233	81.47	23	43.40
Non-vegetarian	23	37.10	152	59.14	53	18.53	30	56.60



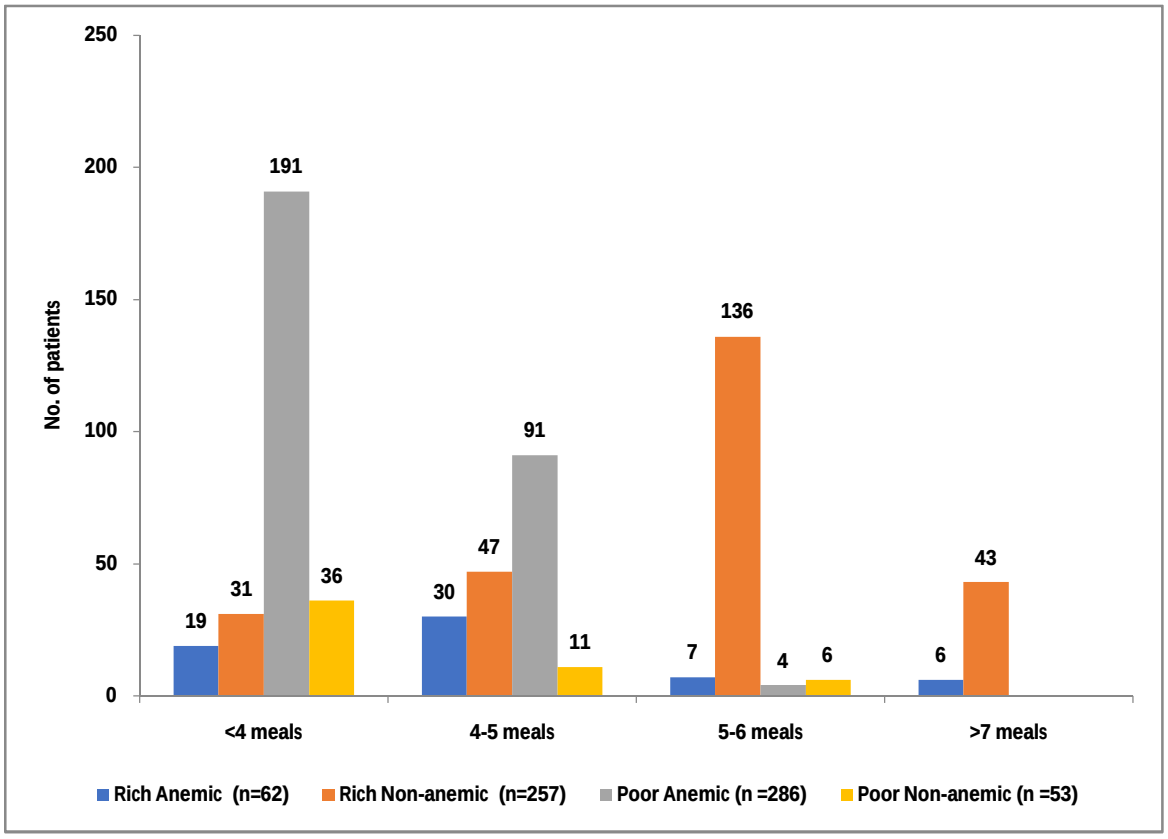
Graph 3: Comparison of Dietary Habits and its Association with Anemia among the Study Groups

4. Comparison of Number of Meals Per-Day and its Association with Anemia among the Study Groups:

The given table 8 displays the comparison of number of meals per day and its association with anemia in the study group. It was observed that 30.65% of the rich pregnant women who had less than 4 meals per day, were anemic, 48.39% of them who had 4-5 meals per day too were anemic while there were only 11.29% of the same category who had at least 5 meals per day and were anemic. However, in the rich non-anemic there were only 12.06% and 18.29% of women who had meals either less than 4 and 4-5 times per day respectively. When comparing the data with the poor anemic women it was seen that there were 66.78% of women who had meals less than 4 times a day. While 31.82% women had meals 4-5 times a day and were anemic. While in the poor non-anemic there were only 67.92% women consumed food less than 4 times and 20.75% had meals 4-5 times a day, while among the rich non-anemic there were 52.92% who had meals 5-6 times a day.

Table 8: Comparison of Number of Meals Per-Day and its Association with Anemia among the Study Groups

Number of meals / days	Rich (Total= 319)				Poor (Total= 339)			
	Anemic (n=62)		Non-anemic (n=257)		Anemic (n =286)		Non-anemic (n =53)	
	Number	%	Number	%	Number	%	Number	%
<4 meals	19	30.65	31	12.06	191	66.78	36	67.92
4-5 meals	30	48.39	47	18.29	91	31.82	11	20.75
5-6 meals	7	11.29	136	52.92	4	1.40	6	11.32
>7 meals	6	9.68	43	16.73	0	0.00	0	0.00



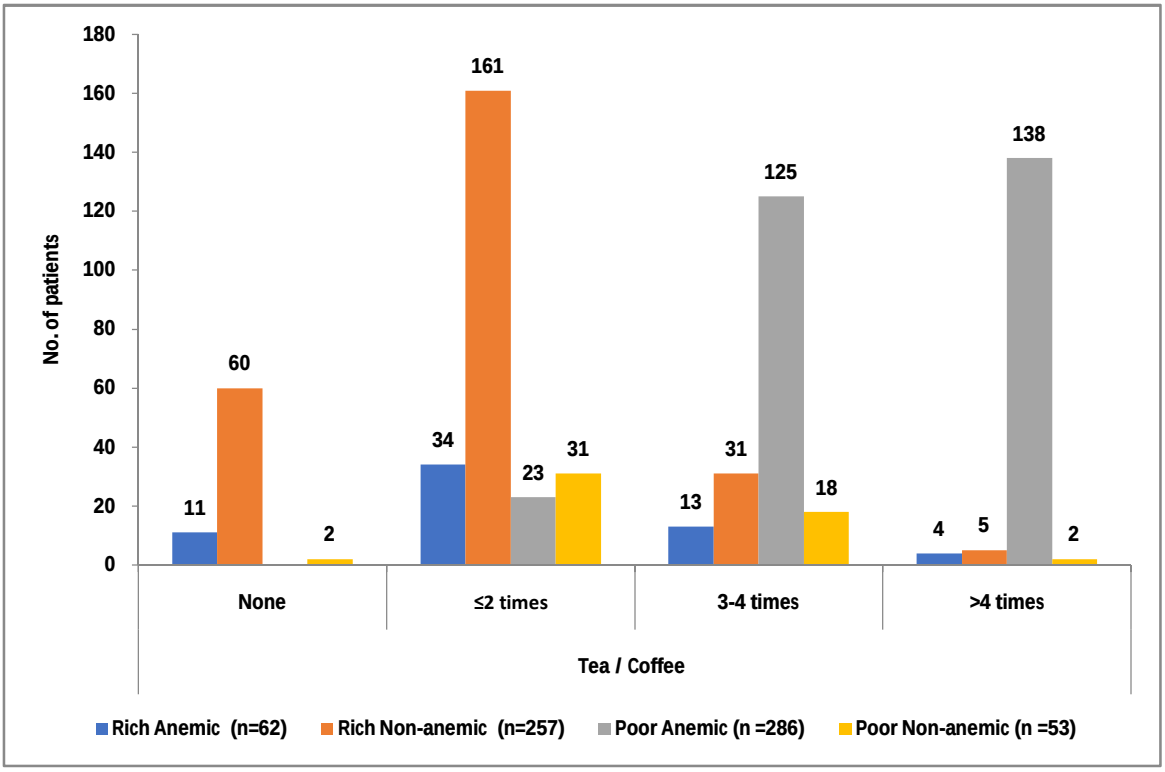
Graph 4: Comparison of Number of Meals Per-Day and its Association with Anemia among the Study Groups

