MATERNAL DIETARY PATTERNS AND INFANT BIRTH OUTCOME AMONG NEPALESE MOTHER AND CHILD IN TERTIARY HOSPITAL: A BIRTH COHORT STUDY

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ABSTRACT

Maternal nutrition during pregnancy significantly impacts fetal health in the long term. Inadequate nutrient intake can lead to maternal anemia, which increases the risk of other complications and maternal mortality. It can also result in fetal growth retardation and low birth weight. Both the quality and quantity of nutrition are crucial during this critical period. The current study aimed to analyze the relation between maternal dietary patterns and infant birth outcome among Nepalese mother. This study was hospital-based birth cohort prospective study. Ethical approval was taken from Paropakar Maternity and Women's Hospital (Ref no: 63/1180). It was conducted from March 2023 to December 2024 at Paropakar Maternity and women's Hospital. A total of 367 participants were recruited for the study. The pregnant women who attended ANC OPD at 20 to 26 weeks of gestation were selected. Convenience sampling method was used. Dietary intake assessment was done and the pregnancy outcomes was recorded after delivery. Descriptive statistics, chi-square ($\chi 2$) test, and Manova Test was applied. Dietary assessments showed higher adequate consumption of pulses, green leafy vegetables, and dairy products, with a significant relationship ($p = 0.001$) between dietary adequacy and fetal macrosomia, despite only 4.3% of neonates being macrosomic. Maternal age and occupation had no significant impact on delivery outcomes, and neither did smoking, alcohol, or chronic diseases. Adequate dietary diversity was associated with better mode of delivery outcomes, though it did not significantly affect other neonatal outcomes. Maternal nutrition, particularly dietary diversity, is crucial for neonatal outcomes, with significant associations found for adequate food consumption and delivery outcomes, while other maternal factors showed no significant effects.

KEYWORDS

Fetal macrosomia, infant, newborn, nutrition, pregnancy outcome, cohort study

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INTRODUCTION

Pregnancy is a crucial time for women to be wellnourished.[1] Maternal nutrition during pregnancy has long-term effects on fetus health.[2] Nutrition during pregnancy is the main determinant of fetal outcome for example: growth development, birth weight and infant's disease.[3] The role of maternal health and nutrition has been emphasized by the recognition of the problem of low birth weight which affects some 20 million newborns annually, mainly in developing countries.[4] Factors that lead to a healthy pregnancy include overall health, appropriate weight gain, physical activity during pregnancy, intake of various foods, mineral supplements and vitamins.[5] A suboptimal maternal diet and inadequate gestational weight gain during pregnancy increase risk for adverse health outcomes for both mother and child.[6] To improve maternal and child health outcomes, women should weigh within the normal BMI range when they conceive and strive to gain within ranges recommended by the Institute of Medicine (IOM) 2009 pregnancy weight guidelines.[7] Association between pre-pregnancy body mass index and pregnancy outcomes in western countries has been reported.[8] Maternal undernutrition remains an important challenge for Nepal, as many women continue to suffer from chronic energy as well as micronutrient deficiencies.[9]

To our knowledge, data are limited on maternal nutritional status during pregnancy and its association with birth outcomes in developing countries. Better understanding of associations between markers of maternal nutrition status and infant birth outcomes can guide development of appropriate prenatal nutrition policies, guidelines, and practices for better outcomes to pregnancy.

MATERIALS AND METHODS

This study was hospital-based birth cohort study. It was conducted from March 2023 to December 2024 at Paropakar Maternity and Women's Hospital. This hospital serves as the tertiary level center. The pregnant women who attended Antenatal Clinic (ANC) OPD at 20 to 26 weeks of gestation were selected. Convenience sampling method was used. Data collection was started after getting letter of permission from the Institutional Review Board, Paropakar Maternity and Women's Hospital (Ref No: 63/1180). All participants included in this study were informed about the study and its objectives. Written consent was taken from the participants. Privacy and confidentiality were maintained.

The sample size was calculated based on an estimated prevalence from previous study by using the following formula

sample size: $n = Z^2p\ (1-p)/d^2$

n = sample size

z = level of confidence according to the standard normal distribution (for a level of confidence of 95%, z = 1.96)

p = prevalence of low birth weight = 36.5%=0.365 (Maternal dietary pattern and pregnancy outcome)[10]

d = tolerated margin of error=5%

$$n = \frac{(1.96)^2 0.365(1-0.365)}{(0.05)^2} = 365.15 \sim 367$$

The total sample size calculated was 367.

