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Lahore Pregnancy Cohort Study: Association of Maternal Nutritional Status, Environmental Factors and Psychological Status with Neonatal Anthropometric Data and Pregnancy Outcomes Among Pakistani Pregnant Women

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Abstract:
Globally, the Maternal mortality rate is a high concern. In Pakistan, its prevalence rate is on the higher side than in other developing countries. Nutrition is a modifiable risk factor of public health significance that has a great effect on health throughout life especially in fetal growth and birth outcomes. The Lahore pregnancy cohort project aims to investigate the relationship between maternal nutritional status, environmental factors, psychological status, and neonatal anthropometric data as well as pregnancy outcomes among Pakistani pregnant women. A total of 227 normal pregnant women aged 19-40 were enrolled in the study. Socioeconomic, anthropometric, dietary and psychological data were obtained from direct measurements, questionnaires and hospital records. The findings revealed that most respondents were food-secure (100%) however mild depression was observed among the mothers. Socio-demographic, socio-economic, and dietary variables were associated with the prevalence of anemia. There was a significant difference in the prevalence of anemia at different points in pregnancy and post-partum, with mean Hb levels of 11.61 ± 1.05 (2nd trimester), 11.11 ± 1.62 (3rd trimester), and 10.41 ± 1.56 (post-partum). Insufficient dietary intake was observed with a higher reliance on supplements to meet nutritional needs. Dietary adequacy was found to be related to anthropometric measurements, with certain food items effecting differently. The study highlighted key issues related to maternal and infant health in Lahore, such as not consuming adequate serving sizes of fruits and vegetables, reliance on supplements, and negative associations between fat consumption and neonatal weight. Sociodemographic, socioeconomic, and dietary variables were found to be associated with anemia among pregnant women, which may lead to adverse pregnancy outcomes. Additionally, overweight and obesity before pregnancy resulted in excessive weight gain among mothers throughout pregnancy and post-partum. It was also discovered that a mother's increased meat consumption had a negative correlation with her newborn's APGAR score. In conclusion, a pregnant woman's diet must be well-balanced and full of the nutrients that her body needs because it will have an impact on both the mother's and the newborn's health.

Keywords: Maternal health, Neonatal Health, Nutritional status, Pregnancy, Pakistan

Introduction

Nutrition has a great effect on health throughout life but it plays a vital role in influencing fetal growth and birth outcomes. It is a modifiable risk factor of public health significance. Maternal nutritional status could be considered as primary predictor for the nutritional status of neonates, However, the association between maternal nutrition and birth outcome is complex and is influenced by many physiological, socioeconomic and demographic factors. The state of maternal nutrition is one of the important factors, which might affect the period of pregnancy. The fetal growth and dramatic changes including hormonal and metabolic alterations consequential during pregnancy impose great stress and increase the expectant mother's nutritional requirements (Tyagi, Toteja and Bhatia, 2019). Some other factors are also interrelated and can confound the results in addition to modifying the independent estimates of relative risk associated with a risk factor. These risk factors include maternal malnutrition, hypertension (Pre-eclampsia), gestational diabetes mellitus, poverty, food insecurity, smoking, and depression (Saeed, Humayun and Raana, 2018).

The nutritional status of the pregnant mother and her total weight gain during the period also affect the preterm birth rate. In both pre and post-pregnancy states, nutritional status is relevant because underweight or obese women might increase the risk for preterm birth more than 2-4 times. Even if the mother has a healthy weight before pregnancy, they must achieve recommended weight gain during gestation. It is also important for the mother to maintain a healthy weight during pregnancy. Excessive weight gain or weight loss during pregnancy can increase the risk of complications, such as gestational diabetes and pre-eclampsia. In addition, a well-nourished mother is more likely to have more energy and be better equipped to handle the physical and emotional demands of pregnancy. A balanced diet that includes all food groups as well as vitamins and minerals in adequate amounts is recommended for the growth and development of the baby. Moreover, it is advised to avoid certain foods, such as raw or undercooked meats, unpasteurized dairy products, and fish with high levels of mercury, as these can be harmful to the baby (Xinxo et al., 2013)

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One more important factor to consider during pregnancy is maternal anemia. It has been seen that 17.7% of the total fetal mortality rate is associated with pregnant women who have anemia. (Hameed et al., 2018). In Pakistan, when compared with other areas of the country, Punjab has been declared the least prevalent area concerning the presence of anemic pregnant women. Despite this, prevalence is still higher in the list as far as comparison with other countries is concerned. Furthermore, being exposed to depression can influence the mother throughout the pregnancy and can also lead to developmental issues. Therefore, prenatal depression was considered a factor related to children's development. Moreover, postnatal abuse was significantly associated with maternal depression and other disorders related to mental well-being (Sikander et al., 2019).