5. Comparison of Number of Coffee / Tea Per-Day and its Association with Anemia among the Study Groups:

This given table 9 compares the frequency of tea or coffee consumption and its association with anemia among the study group. It was perceived that 43.71% and 48.25% of the poor pregnant women had coffee or tea 3-4 times or more than 4 times a day respectively and were anemic whereas 20.97% and 6.45% of the rich anemic pregnant women who had tea or coffee more than 3 times or tea 3-4 times a day respectively and were anemic. A higher percentage 58.49% and 62.65% poor and rich pregnant women respectively had tea less than 2 times a day and were non-anemic.

Table 9: Comparison of Number of Coffee / Tea Per-Day and its Association with Anemia among the Study Groups

No. of coffee / tea per day	Rich (Total= 319)				Poor (Total= 339)			
	Anemic (n=62)		Non-anemic (n=257)		Anemic (n =286)		Non-anemic (n =53)	
	Number	%	Number	%	Number	%	Number	%
None	11	17.74	60	23.35	0	0.00	2	3.77
≤ 2 times per day	34	54.84	161	62.65	23	8.04	31	58.49
3 - 4 times per day	13	20.97	31	12.06	125	43.71	18	33.96
> 4 times per day	4	6.45	5	1.95	138	48.25	2	3.77



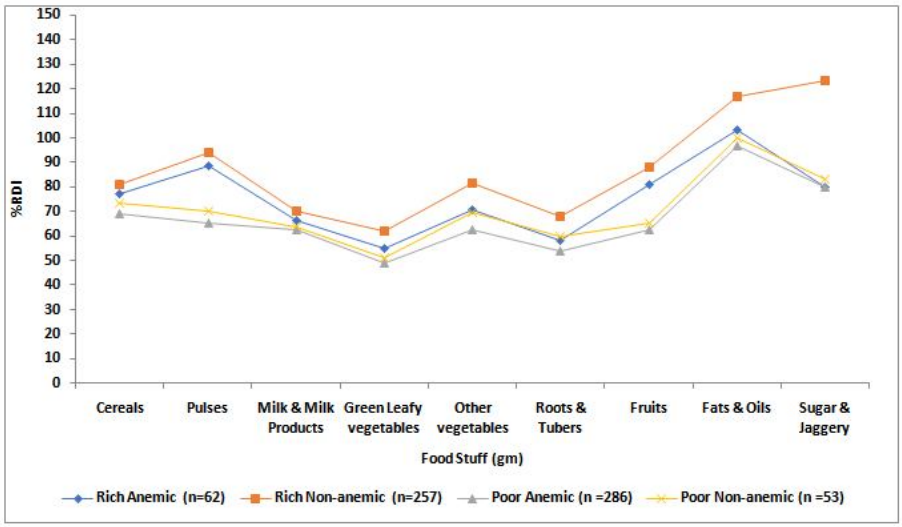
Graph 5: Comparison of Number of Coffee / Tea Per-Day and its Association with Anemia among the Study Groups

6. Comparison of the Intake of Food Stuff as Percent Balanced Dietin the Study Groups:

The given table 10 compares the food intake of the rich and poor pregnant women with that of RDI. The % RDI for various food stuff namely cereals, pulses, milk and milk products, green leafy vegetables, other vegetables, roots and tubers, fruits, fats and oils and sugar and jaggery was 76.92%, 88.75%, 66.25%, 55%, 70.67%, 58%, 80.91%, 103% and 80% respectively for the rich anemic, while for the poor anemic the values were 69.23%,65%,62.37%, 49%, 62.66%, 54%, 62.72%, 96.66% and80%. Contrasting these data for the rich non-anemic the values were 80.76%, 93.75%, 70%, 62%, 81.33%, 68%, 88%, 116.66% and 123.33%. However, for the poor nonanemic the value for % RDI for the food stuff were 73.46%, 70%, 63.87%, 51%, 69.33%, 60%, 65.45%, 100% and 83.33%.

Table 10: Comparison of the Intake of Food Stuff as Percent Balanced Diet in the Study Groups

Food Stuffs (gm)	Suggested Intake in gm (RDI)	Rich (Total= 319)				Poor (Total= 339)			
		Rich Anemic (n=62)		Rich Non-anemic (n=257)		Poor Anemic (n =286)		Poor Non-anemic (n =53)	
		Mean	%RDI	Mean	%RDI	Mean	%RDI	Mean	%RDI
Cereals	260	200	76.92	210	80.76	180	69.23	191	73.46
Pulses	80	71	88.75	75	93.75	52	65	56	70
Milk & Milk Products	800	530	66.25	560	70	499	62.37	511	63.87
Green Leafy vegetables	100	55	55.00	62	62	49	49	51	51
Other vegetables	75	53	70.67	61	81.33	47	62.66	52	69.33
Roots & Tubers	50	29	58.00	34	68	27	54	30	60
Fruits	110	89	80.91	97	88	69	62.72	72	65.45
Fats & Oils	30	31	103.33	35	116.66	29	96.66	30	100
Sugar & Jaggery	30	24	80.00	37	123.33	24	80	25	83.33