First trimester of pregnancy and age between 18–40 years and had delivered a singleton, live baby were included in the study. Participants with chronic diseases such as hypertension, heart and renal disease other types of diabetes; and adherence to special diet were excluded.

Data was collected by principal investigator and with the help of postgraduate students. Women's personal and medical history was taken. They were personally interviewed after taking the written consent.

The first part of questionnaire consisted of demographic variables like age, education, job status, income, chronic illnesses, health-related factors, physical activity, and food frequency questionnaire. In second part of questionnaire, neonatal outcome was recorded (mode of delivery, birth status, baby weight, Apgar score).

Dietary intake assessment was done. Participants were administered a semi-quantitative food frequency questionnaire (FFQ)[11] inquiring how often, on average, a participant had consumed common foods in the preceding month. The FFQ was developed to reflect the local dietary patterns in the general population in Nepal. For each food item, participant was asked to select the option that would best reflect her intake in the past months: never (0 times in a month), less than once a week,1–3 times in a week, 4–6 times per week, 1 time per day, twice a day,3 times or more a day. Based on the reported frequency, we derived serving/day for each individual food item (0 serving/day for "never," 0.5 serving/day for "less than once per week," 2 serving/day for "1-3 times per week," 5 serving/day for "4-6

times per week," 7 serving/day for "once a day," 14 serving/day for "twice a day", 21 serving/day for "3 times or more a day." The scores were then summed to give the total prime diet quality score (PDQS) score.

A digital weight scale was used to measure maternal weight. Similarly, blood pressure was measured using manual sphygmomanometers in clinical settings.

Data collection was done in an individual forms prepared for each participant. The data was entered into a KOBE spreadsheet and later was exported to SPSS-20 and coded for analysis. The analysis included both descriptive and inferential statistics.

Descriptive statistics (frequencies, means, and standard deviations) was used to describe the variables of interest. The chi-square ($\chi 2$) tests were used to assess the bivariate relationships between these factors as well as for difference in proportions and for other categorical variables. Manova test was applied to assess the differences in the means of multiple dependent variables across different groups. In all statistical tests P=0.05 or less was considered statistically significant.

RESULTS

Maternal characteristics: Of the 367 mothers enrolled, the median age of the mothers was 26 years old with higher involvement from Janajati group 155 (42.2%). Most of the mothers involved in the study had primary level of education 90 (24.5%). Most of the participants were housemakers 274 (74.7%). Regarding the household income both earning more than NRs. 20,000 were 182 (49.6%). When asked about their personal habit, only 4 (1.1%) smoked during pregnancy period and 6 (1.6%) consumed alcohol. The number of participants who were not involved in physical activity during pregnancy was 263 (71.7%). Only 27 (7.4%) suffered from chronic diseases. Approximately, 174 (47.4%) lied in Obese II category while 131 (35.7%) participants were Obese I category. Only 2 (0.5%) were undernourished (Table 1).

Foods like pulses, green leafy vegetables, and dairy products have a higher percentage of adequate consumption compared to the inadequate group. Pulses, vegetables, green leafy vegetables, dairy products, seasonal fruits, and meat products show significant differences in consumption. Grains and cereals, as well as nuts and seeds, do not show significant differences.

Table 1: Baseline characteristics of all mothers(n=367)

Baseline characteristics	n (%)
Age (years) median (IQR)	26 (4)
Ethnicity	
Brahmin	47 (12.8)
Chettri	95 (25.9)
Janajati	155 (42.2)
Dalit	34 (9.3)
Others	36 (9.8)
Education	
Primary	90 (24.5)
Secondary	72 (19.6)
High school	83 (22.6)
+2	83 (22.6)
Bachelor	35 (9.5)
Masters	4 (1.1)
Occupation	
Housemakers	274 (74.7)
Employed	93 (25.3)
Household income	
Both <20000	121 (33.0)
Either >20000	64 (17.4)
Both >20000	182 (49.6)
Smoking during pregnancy	
Yes	4 (1.1)
No	363 (98.9)
Alcohol consumption during pregnancy	
Yes	6 (1.6)
No	361 (98.4)
Physical activity	
None	263 (71.7)
Less than once weekly	50 (13.6)
times weekly	31 (8.4)
>3 times weekly	23 (6.3)
Chronic diseases	
Yes	27 (7.4)
No	340 (92.6)
Weight at 20 to 26 weeks gestation (kg), median (IQR)	62 (4)
BMI at 20 to 26 weeks gestation (kg/m^2), median (IQR)	29.2 (3.4)