From conception until the age of two years, also called the first 1000 days of life, is a unique period of remarkable physiological growth and rapid functional development of the body’s organs. In this duration, a fetus, infant (<12 months of age), or toddler (1-2 years of age) is most vulnerable to environmental influences that can profoundly affect critical stages of this development process, with subsequent short or long-term consequences for health and physical performance (Toro Ramos et al., 2015). Maternal malnutrition (including under and over-nutrition) can have profound distresses on embryonic development & fetal growth, and subsequent infant growth and development during and beyond the breastfeeding period. The first three months of a child are more crucial for normal physical and conceptual development. Even cognitive and emotional potential develop early, as social, intellectual, and emotional competencies might be established during this time. During 3-12 months, poor nutrition leads to perceptive defects such as delayed motor and cognitive development, behavioral problems, lack of social skills, a lesser attention span, learning disabilities, and lower educational attainments (WHO, 2019). Globally maternal malnutrition is an important determinant of adverse outcomes for mothers and offspring. A range of preventive and therapeutic nutrition-specific interventions can potentially address these risks. Aimed to investigate the association of maternal nutritional status, environmental factors, and psychological factors with neonatal anthropometric data among Pakistani pregnant women.

Material and Methods

A longitudinal study design was applied in this study. The location of this study was the Gynecology Department at Fatima Memorial Hospital in Lahore Pakistan. The location of data collection was selected considering the availability of Gynae OPD, Labor Room and neonatal nursery at Fatima Memorial Hospital Lahore Pakistan. The source of the population selected was the mothers of the second trimester till post-partum. The inclusion criteria for this study target pregnant women aged 19-40 in their second trimester, specifically those with singleton pregnancies

and generally healthy conditions, including controlled gestational diabetes mellitus (GDM) and preeclampsia. Exclusion criteria was mothers with twin pregnancies, pregnant women with pre-existing chronic diseases (excluding diabetes and hypertension), and those experiencing intrauterine growth restriction (IUGR). Subjects were chosen by using a purposive convenience sampling technique, recruiting all mothers who meet the inclusion criteria as they become available. Out of the 420 approaches, 227 pregnant Pakistani women in their second trimester were enrolled, with a response rate of 63.3%. Structured questionnaires were used to collect the data regarding the sociodemographic, health history, family strength, anthropometrics, biochemical tests, dietary record (24-hour recall), food security (HFIAS), as well as depression, stress and anxiety (DASS-21). Research data was collected by using self-developed interviewer-directed questionnaires. Evaluations were scheduled over 3 different time point's i.e. 2nd, 3rd trimester and post-partum.

Anthropometric measurements were taken following the standard procedures (WHO, 1995; de Onis et al., 2004; Mirnalini et al., 2007; NHANES, 2009). Gestational weight gain was calculated based on the difference between the pre-pregnancy weight of the mother collected from hospital electronic records and the last weight measured upon recruitment during the third trimester. The biochemical assessment included hemoglobin (Hb) and levels random and fasting blood glucose levels during the 2nd, 3rd trimesters and post-partum. Two days (Sunday & Tuesday) maternal diet history was recorded using 24-hour recall. The assistant nutritionist has used specific household measurements such as cups, tablespoon and glass.

Depression Anxiety Stress Scale: DASS 21 were used by Naeem Aslam (National Institute of Psychology, Quaid-E-Azam University Islamabad, Pakistan). Data collected through the questionnaire was converted to digital data by inserting it through Microsoft Excel. Conversion of this data was made into suitable units before conducting statistical analysis. Analysis of statistics was done through SPSS 20.0 while graph preparation used a mix of Excel Sheets and SPSS. Basic descriptive analysis was performed to obtain the frequency of data which was used for conversion of data to percent values. In addition, a comparative analysis of descriptive data was made through chi-square for qualitative nominal and categorical data where conditions for eligibility were met. The violation of the condition for chi-square was followed by a logistic regression analysis for the categorical data. Quantitative data was presented using basic descriptive statistics (Mean and standard deviation) and comparisons were made using paired sample T-tests and one-way ANOVA. As data for 24-hours' dietary recall contained different intervals as well as different days of data collection, Friedman's test was used to compare the results within the days in addition to paired sample T-test for between-day comparison. All of these statistics were used with a 0.05% probability and 95% confidence interval.

Results and Discussions

1.1 Anthropometric Measurements

Compared to the values published by Institute of Medicine (IOM) following the classification of WHO criteria, most of the women in current study had a healthy weight gain in the underweight and normal category of BMI while, the overweight and obese women had greater weight gain as compared to the criteria.