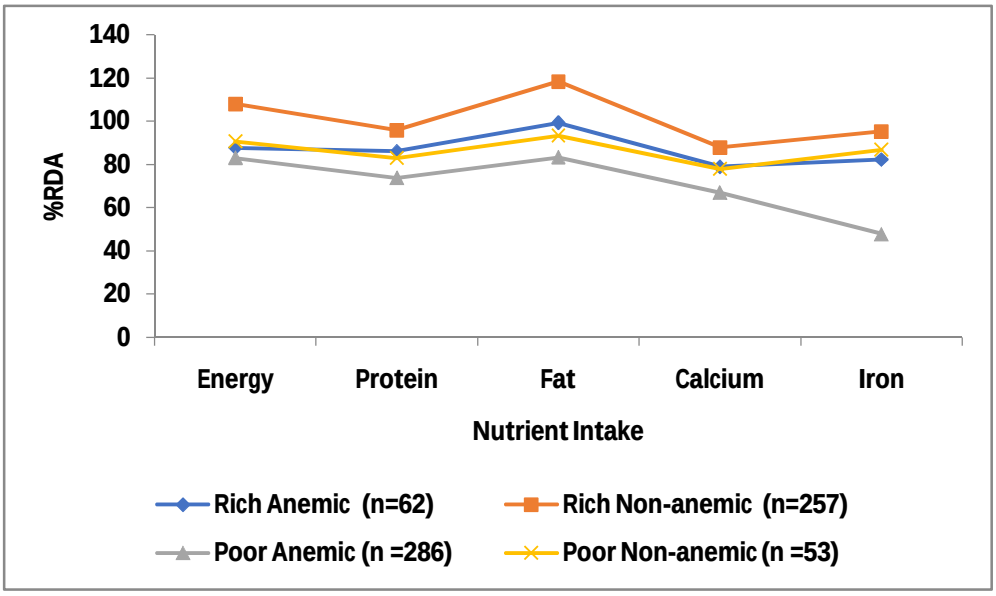
Graph 6: Comparison of the Intake of Food Stuff as Percent Balanced Diet in the Study Groups

7. Comparison of Nutrition Intake and its Association with Anemia among the Study Groups:

Associating and comparing the role of nutrition for the occurrence of anemia. The rich anemic pregnant women had their % RDA for energy, protein, fat, calcium and iron as 87.77%, 86.15%, 99.33%, 79% and 82.37% respectively while the poor anemic had their % RDA values for the same criteria as 83.08%, 73.84%, 83.33%, 67% and 47.89% respectively. Comparing these values of % RDA for the rich non-anemic it was found to be 107.86%, 95.85%, 118.33%, 87.90% and 95.26% respectively while for the poor non-anemic the value of % RDA for energy, protein, fat, calcium and iron was 90.62%, 83.08%, 93.33%, 78% and 86.84% respectively .

Table 11: Comparison of Nutrition Intake and its Association with Anemia among the Study Groups

		RDA values	Rich (Total= 319)						Poor (Total= 339)					
			Rich Anemic (n=62)			Rich Non-anemic (n=257)			Poor Anemic (n =286)			Poor Non-anemic (n =53)		
			Mean	SD	%RDA	Mean	SD	%RDA	Mean	SD	%RDA	Mean	SD	%RDA
Nutrient Intake	Energy (kcal)	2175	1909	168.46	87.77	2346	133.12	107.86	1807	169.4	83.08	1971	170.2	90.62
	Protein (gm)	65	56	2.1	86.15	62.32	2.2	95.85	48	2.5	73.84	54	3.2	83.08
	Fat (gm)	30	29.8	3.2	99.33	35.5	2.08	118.33	25	3.1	83.33	28	2.8	93.33
	Calcium (mg)	1000	790	62	79.00	879	68	87.90	670	61	67	780	65	78.00
	Iron (mg)	38	31.3	2.1	82.37	36.2	5	95.26	18.2	3.1	47.89	33	5.1	86.84



Graph 7: Comparison of Nutrition Intake and its Association with Anemia among the Study Groups

DISCUSSION

1. Phase I: Specific Information with Respect to Nutritional Profile and its Association with Anemia in the Study Groups:

There were 75.87% poor pregnant women who had their BMI < 18.4 kg/m^2 and 96.15% women who gained less than 10 kgs during the pregnancy and were found anemic. While a little more than half, 51.61% of the rich pregnant women who had their BMI < 18.4 kg/m^2 and 85.49 % women who gained less than 10 kgs during the pregnancy were also found to be anemic. Thus, to state that BMI < 18.4 kg/m^{2}and being underweight both these factors were found to be statistically significant ($p<0.05$) for the occurrence of anemia (Table 5).

Macro and micro deficiencies resulting in maternal undernutrition is considered as a grave public helath problem in various developing countries like South Asia (Popkin, B. M., Adair, L. S., & Ng, S. W., 2012); (World Health Organization., 2014).

An international study by Thorsdottir, I. *et al*., (2002); Lozano, R.*et al*., (2012); Kassebaum, N. J.*et al*., (2014); Brannon, P. M., & Taylor, C. L. (2017) and Varghese, J. S., & Stein, A. D. (2019) validates with our study while stating that inadequate weight gain during pregnancy due to low nutrient diet can restrict the growth and development of the fetus leading to IUGR.

A balanced and nutritious diet results in a term pregnancy with minimum physical dangers, and the utmost quality of life for the pregnant women resulting in the birth of a healthy baby stated Martínez-Galiano, J. M.*et al.,* (2020) in their study.

2. Comparison of the Deficiency Signs and Symptoms among the Study Groups:

It was evident that the clinical deficiency signs and symptoms of breathlessness, weakness, dizziness / fatigue and pale conjunctivitis of the eyes were seen in anemic women of the rich and the poor section, thus signifying its statistical significance ($p<0.05$) with anemia in both the groups (Table 6).

Levy, A.*et al*., (2005); Chowdhury, S., Rahman, M., & Moniruddin, A. B. M. (2014); Barton, J. C., Barton, J. C., & Bertoli, L. F. (2016) and Banjari., (2018) in their study said that ID results in tiredness, loss of strength, weak immune response and certain degree of behavioural issues.

3. Comparison of Dietary Habits and its Association with Anemia among the Study Groups:

It was evidently observed that both rich and poor pregnant women who were on vegetarian diets with 62.90% and 81.47% respectively were anemic. Therefore, concluding that dietary habits and onset of anemia has a statistical significance with $p<0.05$. The Chi-square test too reject the null hypothesis (Table 7).