Table 2: Relationship between women's dietary diversity score with different food categories

Food groups consumed/Not consumed	WDDS*		p value
	Adequate n (%)	**Inadequate n (%)**	
Food made from grains and cereals	162 (44.9) 2 (33.3)	199 (55.1) 4 (66.7)	0.57
Pulses	155 (52.2) 9 (13.4)	142 (47.8) 58 (86.6)	0.001
Vegetables	164 (45.6) -	196 (54.4) 7 (100)	0.016
Green leafy vegetables	157 (52.7) 7 (10.1)	141 (47.3) 62 (89.9)	0.001
Dairy products	136 (52.9) 28 (25.5)	121 (47.1) 82 (74.5)	0.001
Seasonal fruits	158 (54.3) 6 (7.9)	133 (45.7) 70 (92.1)	0.001
Nuts and seeds	80 (47.6) 84 (42.2)	88 (52.4) 115 (57.8)	0.29
Meat products	76 (65.5) 88 (35.1)	40 (34.5) 163 (64.9)	0.001

*Women dietary diversity score

Table 3: Relationship between maternal dietary patterns and neonatal outcomes

Variables	**Category**	**WDDS**		**p value**
		Adequate	**Inadequate**	
Birth weight	Normal Low birth Weight	145 (44.9) 19 (43.2)	178 (55.1) 25 (56.8)	0.83
Mode of delivery	Vaginal Caesarean Normal	53 (34.9) 66 (47.5) 45 (59.2)	99 (65.1) 73 (52.5) 31 (40.8)	0.002
Birth	Full term Preterm	157 (45.5) 2 (9.1)	188 (54.5) 20 (90.9)	0.001
Fetal macrosomia	Yes No	16 (100) 152 (43.3)	- 199 (56.7)	0.001

Table 3 shows the results underscore the importance of mode of delivery, gestational age, and fetal size in determining the adequacy of nutrition in birth outcomes, while birth weight alone does not appear to be a significant factor in this analysis.

The results show a significant relationship (p-value of 0.001) between fetal macrosomia and dietary adequacy. Although only 4.3% of newborn were classified as macrocosmic, a larger portion of those without macrosomia (41.4%) fell into the inadequate category.

Maternal age and occupation do not significantly affect mode of delivery, birth type, low birth weight, or Apgar scores, as indicated by high p-values and low effect sizes. Smoking and alcohol consumption during pregnancy also show no significant influence on these outcomes, nor does maternal chronic disease. In contrast, adequate maternal dietary diversity is associated with better outcomes in mode of delivery, while other neonatal outcomes do not show significant associations with dietary diversity score (DDS) (Table 4).

Table 4: The association between maternal factors and infant birth outcome among pregnant women through MANOVA test