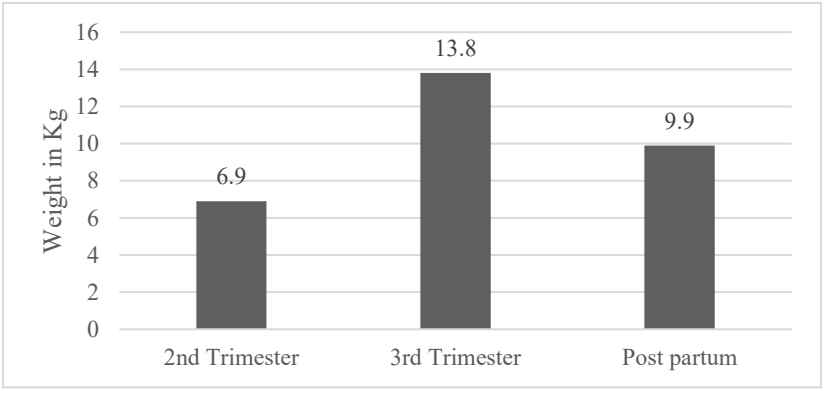

Figure 1 Mean changes in weight as compared to pre-pregnancy

A healthy weight gain during pregnancy can range from 7-11.5 kg for overweight and 11.5-16 kg for normal individuals (Rasmussen et al., 2010). Based on this, the weight gain shown in the study (Figure 1) was ideal as majority of the study respondents were either normal or overweight. Mean difference recorded at post-partum was also greater than weight before pregnancy which is found to be present among 20-30% women (Lovelady, 2011). Some of this weight is due to lack of lactation by the mother (Ciampo and Ciampo, 2018) while others can be due to a sedentary lifestyle or increased BMI pre-pregnancy (Lim et al., 2015).

1.2 Biochemical Assessment

Findings in current research revealed a slight increase in the anemic status of pregnant women from 2nd trimester to post-partum. This increase was gradual over time.

Table 1: Hb levels and anemia status of respondents at different intervals among the study respondents

Variable	2nd Trimester		3rd Trimester		Post-partum		p-value
	n (%)	Mean ± SD	n (%)	Mean ± SD	n (%)	Mean ± SD	
Hemoglobin (Hb)	11.61 ± 1.05^{A}		11.11 ± 1.62^{B}		10.41 ± 1.56^{C}		0.00
Non-Anemic	176 (77.5)	-	165 (72.7)	-	156 (68.7)	-	0.04
Anemic	51 (22.5)	-	62 (27.3)	-	71 (31.3)	-	

Data is presented either in the form of frequency (percentage) or Mean ± SD. Basic descriptive analysis is applied with one-way ANOVA for numerical data with LSD post hoc test presented in capital alphabets to compare means. P-values below <0.01 are highly significant, <0.05 are significant while values >0.05 are non-significant.
The CDC defines anemia in pregnancy as a hemoglobin level of less than 11 g/dL during the first and third trimesters, and less than 10.5 g/dL during the second trimester (Kanu et al., 2022). Study respondents from this study showed no signs of anemia based on this criterion. However, Hb levels at post-partum were found to be lower as compared to the identified standard) to prevent anemia. In addition, the majority of the respondents were involved in surgical procedures for delivery as compared to normal delivery which showed an increase in blood loss with additional post-pregnancy vaginal bleeding among 3.08% of pregnant women. All of these factors can contribute to the lower Hb levels recorded post-partum in the study.

Neither of the mothers was diabetic before the onset of pregnancy, however a continuous rise seemed to be present throughout the trimesters. Results of the study found 5.3% GDM in 2nd trimester, 11.9% GDM in 3rd trimester and only 1.8% GDM in post-partum indicating an increasing trend from 2nd to 3rd trimester, then a normalizing trend towards the end of pregnancy.

1.3 Dietary Recall and Supplement Intake

Important physiological changes during third trimester that require additional nutrients to meet up the health outcomes standard were communicated to the pregnant women. which enable the women to slightly modify their dietary intake causing a rise in 3 most important and readily consumed food groups in the 3rd trimester (Shagana, Dhanraj, Jain, and Nirosa, 2018).