In a study performed by Banjari, I. (2018) who said that it is a mandatory to have a well-balanced diet so as to absorb iron and other important nutrients keeping in mind that plant-based food contains certain elements that obstruct iron absorption in the stomach. Findings of Dyson, T., & Moore, M. (1983); Hunt, J. R. (2003); Thankachan, P. *et al*., (2007); Senarath, U., & Gunawardena, N. S. (2009); Self, S., & Grabowski, R. (2012); Rammohan, A., Awofeso, N., & Robitaille, M. C. (2012); Banerjee, S., & Roy, A. (2015); Al Hasan, S. M. *et al*., (2016); Osamor, P. E., & Grady, C. (2016); Tsakiridis, I. *et al*., (2020) and Jordaan, E. M. *et al*., (2020) have been in alignment with the present research.

Dietary patterns and behaviours during pregnancy are also determined by sociodemographic conditions, lifestyle, and other pregnancy related factors as per Doyle, I. M. *et al*., (2017).

Nutrition during pregnancy mainly to be focused in the second and third trimester by which the key processes such as organogenesis have been completed stated Hajianfar, H. *et al*., (2020).

During pregnancy, mothers' diet can have an impact on their pregnancy's outcome. Nutritional requirements of pregnant women vary during pre-conception, pregnancy, and breastfeeding. A better outcome requires an optimally adapted diet and lifestyle. Furthermore, nutrition issues may differ based on a pregnant woman's religious beliefs, financial status, age, education, traditions, and culture (Iordachescu, A. C. *et al*., 2020).

4. Comparison of Number of Meals Per-Day and its Association with Anemia among the Study Groups:

Commenting on the number of meals it was seen that among the poor pregnant women who ate less than 4 times a day were 66.78% and were anemic and among the rich there were 30.65% who had less than 4 times a day and were anemic. Hence number of meals and anemia was statistically significant (Table 8).

Our findings were consistent with the literature by Measham, A. R., & Chatterjee, M. (1999); Suryanarayana, R. *et al*., (2017), stating that lesser number of meals results in deficiency of nutrients, eventually leading to anemia and affecting the birth outcomes.

Given the high risk of nutritional vulnerability among the adolescent and poor pregnant women, it is crucial to ensure good dietary practices and modifications. Educating pregnant women has been shown to be effective in preventing some complications during pregnancy (Singh, M. B., Fotedar, R., & Lakshminarayana, J. 2009; O'Brien, C. M., Grivell, R. M., & Dodd, J. M., 2016; Keats, E. C.*et al*., 2019).

5. Comparison of Number of Coffee / Tea Per-Day and its Association with Anemia among the Study Groups:

There was a strong association between the amount of coffee/tea per day and occurrence of anemia. It was visualized that 91.96% of the poor pregnant women consumed tea or coffee more than 3 times a day. While, among the rich pregnant women it was seen that 27.42% of women consumed tea more than thrice a day and were anemic. Therefore, it could be stated that there was a statistically significant ($p<0.05$) between the amount of tea or coffee consumed per day and the occurrence of anemia among the poor pregnant women (Table 9).

Similar studies stating the adverse effect of coffee and tea for the onset of anemia was done by Sharma, J. B.*et al*., (2003); Thankachan, P. *et al*., (2008); Shah, T., Warsi, J., & Laghari, Z. (2020) and John, S., & Sharma, P. C. (2020).

6. Comparison of Nutrition Intake and its Association with Anemia among the Study Groups:

It was observed that the %RDA for enegery, protein, fat, calcium and iron was much less among the poor anemic pregnant women than the rich anemic pregnant women. This rich anemic had their %RDA very close to the poor non-anemic (Table 11). Therefore %RDA and onset of anemia were found to be statically significant with p value < 0.05.

From conception, the embryo assesses the nutrition milieu and regulates its growth accordingly (Sibley, C. P.*et al*., 2004) and (Lowensohn, R. I., Stadler, D. D., & Naze, C. 2016). A balanced nutrition results in a term pregnancy with minimum physical dangers, and the utmost quality of life for the pregnant women resulting in the birth of a healthy baby. During pregnancy, optimal dietary intakes are extremely essential and crucial in meeting and maintaining the nutrient level during the period of pregnancy.

An international study by Derbyshire, E. (2011); Huberty, J. *et al*., (2013); Dean, S. V. *et al*., (2014); Thakur, N. *et al*., (2014); Di Renzo, G. C. *et al*., (2015); Martin, J. C. *et al*., (2016); Zelalem, A. *et al.,* (2017); Chishty, S., & Singh, N. (2018) and Kinshella, M. L. W., Moore, S. E., & Elango, R. (2021) stated that the etiology of anemia during pregnancy was poor nutrition and deficiency of iron and other micronutrients like that of folic acid, protein and Vitamin B_{12}.

7. Comparison of the Various Grades of Anemia before Pregnancy in the Study Groups:

It was noticed that nearly 86% of the rich pregnant women and 93% of the poor pregnant women entered into pregnancy being anemic. Hence entering into the phase of pregnancy with already depleted stores of iron were found to be statistically significant in both the study groups with p value < 0.05.

Our study was found consistent with other studies which stated that every woman who enter into pregnancy with low iron stores have higher risk of going into delivery being anemic. Kassa, G. M. *et al*., (2017) Gari, W., Tsegaye, A., & Ketema, T. (2020). The various psychological, social, economic, demographic and nutritional cumulatively exert its effect for the development of anemia in pregnancy.

Ronnenberg, A. G.*et al*., (2004); Yi, S. W., Han, Y. J., & Ohrr, H. (2013); and Zhang, X. *et al*., (2018) have stated an association of pre-conception Hb and anemia and pregnancy outcome.

8. Phase-II Comparison of the Various Grades of Anemia in the Second and Third Trimester in the Study Groups:

Haider, B. A. *et al*., (2013) have stated that anemia in early pregnancy has been associated with adverse outcomes. Anemia is a major public health and economic problem which directly or indirectly causes maternal and fetal morbidity and mortality. In our study there were 72.58% who were mildly anemic and 24.19% were moderately anemic and 3.23% were severely anemic in their third trimester among the rich pregnant women. The mean$\pm$SD in the third trimester was 10.4$\pm$1.02. While among the poor pregnant women 38.81%, 51.05% and 10.14% were suffering from mild anemia, moderate anemia and severe anemia among the in their third trimester. The mean$\pm$SD in the third trimester was 9.0$\pm$0.02. The Chi square test validates the psychological factors responsible for the onset of anemia in both the study groups and various r values also validates the same, thus rejecting the null hypothesis.