Maternal factors	Dependent variable				Wilks lambda
	Mode of delivery	Birth type	Low birth weight	Apgar score	
Age					
<30	1.77±0.7	1.06±0.2	1.88±0.3	1.13±0.3	
≥ 30	1.86±0.7	1.07±0.2	1.87±0.3	1.13±0.3	0.99
F	0.95	0.22	0.001	0.001	
pvalue	0.33	0.63	0.97	0.97	
Partial Eta squared	0.003	0.001	0.00	0.00	
Ethnicity					
Privileged	1.79±0.74	1.06±0.23	1.88±0.32	1.12±0.37	
underprivileged	1.87±0.9	1.07±0.25	1.83±0.37	1.23±0.50	0.99
F	0.30	0.02	0.67	2.41	
p value	0.58	0.87	0.41	0.12	
Partial Eta squared	0.001	0.00	0.002	0.007	
Occupation					
Employed	1.81±0.77	1.05±0.21	1.89±0.31	1.14±0.39	
Unemployed	1.75±0.71	1.10±0.29	1.85±0.36	1.11±0.37	0.98
F	0.34	3.00	1.10	0.34	
p value	0.55	0.08	0.29	0.55	
Partial Eta squared	0.001	-.008	0.003	0.001	
Smoking during pregnancy					
Yes	1.25±0.5	1.0±0.0	1.75±0.5	1.0±0.0	
No	1.80±0.76	1.06±0.23	1.88±0.32	1.13±0.38	0.98
F	2.06	0.25	0.64	0.44	
p value	0.15	0.61	0.42	0.50	
Partial Eta squared	0.006	0.001	0.002	0.001	
Alcohol					
Yes	1.67±0.51	1.00±0	1.83±0.40	1.00±0	
No	1.80±0.76	1.06±0.24	1.88±0.32	1.13±0.39	0.08
F	0.16	0.38	0.12	0.66	
p value	0.68	0.53	0.72	0.41	
Partial Eta squared	0.00	0.001	0.00	0.002	
Physical exercise					
Yes	1.79±0.70	1.08±0.27	1.88±0.33	1.15±0.44	
No	1.80±0.78	1.05±0.22	1.88±0.32	1.12±0.35	0.99
F	0.008	1.12	0.02	0.54	
p value	0.92	0.29	0.87	0.46	
Partial Eta squared	0.00	0.003	0.00	0.001	
Chronic disease					
Yes	1.81±0.68	1.04±0.19	1.89±0.32	1.11±0.32	
No	1.79±0.76	1.06±0.23	1.88±0.32	1.13±0.39	0.02
F	0.02	0.27	0.02	0.05	
p value	0.87	0.60	0.88	0.81	
Partial Eta squared	0.00	0.001	0.00	0.000	
DDS					
Adequate	1.95±0.77	1.06±0.24	1.88±0.32	1.14±0.39	
Inadequate	1.67±0.72	1.06±0.23	1.88±0.4	1.12±0.38	0.96
F	13.2	0.006	0.046	0.29	
p value	0.00	0.94	0.83	0.58	
Partial Eta squared	0.03	0.00	0.00	0.001	

DISCUSSION

This study tried to assess the maternal dietary pattern and its association with birth outcome among pregnant mothers attending their routine antenatal care service.

In the present study, we identified women's dietary diversity score (WDDS) and then assessed the association between women's sociodemographic indices and neonatal status (LBW, preterm, macrosomia, anthropometric indices) in pregnant women. In the previous study[10] three major dietary patterns using 168 items FFQ and factor analysis method and then assessed the association between them and GDM, anemia, mothers' anthropometric indices and neonatal status. In Tanzanian research,[12] maternal dietary diversity and diet quality using minimum dietary diversity and prime diet quality score and their associations with inappropriate gestational weight gain and adverse birth outcomes in a healthy pregnancy cohort.

In this study, fetal macrosomia showed a significant relationship with dietary adequacy (p-value of 0.001), suggesting that improved maternal nutrition could potentially reduce the risk of macrosomia. A study in Nigeria[13] also identified frequent ingestion of high glycemic index diets and soft drinks, along with the avoidance of dietary fibers, as maternal nutritional habits associated with fetal macrosomia.

Maternal age and occupation do not significantly affect mode of delivery, birth type, low birth weight, or Apgar scores, as indicated by high p-values and low effect sizes. This suggests that these demographic factors may be less influential than previously thought.[14]

Similarly, smoking and alcohol consumption during pregnancy, along with maternal chronic diseases, did not show significant associations with the analyzed outcomes in the provided text. However, it is important to note that other studies[15,16] have shown that smoking and alcohol consumption during pregnancy can lead to adverse birth outcomes, such as preterm birth and low birth weight. A study in Brazil found that alcohol consumption during pregnancy increased the chance of maternal anemia and gestational diabetes, while tobacco consumption doubled the chance of low birth weight.[17]

In the present Manova analysis, many maternal factors did not show significant effects on delivery outcomes in this study, the strong association between dietary diversity and neonatal health outcomes is a crucial finding. This emphasizes the need for targeted interventions aimed at improving maternal nutrition, which could lead to better health outcomes for mothers and their infants.

In conclusion, this study highlights the multifaceted role of maternal nutrition in influencing neonatal outcomes. While certain food groups demonstrate clear associations with dietary adequacy and fetal health, other factors such as maternal age, lifestyle choices, and chronic diseases appear less impactful.

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