Table 2: Supplement intake data of respondents

Variable	2nd Trimester	3rd Trimester	p-value
	n (%)	n (%)	
Supplements			
No	88 (38.77)	129 (56.83)	0.00
Yes	139 (61.23)	98 (43.17)	
Supplement type			
Biotin	05 (03.60)	04 (04.08)	0.78
Calcium + Vit C	16 (11.51)	10 (10.20)	
Calcium	20 (14.39)	18 (18.37)	
Folic acid	31 (22.30)	30 (30.61)	
Iron	35 (25.18)	20 (20.41)	
Multivitamin	22 (15.83)	14 (14.29)	
Vitamin D	06 (04.32)	02 (02.04)	
Zinc	04 (02.88)	00 (00.00)	

Further, a trend of greater consumption during the 3rd trimester for meat, milk and cereals was recorded. A well-balanced diet composed of ample nutrients according to the need of the body is necessary for a normal human being. The emphasis of well-balanced nutrition through diet is even more important in pregnancy as, the future life of mother and new born child is dependent upon it (Ho, Flynn, and Pasupathy, 2016).

The development of accessary organs as well as the growth of fetus required rapid wear and tear which is met by the consistent supply of macronutrients especially proteins (Elango and Ball, 2016). These requirements are met by food sources rich in protein including meat, milk, legumes and certain plant based proteins (Soy). In addition, foods high in carbohydrates meets the increased energy requirements while fatty food supports the process of wear and tear and fetus development (Plećaš, Plešinac, and Kontić-Vučinić, 2014). Fruits and vegetables aid in the provision of micronutrients which are necessary for healthy outcomes.

1.4 Depression, Anxiety and Stress

Data on the psychological status of the respondent was collected on the depression anxiety, stress scale (DASS-21). The status of depression, anxiety and stress was found to be absent or mildly present among the studied participants in current research. Each of these parameters of psychological health was found to be non-significantly different through pregnancy and post-partum.

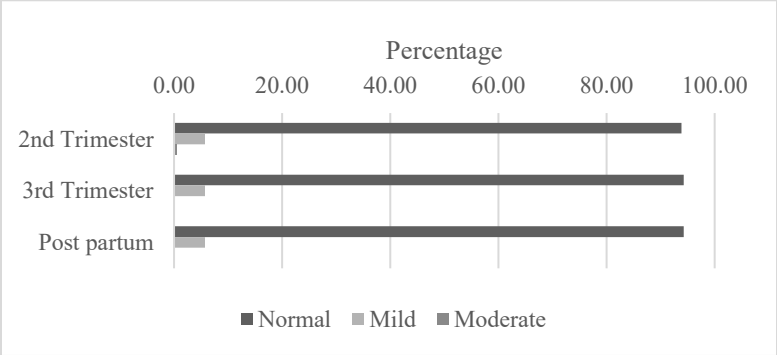

Figure 2 Percent depression recorded at different time points

Pregnancy itself causing severe physiological changes can only be made worst with the onset of depression. Mothers with pre-partum and postpartum depression symptoms exhibited higher cortisol and norepinephrine levels, lower dopamine levels in their babies (Osman and Bahri, 2019). Stress is another one of the most important psychological condition that effect pregnancy outcomes (Cardwell, 2013). Incidence of stress can result in pre-term birth (Schetter, Glynn, Contrada, and Baum, 2011) and low birth weight (Schetter and Lobel, 2012) both of which are negative pregnancy outcomes.

1.5 Neonate's Anthropometry

One of the most important stage of this research was to address the effects of different variables associated with mother on the anthropometric assessment of newborn infant. Gender for most of the infants was male (55.07%) while 44.93% were female. Moreover, anthropometric data of infants revealed a mean length (cm) 45.72 ± 5.75, mean weight (kg) of 2.91 ± 0.55, mean APGAR score 8.32 ± 0.6, mean head circumference (cm) 35.74 ± 4.21 and mean abdominal circumference (cm) 28.98 ± 3.88.

Table 3 Results for anthropometric measures of the Neonates

Variable	n (%)	Mean ± SD
Gender		
Female	102 (44.93)	-
Male	125 (55.07)	-
Length (cm)	-	45.72 ± 5.75
Weight (Kg)	-	02.91 ± 0.55
Low	42 (18.5)	
Normal	185 (81.5)	
APGAR Score	-	08.32 ± 0.60
Head circumference (cm)	-	35.74 ± 4.21
Abdominal circumference (cm)	-	28.98 ± 3.88

Data is presented either in the form of frequency (percentage) or Mean ± SD. Basic descriptive analysis is applied

A healthy body weight at birth is between 2.5-4 kg for neonates born in Asia which indicates that the mean weight recorded in the study is within the normal range indicating healthy pregnancy outcome in most of the study respondents. In addition, APGAR score between 7-9 is also an indicator of healthy pregnancy outcome and a healthy baby (Simon, Hashmi, and Bragg, 2017). Mean APGAR score in this study is also in the normal range which shows that majority of the respondents are having healthy pregnancy outcomes. The rest of anthropometric measurements including length, head circumference and abdominal circumference also indicates healthy pregnancy outcomes in this study.