Anemia during pregnancy has profound short-term and far-reaching sequelae on the new-born as per studies by Goonewardene, M., Shehata, M., & Hamad, A. (2012); Lee, A. I., & Okam, M. M. (2011); Chang, S. *et al*., (2013) and Stevens, G. A. *et al*., (2013).

Several grades of anemia have association with maternal and neonatal morbidity and mortality in pregnancy according to the studies by Klebanoff, M. A.*et al*., (1991); Brabin, B. J., Hakimi, M., & Pelletier, D. (2001); Stoltzfus, R. J., Mullany, L., & Black, R. E. (2004); Levy, A.*et al*., (2005); Adebisi, O. Y., & Strayhorn, G., (2005); Ren, A.*et al*., (2007); N. Kozuki, *et al.,* (2012) which validated our research.

CONCLUSION

Considering the rich pregnant women, there were 62 women of the total who suffered with anemia which constituted to be 19.45%, out of which 72.58%, 24.19% and 3.23% of women suffered from mild anemia, moderate anemia and severe anemia in their third trimester respectively. However, 286 poor women who were found to be anemic in the third trimester which constituted to a very high percentage of 84.36% with 38.81% of women suffering from mild anemia, 51.05% of them suffering from moderate anemia and a 10.14% suffering from severe anemia in their third trimester. Thereby, concluding that the poor pregnant women are most adversely hit by the evil hazard of anemia with more severity as they have higher percentage of women in moderate and severe anemia. The mean$\pm$SD of Hb at third trimester of the rich and poor was 10.4$\pm$1.02 and 9.0$\pm$0.02 respectively.

1. Specific Information with Respect to Nutritional Profile and its Association with Anemia in the Study Groups:

Anthropometric Measurements:

- The study directly pinpoints the direct impact of BMI and weight gain during gestation and incidence of anemia among the poor pregnant women.
- There were 75.87% poor women who had their BMI > 18.4kg/m^2 and were anemic.

47.90% poor pregnant women who gained less than 5kg and were anemic. This BMI and weight gain significantly affect anemia among the poor pregnant women.

- Among the urban poor pregnant women, weight gain reduced with increasing number of children and pregnancies. Joint families, excessive occult practices, lack of education, persistent poor diet, low socio-economic status, poor stature and less maternal age cumulatively results in poor weight gain which in turn leads to fetal growth retardation. Weight gain was extremely less among severely anemic and moderately anemic mothers.
- However, among the rich 'fat taboo' and nuclear family, were the main cause leading to poor weight gain or unhealthy food habit leading to intake of non-nutritious food but resulting in obesity also causing anemia and adverse birth outcomes.
- There was a significant and mild correlation of BMI and anemia among the rich and poor with r value 0.38 for the rich and r value 0.349 for the poor.

Deficiency Signs and Symptoms:

- As soon as the duration for the onset of anemia progresses, deficiency signs and symptoms like breathlessness, weakness, dizziness/fatigue, pale conjunctivitis of the eyes increases. Therefore, deficiency signs and symptoms were significantly associated with anemia for both the rich and the poor pregnant women.
- However, the impact was seen more among the rich section even though the severity of anemia was more among the poor section, this could be due to the hard kind of living and low self-worth for themselves among the poor pregnant women.

Dietary Habits and Diet Patterns:

- The study reveals the significance of diet on the prevalence of anemia.
- In both the study groups, those on the vegetarian diet were found to be anemic. Among the rich pregnant women 62.90% while in the poor pregnant women 81.47%, on vegetarian diet and were anemic.
- Diet pattern and dietary habits were seen to be significant associated in causing anemia in both the study group.
- Among the rich, a smaller number of meals was basically due to life style stress, no support due to nuclear families that resulted in anemia.
- Among the poor, it was food culture, joint families and low-socio-economic status leading to food in security, that curtailed them to a smaller number of meals per day.

Number of Tea and Coffee Intake:

- Among the poor greater number of intakes of teaor coffee was found to be significantly associated with anemia with 91.96% women consuming teaor coffee more than 3 times a day.

Nutritional Profile:

- The comparison of nutrient intake with RDA showed a deficient intake of energy, protein, fat, calcium and iron.
- Various socio-economic and demographic factors, psychological fears and customs influenced the intake of food and was significant for the onset of anemia among the poor pregnant.

Grades of Anemia before Pregnancy and anemic pregnancy:

- 100% poor anemic pregnant women entered into pregnancy with low iron score that is being anemic, therefore their condition worsened as pregnancy proceeded. Hence, anemic level prior to pregnancy was highly significant for the poor pregnant women for the onset of anemia during pregnancy.

RECOMMENDATION AND SUGGESTIONS

Association of Various Determinants Causing Anemia Among the Pregnant Women and Pregnancy Outcome: This kind of research can be extended to the rural settings of Ajmer city.

Association of Nutritional Profile of Schedule Caste and Schedule Tribe and Pregnancy Outcome in Ajmer City: In order to assess the nutritional profile of the schedule castes and schedule tribes in the poorer sections of the society, as well as their health conditions

pregnancy outcomes, a comparative study can be performed.

Prevention and Management: There is a wide scope of research to improve the prevalent condition of the pregnant women. Early diagnosis, improved awareness, education programs, dietary patterns, family support and self-care prevention and management can reduce the complications of anemia and enhance the pregnancy outcomes.

References

1. AAP, C., & American Academy of Pediatrics. (1993). Committee on Nutrition), Pediatric Nutrition Handbook. *Elk Grove, Ill.: American Academy of Pediatrics*.
2. AAP, C., & American Academy of Pediatrics. (1993). Committee on Nutrition), Pediatric Nutrition Handbook. *Elk Grove, Ill.: American Academy of Pediatrics*.
3. Adebisi, O. Y., & Strayhorn, G. (2005). Anemia in pregnancy and race in the United States: blacks at risk. *Family Medicine-Kansas City-*, *37*(9), 655.
4. Al Hasan, S. M., Hassan, M., Saha, S., Islam, M., Billah, M., & Islam, S. (2016). Dietary phytate intake inhibits the bioavailability of iron and calcium in the diets of pregnant women in rural Bangladesh: a cross-sectional study. *BMC Nutrition*, *2*(1), 1-10.
5. Balarajan, Y., & Ramakrishnan, U. zaltin E, Shankar AH, Subramanian S (2011) Anaemia in low-income and middle-income countries. *Lancet*, *378*(9809), 212335.
6. Bamji, M. S. (1999). Dietary consumerism and nutrition security: The Indian perspective. *Current Science*, *76*(1), 41-45.
7. Banerjee, S., & Roy, A. (2015). Determinants of female autonomy across Indian states. *Journal of Economics, Business and Management*, *3*(11), 1037-1040.
8. Banjari, I. (2018). Iron deficiency anemia and pregnancy. *Current Topics in Anemia*, *73*.
9. Barton, J. C., Barton, J. C., & Bertoli, L. F. (2016). Pica for uncooked basmati rice in two women with iron deficiency and a review of ryzophagia. *Case reports in medicine*, *2016*.
10. Bentley, M. E., & Griffiths, P. L. (2003). The burden of anemia among women in India. *European journal of clinical nutrition*, *57*(1), 52-60.
11. Brabin, B. J., Hakimi, M., & Pelletier, D. (2001). An analysis of anemia and pregnancy-related maternal mortality. *The Journal of nutrition*, *131*(2S-2), 604S-614S.
12. Brabin, B. J., Premji, Z., & Verhoeff, F. (2001). An analysis of anemia and child mortality. *The Journal of nutrition*, *131*(2), 636S-648S.
13. Brannon, P. M., & Taylor, C. L. (2017). Iron supplementation during pregnancy and infancy: uncertainties and implications for research and policy. *Nutrients*, *9*(12), 1327.
14. Centers for Disease Control (CDC. (1989). Measles prevention. *MMWR supplements*, *38*(9), 1-18.
15. Chang, S., Zeng, L., Brouwer, I. D., Kok, F. J., & Yan, H. (2013). Effect of iron deficiency anemia in pregnancy on child mental development in rural China. *Pediatrics*, *131*(3), e755-e763.
16. Chishty, S., & Singh, N. (2018). Nutritional status of tribal women (Saharia and Meena), Baran district of Rajasthan, India. *Nutrition & Food Science*.
17. Chowdhury, S., Rahman, M., & Moniruddin, A. B. M. (2014). Anemia in pregnancy. *Medicine Today*, *26*(1), 49-52.
18. Dean, S. V., Lassi, Z. S., Imam, A. M., & Bhutta, Z. A. (2014). Preconception care: nutritional risks and interventions. *Reproductive health*, *11*(3), 1-15.
19. Derbyshire, E. (2011). *Nutrition in the childbearing years*. John Wiley & Sons.
20. Di Renzo, G. C., Spano, F., Giardina, I., Brillo, E., Clerici, G., & Roura, L. C. (2015). Iron deficiency anemia in pregnancy. *Women's Health*, *11*(6), 891-900.
21. Doyle, I. M., Borrmann, B., Grosser, A., Razum, O., & Spallek, J. (2017). Determinants of dietary patterns and diet quality during pregnancy: A systematic review with narrative synthesis. *Public health nutrition*, *20*(6), 1009-1028.
22. Dyson, T., & Moore, M. (1983). On kinship structure, female autonomy, and demographic behavior in India. *Population and development review*, 35-60.
23. Ezzati, M., Lopez, A. D., Rodgers, A. A., & Murray, C. J. (2004). *Comparative quantification of health risks: global and regional*

burden of disease attributable to selected major risk factors. World Health Organization.

24. Gari, W., Tsegaye, A., & Ketema, T. (2020). Magnitude of anemia and its associated factors among pregnant women attending antenatal care at Najo General Hospital, Northwest Ethiopia. *Anemia*, *2020*.

25. Goonewardene, M., Shehata, M., & Hamad, A. (2012). Anaemia in pregnancy. *Best practice & research Clinical obstetrics & gynaecology*, *26*(1), 3-24.

26. Gopalan, C., Shastri, R.,B.V., & Balasubramanian, S.C. (2000). Recommended Daily Allowance for Indians. Nutritive Value of Indian Foods. NIN, 24

27. Haas, J. D., & Fairchild, M. W. (1989). Summary and conclusions of the International Conference on iron deficiency and behavioural development, October 10–12, 1988. *The American Journal of Clinical Nutrition*, *50*(3), 703-705.

28. Haider, B. A., Olofin, I., Wang, M., Spiegelman, D., Ezzati, M., & Fawzi, W. W. (2013). Anaemia, prenatal iron use, and risk of adverse pregnancy outcomes: systematic review and meta-analysis. *Bmj*, *346*.

29. Hajianfar, H., Abbasi, K., Azadbakht, L., Esmaeilzadeh, A., Mollaghasemi, N., & Arab, A. (2020). The Association between Maternal Dietary Iron Intake during the First Trimester of Pregnancy with Pregnancy Outcomes and Pregnancy-Related Complications. *Clinical nutrition research*, *9*(1), 52-62.

30. Huberty, J., Dinkel, D., Beets, M. W., & Coleman, J. (2013). Describing the use of the internet for health, physical activity, and nutrition information in pregnant women. *Maternal and child health journal*, *17*(8), 1363-1372.

31. Hunt, J. R. (2003). Bioavailability of iron, zinc, and other trace minerals from vegetarian diets. *The American journal of clinical nutrition*, *78*(3), 633S-639S.

32. Iordachescu, A. C., Cirstoiu, M. M., Zugravu, C. A., Teodor, O. M., Turcan, N., Ducu, I., & Bohiltea, R. E. (2020). Dietary behavior during pregnancy. *Experimental and therapeutic medicine*, *20*(3), 2460-2464.

33. Jelliffe, D. B., & World Health Organization. (1966). *The assessment of the nutritional status of the community (with special reference to field surveys in developing regions of the world*. World Health Organization.

34. John, S., & Sharma, P. C. (2020). Nutritional approach for the treatment of anemia and iron deficiency anemia.

35. Jordaan, E. M., van den Berg, V. L., van Rooyen, F. C., & Walsh, C. M. (2020). Anaemia prevalence and dietary diversity among women in the rural Free State, South Africa. *Health SA Gesondheid*, *25*(1).

36. Kassa, G. M., Muche, A. A., Berhe, A. K., & Fekadu, G. A. (2017). Prevalence and determinants of anemia among pregnant women in Ethiopia; a systematic review and meta-analysis. *BMC hematology*, *17*(1), 1-9.

37. Kassebaum, N. J., Jasrasaria, R., Naghavi, M., Wulf, S. K., Johns, N., Lozano, R., Regan, M., Weatherall, D., Chou, D.P., Eisele, T.P., Faxman, S.R., Pullan, R.L., Brooker, S.J., Murray, C. J. (2014). A systematic analysis of global anemia burden from 1990 to 2010. *Blood, the Journal of the American Society of Hematology*, *123*(5), 615-624.