1.6 Effect of Mother's Nutritional Status on Anthropometric Measurement of Neonates

Evident from the study, different food items contributed differently towards the pregnancy outcomes and health of the infant. Meat consumption in mothers was found to be negatively associated with the APGAR score of the newborn infant.

Table 4.1 Correlation between meat intake of mother and anthropometric measurements of neonate

Variables	Variables					
	Weight	Length	Head circumference	Abdominal circumference	APGAR Score	Meat
Weight	1					
Length	0.437**	1				
Head	0.288**	0.488**	1			

circumference						
Abdominal circumference	0.873**	0.512**	0.337**	1		
APGAR Score	0.262**	0.278**	0.349**	0.257**	1	
Meat	-0.081	-0.076	0.063	-0.079	-0.147*	1

Chen et al., (2010) found an increased risk of lower APGAR score associated with an increased BMI of mother. Studies reported a strong association between the consumption of meat and increase in BMI among normal (Rouhani et al., 2014) as well as pregnant women (Thornburg, Purnell, and Marshall, 2022). Additionally, it also aggravates the complications among pregnant women which is negatively associated with APGAR scores among infants (Thornburg et al., 2022), as revealed in the study. Lower milk consumption of the mother was considered to be a strong predictor for the infant's healthy anthropometric measures. A moderate intake was associated with better infant anthropometric measures as compared to lower or no intake (Lise et al., 2012).

Table 4.2 Correlation between cereals/bread intake of mother and anthropometric measurements of neonate

Variables	**Variables**					
	Weight	**Length**	**Head circumference**	**Abdominal circumference**	**APGAR Score**	**Meat**
Weight	1					
Length	0.437**	1				
Head circumference	0.288**	0.488**	1			
Abdominal circumference	0.873**	0.512**	0.337**	1		
APGAR Score	0.262**	0.278**	0.349**	0.257**	1	
Meat	-0.081	-0.076	0.063	-0.079	-0.147*	1

Cereals and milk consumption was positively correlated with head circumference in current study. The bread/cereal is the staple food in Pakistan and is a part of every diet either small or large (Aziz, Mudassar, Iqbal, and Hussain, 2011). The study revealed an average consumption of cereals in all of the three time points of pregnancy which indicated a sufficient supply of carbohydrates as well as some micronutrients. As shown in the table, this contributed towards providing a balanced diet to the pregnant women in this study which resulted in a positive association between cereal consumption and head circumference.

Table 4.3 Correlation between fruits intake of mother and anthropometric measurements of neonate

Stage	**Fruit intake (servings)**	**Reference value**	**Remarks**
	Mean ± SD	**(Suggested servings)**	
2nd Trimester	1.44 ± 01.01	4	Didn't met recommendations
3rd Trimester	0.92 ± 00.94	4	Didn't met recommendations
Post-partum	0.41 ± 00.61	4	Didn't met recommendations

Although fruit consumption showed a negative correlation with weight and abdominal circumference of the mother, it is important to discuss that participants involved in this study had lower intake of fruits as compared to the recommended/required ranges.

1.7 The Effect of Mother's Psychological Status on Neonate's Anthropometry

Depression in pregnancy is a contributor to negative outcomes. Becker, Weinberger, Chandy, and Schmukler (2016) reported a strong association of depression with low birth weight and pre-term birth among infants. The study further reported this association to be linked with the consumption of anti-depressants. Further, Alvarez et al., (2015) reported the association of maternal depression with developmental delay in children. These studies showed a strong effect of depression on infant's health however, this study did not find any associations.

Table 5 Association between depression of mother and anthropometric measurements of infant

Variables	**Variables**					
	Weight	**Length**	**Head circumference**	**Abdominal circumference**	**APGAR Score**	**Meat**
Weight	1					
Length	0.437**	1				
Head circumference	0.288**	0.488**	1			
Abdominal circumference	0.873**	0.512**	0.337**	1		
APGAR Score	0.262**	0.278**	0.349**	0.257**	1	
Meat	-0.081	-0.076	0.063	-0.079	-0.147*	1

A possible reason for this outcome is the lower levels of depression among the study participants. The presence of no depression among most of the respondents while the presence of only mild depression among a little proportion of respondents explained this non-significant effect on infant's anthropometry as no special medical attention was required to attenuate the levels of maternal depression. Further, anxiety assessment revealed an interesting finding showing a positive correlation with head circumference which is a positive health outcome. However, studies revealed that the increase in maternal anxiety can lead to negative health outcomes for the infants (Grigoriadis et al., 2018, Field, 2017).