38. Keats, E. C., Neufeld, L. M., Garrett, G. S., Mbuya, M. N., & Bhutta, Z. A. (2019). Improved micronutrient status and health outcomes in low-and middle-income countries following large-scale fortification: evidence from a systematic review and meta-analysis. *The American journal of clinical nutrition*, *109*(6), 1696-1708.

39. Kim, I., Hungerford, D. W., Yip, R., Kuester, S. A., Zyrkowski, C., & Trowbridge, F. L. (1992). Pregnancy nutrition surveillance system—United States, 1979–1990. *Morbidity and Mortality Weekly Report: CDC Surveillance Summaries*, 25-41.

40. Kinshella, M. L. W., Moore, S. E., & Elango, R. (2021). The missing focus on women's health in the First 1,000 Days approach to nutrition. *Public Health Nutrition*, *24*(6), 1526-1530.

41. Klebanoff, M. A., Shiono, P. H., Selby, J. V., Trachtenberg, A. I., & Graubard, B. I. (1991). Anemia and spontaneous preterm birth. *American journal of obstetrics and gynecology*, *164*(1), 59-63.

42. Lee, A. I., & Okam, M. M. (2011). Anemia in pregnancy. *Hematology/Oncology Clinics*, *25*(2), 241-259.

43. Levy, A., Fraser, D., Katz, M., Mazor, M., & Sheiner, E. (2005). Maternal anemia during

pregnancy is an independent risk factor for low birthweight and preterm delivery. *European journal of obstetrics & gynecology and reproductive biology*, *122*(2), 182-186.

44. Levy, A., Fraser, D., Katz, M., Mazor, M., & Sheiner, E. (2005). Maternal anemia during pregnancy is an independent risk factor for low birthweight and preterm delivery. *European journal of obstetrics & gynecology and reproductive biology*, *122*(2), 182-186.

45. Lowensohn, R. I., Stadler, D. D., & Naze, C. (2016). Current concepts of maternal nutrition. *Obstetrical& gynecological survey*, *71*(7), 413.

46. Lozano, R., Naghavi, M., Foreman, K., Lim, S., Shibuya, K., Aboyans, V., Abraham, J., Adair, T., Agrawal, R., Ahn, S.Y., AlMazroa, M.A., Alvarado, M., Anderson, H.R., Anderson, L.M., Andrews, K.G., Atkinsons, C., Baddour, L.M., Collo, S.B., Murray, C.J.L., & Remuzzi, G. (2012). Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. *The lancet*, *380*(9859), 2095-2128.

47. Martin, J. C., Zhou, S. J., Flynn, A. C., Malek, L., Greco, R., & Moran, L. (2016, March). The assessment of diet quality and its effects on health outcomes pre-pregnancy and during pregnancy. In *Seminars in Reproductive Medicine* (Vol. 34, No. 02, pp. 083-092). Thieme Medical Publishers.

48. Martínez-Galiano, J. M., Cano-Ibáñez, N., Hernández-Martínez, A., & Delgado-Rodríguez, M. (2020). Nutrition in Reproductive Health: Nutritional Conditioning Factors during Pregnancy and Its Impact on Health. *Reproductive Medicine*, *1*(3), 169-180.

49. McCann, J. C., & Ames, B. N. (2007). An overview of evidence for a causal relation between iron deficiency during development and deficits in cognitive or behavioural function. *The American journal of clinical nutrition*, *85*(4), 931-945.

50. McLean, E., Egli, I., Cogswell, M., Benoist, B. D., & Wojdyla, D. (2007). Worldwide prevalence of anemia in preschool aged children, pregnant women and non-pregnant women of reproductive age. In *Nutritional anemia* (pp. 1-12). Sight and life Press.

51. Measham, A. R., & Chatterjee, M. (1999). *Wasting away: The crisis of malnutrition in India*. World Bank Publications.

52. Murphy, J. F. (2011). Hemoglobin concentrations for the diagnosis of anemia and assessment of severity. Vitamin and Mineral Nutrition Information System. Geneva, World Health Organization, 2011 (WHO/NMH/NHD/MNM/11.1; http://www. who. int/vmnis /indicators/hemoglobin. pdf, accessed 1 December 2012). 4. International Anemia Consultative Group. Report of the 2001 International Anemia Consultative Group Symposium. Why is iron important and what to do about it: a new perspective. Washington, DC, INACG Secretariat, 2002: 1-50.

53. N. Kozuki, AC Lee, and J. Katz, no conflicts of interest. (2012). Moderate to severe, but not mild, maternal anemia is associated with increased risk of small-for-gestational-age outcomes. *The Journal of nutrition*, *142*(2), 358-362.

54. NIN, N. (2010). Requirements and recommended dietary allowances for Indians. *A Report of the Expert Group of Indian Council of Medical Research, National Institute of Nutrition, ICMR, Hyderabad*.

55. O'Brien, C. M., Grivell, R. M., & Dodd, J. M. (2016). Systematic review of antenatal dietary and lifestyle interventions in women with a normal body mass index. *Acta obstetricia et gynecologica Scandinavica*, *95*(3), 259-269.

56. Osamor, P. E., & Grady, C. (2016). Women's autonomy in health care decision-making in developing countries: a synthesis of the literature. *International journal of women's health*, *8*, 191.

57. Popkin, B. M., Adair, L. S., & Ng, S. W. (2012). Global nutrition transition and the pandemic of obesity in developing countries. *Nutrition reviews*, *70*(1), 3-21.

58. Rahman, M. M., Abe, S. K., Rahman, M. S., Kanda, M., Narita, S., Bilano, V., & Shibuya, K. (2016). Maternal anemia and risk of adverse birth and health outcomes in low-

and middle-income countries: systematic review and meta-analysis, 2. *The American journal of clinical nutrition*, *103*(2), 495-504.

59. Rammohan, A., Awofeso, N., & Robitaille, M. C. (2012). Addressing female iron-deficiency in India; is vegetarianism the major obstacle. *ISRN Public Health*.

60. Rao, B. M., & Reddy, P. N. (1996). Textbook of human nutrition. In *Nutrition intervention programmes in India and in neighbouring countries* (pp. 443-453). New Delhi Oxford and IBH Publishing Co. Pvt. Ltd.

61. Rasmussen, K. M. (2001). Is there a causal relationship between iron deficiency or iron-deficiency anemia and weight at birth, length of gestation and perinatal mortality?. *The Journal of nutrition*, *131*(2), 590S-603S.

62. Ren, A., Wang, J., Ye, R. W., Li, S., Liu, J. M., & Li, Z. (2007). Low first-trimester hemoglobin and low birth weight, preterm birth and small for gestational age newborns. *International Journal of Gynecology & Obstetrics*, *98*(2), 124-128.

63. Ronnenberg, A. G., Wood, R. J., Wang, X., Xing, H., Chen, C., Chen, D., Xu, X. (2004). Preconception hemoglobin and ferritin concentrations are associated with pregnancy outcome in a prospective cohort of Chinese women. *The Journal of nutrition*, *134*(10), 2586-2591.

64. Self, S., & Grabowski, R. (2012). Female autonomy and health care in developing countries. *Review of Development Economics*, *16*(1), 185-198.

65. Senarath, U., & Gunawardena, N. S. (2009). Women's autonomy in decision making for health care in South Asia. *Asia Pacific Journal of Public Health*, *21*(2), 137-143.

66. Shah, T., Warsi, J., & Laghari, Z. (2020). Tea drinking and its co-occurrence with anemia in pregnant females. *Rawal Medical Journal*, *45*(1), 163-167.

67. Sharma, J. B., Soni, D., Murthy, N. S., & Malhotra, M. (2003). Effect of dietary habits on prevalence of anemia in pregnant women of Delhi. *Journal of obstetrics and gynaecology research*, *29*(2), 73-78.

68. Sheth, T. N., Choudhry, N. K., Bowes, M., & Detsky, A. S. (1997). The relation of conjunctival pallor to the presence of anemia. *Journal of general internal medicine*, *12*(2), 102-106.

69. Sibley, C. P., Coan, P. M., Ferguson-Smith, A. C., Dean, W., Hughes, J., Smith, P., & Constancia, M. (2004). Placental-specific insulin-like growth factor 2 (Igf2) regulates the diffusional exchange characteristics of the mouse placenta. *Proceedings of the National Academy of Sciences*, *101*(21), 8204-8208.

70. Singh, M. B., Fotedar, R., & Lakshminarayana, J. (2009). Micronutrient deficiency status among women of desert areas of western Rajasthan, India. *Public health nutrition*, *12*(5), 624-629.

71. Stevens, G. A., Finucane, M. M., De-Regil, L. M., Paciorek, C. J., Flaxman, S. R., Branca, F., Rosas, J.P.P., Bhutta, Z.A., Ezzatti, M. Nutrition Impact Model Study Group. (2013). Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995–2011: a systematic analysis of population-representative data. *The Lancet Global Health*, *1*(1), e16-e25.

72. Stoltzfus, R. J. (1997). Rethinking anaemia surveillance. *The Lancet*, *349*(9067), 1764-1766.

73. Stoltzfus, R. J., Mullany, L., & Black, R. E. (2004). Iron deficiency anaemia. *Comparative quantification of health risks: global and regional burden of disease attributable to selected major risk factors*, *1*, 163-209.

74. Suryanarayana, R., Chandrappa, M., Santhuram, A. N., Prathima, S., & Sheela, S. R. (2017). Prospective study on prevalence of anemia of pregnant women and its outcome: A community-based study. *Journal of family medicine and primary care*, *6*(4), 739.

75. Thakur, N., Chandra, J., Pemde, H., & Singh, V. (2014). Anemia in severe acute malnutrition. *Nutrition*, *30*(4), 440-442.

76. Thankachan, P., Muthayya, S., Walczyk, T., Kurpad, A. V., & Hurrell, R. F. (2007). An analysis of the etiology of anemia and iron deficiency in young women of low socioeconomic status in Bangalore, India. *Food and nutrition bulletin*, *28*(3), 328-336.

77. Thankachan, P., Walczyk, T., Muthayya, S., Kurpad, A. V., & Hurrell, R. F. (2008). Iron

absorption in young Indian women: the interaction of iron status with the influence of tea and ascorbic acid. *The American journal of clinical nutrition*, *87*(4), 881-886.

78. Thimmayamma, B. V. S., & Parvathi, R. (2009). Dietary assessment as part of nutritional status. *Textbook Of Human Nutrition, 3/E*, 113.

79. Thorsdottir, I., Torfadottir, J. E., Birgisdottir, B. E., & Geirsson, R. T. (2002). Weight gain in women of normal weight before pregnancy: complications in pregnancy or delivery and birth outcome. *Obstetrics & Gynecology*, *99*(5), 799-806.

80. Tsakiridis, I., Kasapidou, E., Dagklis, T., Leonida, I., Leonida, C., Bakaloudi, D. R., & Chourdakis, M. (2020). Nutrition in pregnancy: a comparative review of major guidelines. *Obstetrical & Gynecological Survey*, *75*(11), 692-702.

81. Urrechaga, E., Hoffmann, J. J. M. L., Izquierdo, S., & Escanero, J. F. (2015). Differential diagnosis of microcytic anemia: role of microcytic and hypochromic erythrocytes. *International journal of laboratory hematology*, *37*(3), 334-340.

82. Varghese, J. S., & Stein, A. D. (2019). Malnutrition among women and children in India: limited evidence of clustering of underweight, anemia, overweight, and stunting within individuals and households at both state and district levels. *The American journal of clinical nutrition*, *109*(4), 1207-1215.

83. World Health Organization, & UNICEF. UNU Iron deficiency anaemia: assessment, prevention and control. A guide for programme managers. Geneva, Switzerland: World Health Organization, 2001.

84. World Health Organization. (1992). *The prevalence of anaemia in women: a tabulation of available information* (No. WHO/MCH/MSM/92.2. Unpublished). World Health Organization.

85. World Health Organization. (2014). *Global nutrition targets 2025: Stunting policy brief* (No. WHO/NMH/NHD/14.3). World Health Organization.

86. Yi, S. W., Han, Y. J., & Ohrr, H. (2013). Anemia before pregnancy and risk of preterm birth, low birth weight and small-for-gestational-age birth in Korean women. *European journal of clinical nutrition*, *67*(4), 337-342.

87. Zelalem, A., Endeshaw, M., Ayenew, M., Shiferaw, S., & Yirgu, R. (2017). Effect of nutrition education on pregnancy specific nutrition knowledge and healthy dietary practice among pregnant women in Addis Ababa. *Clinics in Mother and Child Health*, *14*(3), 265.

88. Zhang, X., Xu, Q., Yang, Y., Wang, L., Liu, F., Li, Q., Yu, Z. (2018). Preconception Hb concentration and risk of preterm birth in over 2· 7 million Chinese women aged 20–49 years: a population-based cohort study. *British Journal of Nutrition*, *120*(5), 508-516.