1.8 Gestational Diabetes and Associated Factors

Gestational diabetes mellitus is a determined condition in the latter half of pregnancy which usually increase the complications associated with pregnancy. Certain risk variables including maternal age (>30 years), parity (>3), prior history of GDM, a family history of GDM, lower education and pre-pregnancy smoking are considered to be relating to the condition (Wagan et al., 2021; Zhang et al., 2021). The presence of neither of such an association was found in the study yet the family income (socioeconomic) and fat consumption (dietary) were found to be positively associated with GDM.

1.9 Table 6 Factors associated with gestational diabetes as a pregnancy outcome

Variables	Variables					
	Weight	Length	Head circumference	Abdominal circumference	APGAR Score	Meat
Weight	1					
Length	0.437**	1				
Head circumference	0.288**	0.488**	1			
Abdominal circumference	0.873**	0.512**	0.337**	1		
APGAR Score	0.262**	0.278**	0.349**	0.257**	1	
Meat	-0.081	-0.076	0.063	-0.079	-0.147*	1

An increase in family income and increase in dietary fat were increasing the odds of GDM among the study respondents. The trend for increased fat intake during pregnancy was strongly associated with the occurrence of GDM as found in the previous researches (Hernandez, Anderson, Chartier-Logan, Friedman, and Barbour, 2013; Spaight, Gross, Horsch, and Puder, 2016). Shin et al. (2015) estimated the relation of income with food choices and found an association of income as the risk factor of GDM while, Shen et al., (2016) reported the involvement of a lower income in the onset of GDM which indicates the presence of mix results in literature on the subject. Results found in the study relates with the findings of Kim et al., (2007) where and the food choices of study respondents were affected by household income evident by the association between GDM and fats consumption.

1.10 Anemia and Associated Factors

Pregnancy several variables of socio-demographics, socioeconomic and dietary intake were studied to assess their association with anemia during pregnancy. Anemic respondents were found to be at maximum in post-partum (31.3%) with the rest of time points showing lesser percentages. Interestingly, neither of the variables tested in our research showed to have a significant association with the onset of anemia. Husband occupation, maternal education, number of pregnancies, earning heads, household income and the consumption of different food items from various food groups had a non-significant association with anemic status of the study respondents (as shown in Table 7).

Table 7 Factors associated with Anemia as a pregnancy outcome

Variable	B	OR (95% Confidence Interval)	Significance
Husband Occupation	-0.041	00.96 (0.59 - 1.56)	0.87
Maternal Education	-0.112	00.89 (0.72 - 1.10)	0.297
No of Pregnancies	-0.077	00.93 (0.53 - 1.61)	0.784
Earning Heads in family	-0.229	00.80 (0.57 - 1.11)	0.18
Household Income	0.00	01.00 (1.00 - 1.00)	0.125
Meat	-0.504	00.60 (0.35 - 1.05)	0.075
Bread	0.108	01.11 (0.69 - 1.79)	0.657

Milk	-0.391	00.68 (0.38 - 1.22)	0.195
Fruits	0.276	01.32 (0.69 - 2.51)	0.402
Vegetables	-0.078	00.93 (0.45 - 1.90)	0.831
Fats	-0.158	00.85 (0.31 - 2.34)	0.759

Multinomial logistic regression model is applied with the basic output. P-values below <0.01 are highly significant, <0.05 are significant while values >0.05 are non-significant

Previous researches had found a strong association of some of these factors with anemia during pregnancy. Lokare, Karanjekar, Gattani and Kulkarni (2012) found that religion, education level of women and husbands, and socioeconomic class were substantially related to the occurrence of anemia in pregnancy. Further, Ullah, Sohaib, Saeed and Iqbal (2019) used a bivariate analysis to identify the factor association of anemia in Pakistani women and found that lower education ($p = 0.01$), women's occupation ($p = 0.03$), poorer income ($p = 0.001$), living in rural community ($p = 0.028$), and a higher number of house members ($p = 0.04$) were all significantly linked with maternal anemia. Adding up to the list even further Bansal et al., (2020) found a statistically significant association with the prevalence of anemia with residence, educational status, monthly family income, occupation, gestational age, iron folic acid supplementation, dietary habits of not eating green leafy vegetables, meat and animal products. These researches provide strong proof of the association of socio-demographic, socio-economic and dietary variables with anemia yet no such association was discovered in the research.

1.11 Conclusion and Recommendation

This study demonstrated that a pregnant woman requires the diet that is well-balanced and rich in the nutrients that body needs because a woman's nutritional status during pregnancy has a significant impact on both the mother's and the baby's health. According to the study's findings, mostly mothers are not consuming a balanced and nutrient rich diet which can lead to low birth weight, which increases the risk of health problems for the baby. In addition, malnutrition during pregnancy has been linked to an increased risk of pre-eclampsia as well as maternal health. Women should seek advice from a healthcare provider or a registered dietitian if they have any concerns about their nutritional status. In addition, Pakistan's health sector's strategy and development have the ability at the initial planning stage, but not at the execution stage. Therefore, it is suggested that in an attempt to address Pakistan's health-related challenges, particularly for mothers and their newborns, firm, and trustworthy policies should be created and put into effect.

References

1. Alvarez, S. L., Meltzer-Brody, S., Mandel, M. & Beeber, L. 2015. Maternal depression and early intervention: A call for an integration of services. *Infants Young Children*, 28, 72
2. Aziz, B., Mudassar, K., Iqbal, Z., & Hussain, I. (2011). Estimating food demand elasticities in Pakistan: An application of almost ideal demand system. *Forman Journal of Economic Studies*, 7(2011), 1-24
3. Bansal, R., Bedi, M., Kaur, J., Kaur, K., Shergill, H. K., Khaira, H. K., & Suri, V. (2020). Prevalence and factors associated with anemia among pregnant women attending antenatal clinic. Adesh University *Journal of Medical Sciences Research*, 2(1), 42-48.
4. Becker, M., Weinberger, T., Chandy, A., & Schmukler, S. (2016). Depression during pregnancy and postpartum. *Current Psychiatry Reports*, 18, 1-9.
5. Cardwell, M. S. (2013). Stress: pregnancy considerations. 68(2), 119-129.
6. Chen, M., Mcniff, C., Madan, J., Goodman, E., Davis, J. M., & Dammann, O. (2010). Maternal obesity and neonatal Apgar scores. *The Journal of Maternal-Fetal Neonatal Medicine*,
7. Ciampo, L. A. D. & Ciampo, I. R. L. D. 2018. Breastfeeding and the Benefits of Lactation for Women's Health. *Revista Brasileira de Ginecologia e Obstetrícia*, 40, 354-359.
8. Elango, R., & Ball, R. O. (2016). Protein and amino acid requirements during pregnancy. *Advances in Nutrition*, 7(4), 839S-844S.

9. Grigoriadis, S., Graves, L., Peer, M., Mamisashvili, L., Tomlinson, G., Vigod, S. N., Dennis, C.-L., Steiner, M., Brown, C. & Cheung, A. 2018. Maternal anxiety during pregnancy and the association with adverse perinatal outcomes: systematic review and meta-analysis. *The Journal of Clinical Psychiatry*, 79, 813.
10. Hameed, H., Hameed, A., Bashir, S., Akram, S., Arshad, M. and Afzal, R., (2018). Study of Prevalence of Anaemia among Pregnant Women and Its Correlation with Different Risk Factors. *Drug Designing: Open Access*. 07(01), 2169-0138
11. Hernandez, T. L., Anderson, M. A., Chartier-Logan, C., Friedman, J. E., & Barbour, L. A. (2013). Strategies in the nutritional management of gestational diabetes. *Clinical obstetrics gynecology*, 56(4), 803.
12. Ho, A., Flynn, A. C., & Pasupathy, D. (2016). Nutrition in pregnancy. Obstetrics, *Gynaecology Reproductive Medicine*, 26(9), 259-264
13. Kanu, F. A., Hamner, H. C., Scanlon, K. S. & Sharma, A. J. 2022. Anemia Among Pregnant Women Participating in the Special Supplemental Nutrition Program for Women, Infants, and Children — United States, 2008–2018. MMWR Morb Mortal Wkly Rep 2022. United States: Center of Diesease Control.
14. Kim, C., McEwen, L. N., Piette, J. D., Goewey, J., Ferrara, A., & Walker, E. A. (2007). Risk perception for diabetes among women with histories of gestational diabetes mellitus. *Diabetes Care*, 30(9), 2281-2286.
15. Lim, S., O'Reilly, S., Behrens, H., Skinner, T., Ellis, I., & Dunbar, J. A. (2015). Effective strategies for weight loss in post-partum women: a systematic review and meta-analysis. *Obesity Reviews*, 16(11), 972-987
16. Lise Brantsæter, A., Olafsdottir, A., Forsum, E., Olsen, S., & Thorsdottir, I. (2012). Does milk and dairy consumption during pregnancy influence fetal growth and infant birthweight? A systematic literature reviews. *Food Nutrition Research*, 56(1), 20050.
17. Lokare, P. O., Karanjekar, V. D., Gattani, P. L., & Kulkarni, A. P. (2012). A study of 170 prevalence of anemia and sociodemographic factors associated with anemia among pregnant women in Aurangabad city, India. *Annals of Nigerian Medicine*, 6(1), 30.
18. Lovelady, C. (2011). Balancing exercise and food intake with lactation to promote postpartum weight loss. *Proceedings of the Nutrition Society*, 70(2), 181-18
19. Osman, N. N. & Bahri, A. I. 2019. Impact of altered hormonal and neurochemical levels on depression symptoms in women during pregnancy and postpartum period. *Journal of Biochemical Technology*, 10, 16.
20. Plećaš, D., Plešinac, S., & Kontić-Vučinić, O. (2014). Nutrition in pregnancy: basic principles and recommendations. *Srpski Arhiv Za Celokupno Lekarstvo*, 142(1-2), 125-130.
21. Rasmussen, K. M., Abrams, B., Bodnar, L. M., Butte, N. F., Catalano, P. M., & Siega-Riz, 176 A. M. (2010). Recommendations for weight gain during pregnancy in the context of the obesity epidemic. *Obstetrics Gynecology*, 116(5), 1191
22. Rouhani, M., Salehi-Abargouei, A., Surkan, P. & Azadbakht, L. 2014. Is there a relationship between red or processed meat intake and obesity? A systematic review and meta-analysis of observational studies. *Obesity Reviews*, 15, 740-748.
23. Schetter, C. D., & Lobel, M. (2012). Handbook of health psychology.
24. Schetter, C. D., Glynn, L. M., Contrada, R., & Baum, A. (2011). The handbook of stress science: biology, psychology, and health. New York: *Springer Publishing Company*.
25. Shen, G. X., Shafer, L. A., Martens, P. J., Sellers, E., Torshizi, A. A., Ludwig, S., McGavock, J. (2016). Does First Nations ancestry modify the association between gestational diabetes and subsequent diabetes: a historical prospective cohort study among 178 women in Manitoba, Canada. *Diabetic Medicine*, 33(9), 1245-1252.
26. Shin, D., Lee, K. W. & Song, W. O. 2015. Dietary patterns during pregnancy are associated with risk of gestational diabetes mellitus. *Nutrients*, 7, 9369-9382

27. Sikander, S. et al., (2019). Cohort Profile: Perinatal depression and child socioemotional development; the Bachpan cohort study from rural Pakistan. *BMJ Open*. 9(5), 025644
28. Spaight, C., Gross, J., Horsch, A., & Puder, J. J. (2016). Gestational diabetes mellitus.*Novelties in Diabetes*, 31, 163-178
29. Thornburg, K. L., Purnell, J., & Marshall, N. (2022). Concerns regarding red meat consumption during pregnancy: a reply. *American Journal of Obstetrics Gynecology*, 227(2), 360-362.
30. Toro-Ramos, T., Paley, C., Pi-Sunyer, F. X. and Gallagher, D., (2015). Body composition during fetal development and infancy through the age of 5 years. *European Journal of Clinical Nutrition*. 69(12), 1279–1289. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4680980
31. Tyagi, S., Toteja, G. S. and Bhatia, N., (2019). Maternal Dietary Intake During Pregnancy and Its Association with Size of Offspring at Birth and One Year of Age. *Current Developments in Nutrition*. 3(1), 11-031-19
32. Ullah, A., Sohaib, M., Saeed, F., & Iqbal, S. (2019). Prevalence of anemia and associated 181 risk factors among pregnant women in Lahore, Pakistan. *Women Health*, 59(6), 660-671
33. Ullah, A., Sohaib, M., Saeed, F., & Iqbal, S. (2019). Prevalence of anemia and associated 181 risk factors among pregnant women in Lahore, Pakistan. *Women Health*, 59(6), 660-671.
34. Wagan, N., Amanullah, A. T., Makhijani, P. B., Kumari, R., Wagan Sr, N., tahir Amanullah, A., & bai Makhijani, P. (2021). Factors associated with gestational diabetes mellitus: A cross-sectional study. *Cureus*, 13(8).
35. World Health Organization. (2019). Global status report on alcohol and health 2018. World Health Organization
36. Xinxo, S., Bimbashi, A., Kakarriqi, E. and Zaimi, E., (2013). Association Between Maternal Nutritional Status of Pre Pregnancy, Gestational Weight Gain and Preterm Birth. *Materia Socio Medica*. 25(1), 6
37. Zhang, Y., Xiao, C.-M., Zhang, Y., Chen, Q., Zhang, X.-Q., Li, X.-F., Gao, Y.-M. (2021). Factors associated with gestational diabetes mellitus: a meta-analysis. *Journal of Diabetes Research*, 2021, 1-18.