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Original Article

Determinants of Minimum Dietary Diversity and its Association with Malnutrition in Pregnant Women of Lahore, Pakistan: A Cross-Sectional Study

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Abstract: Background: Information regarding the factors determining dietary diversity among pregnant women is limited. Adding a variety of foods to the diet of pregnant women is a sustainable intervention to prevent the intergenerational cycle of malnutrition. This study was conducted to evaluate unconventional determinants of dietary diversity and their association with malnutrition in pregnant women of Lahore, Pakistan. **Methods:** A cross-sectional study was conducted involving 400 pregnant women from different government hospitals in Lahore, Pakistan. MUAC measurements were used to assess maternal nutritional status, and the dietary recall method was used to determine MDD-W. Data were entered and analyzed using SPSS version 23, and both bivariate and multivariate binary logistic regression analyses were used to determine the interrelation between maternal DD and maternal underweight. **Results:** The MDD-W were met by 88.75% pregnant women out of 400. The prevalence of maternal underweight (MUAC <25cm) among pregnant women was 28.2%. The analysis demonstrates that women belonging to a low household wealth index had two times greater chances of achieving the MDD-W (AOR 2.368, Cl 1.163, 4.824). Poor food consumption score women less achieved MDD-W because its value was 100%. One time, more highly achieved women had a minimum dietary diversity score by women belonging to low household size (AOR 1.204, Cl 0.454, 3.199). Risk factors for maternal underweight included poor to borderline food consumption scores and younger maternal age (21-35). In pregnant women, there is no relationship between MDD-W and maternal underweight. **Conclusion:** This cross-sectional study shows that food security is associated with maternal underweight during pregnancy (measured by food consumption score rather than MDD-W) in different government hospitals of Lahore, Pakistan.

Keywords: Dietary diversity, Pregnant women, MDD-W, MAUC, Malnutrition

1. Introduction

Dietary diversity is an essential component of a healthy diet, especially in pregnant women. Pregnancy is the most physiologically challenging phase of a woman's life to fulfill the nutritional needs of the developing fetus and the mother (Kuma et al., 2021). Maternal malnutrition is a major public health concern globally, primarily affecting the larger population of mothers in developing nations (Bhutta et al., 2013). Due to prolonged macro and micro nutrient deficiency and lack of dietary diversity**,** particularly among women of reproductive age (WRA) are more prone to malnutrition, predominantly in Africa, South Central and South East Asia (Black et al., 2016). Maternal malnutrition can irreversibly impact the development of the foetus, increasing the likelihood of cognitive growth restriction, low birth weight, preterm birth, and maternal or child morbidity and mortality, particularly in low and middle-income countries (Desta et al., 2019). Dietary diversity consists of a variety of contrasting food groups ingested over a certain time period, but the observation period can be different; however, it is usually the preceding day or week. According to a scientific review of literature, dietary diversity is the key determinant of household food security and nutrient insufficiency in the diet of women of childbearing age (Saaka et al., 2021).

Malnutrition, along with limited dietary diversity in pregnant women, is typically associated with elevated nutritional needs throughout pregnancy, lactation, illnesses, socioeconomic variables, perinatal medical conditions, dietary intake variables, and external factors (Dadi et al., 2019; Kedie et al., 2016; Mariyam et al., 2018; Shiferaw et al., 2019). Dietary diversity is the sustainable approach to improve dietary intake of pregnant women that is based on the idea of adequate macro

and micronutrient consumption to prevent irreversible growth or developmental impairments of the foetus (Agyei et al., 2021). Among several factors that lead to nutrient inadequacy in the women of third-world countries are teenage pregnancy, short interval between pregnancies, and poor-quality food.

For the woman of fertile age, dietary diversity is measured using the Minimum Dietary Diversity for Women (MDD-W) scale introduced by the Food and Agriculture Organisation of the United Nations (FAO) (Geta et al., 2022). Previous studies have shown that MDD in pregnant women is influenced by several variables, including mothers' education level, meal frequency, wealth index, maternal occupation, and socio-economic status (Kuma et al., 2021). This study was conducted to identify the magnitude of dietary diversity and associated factors and their correlation with the nutrition profile of pregnant women in Lahore, Pakistan (Kuma et al., 2021; Desta et al., 2019).

2. Materials and Methods

Research settings: This research was conducted in the different government hospitals of Lahore.

Research design, population, and sampling: The cross-sectional design analysis was conducted to gather quantitative data from 400 pregnant women in Lahore. We selected pregnant women of all trimesters. The data were collected from 3 different government hospitals (Sir Ganga Ram Hospital, Mayo Hospital, Lady Willington Hospital) of Lahore.

$$n=z2p\ (1-p)/\ d2$$

Where n was the required sample size, z was 1.96 at a confidence level of 95%, p was the estimated proportion of pregnant women, which was equal to 50%, and d was the margin of error at 5% (standard value of 0.05). The total required sample size calculated was 384. By allowing for a 20% non-response rate (76 respondents), the overall sample was adjusted to 460 respondents. Only 400 participants responded to our questionnaire, so the sample size was n=400.

Data collection: The interview-based questionnaire was used to collect statistics from the respondents (Saaka et al., 2021). Anthropometric measurement includes the mid-upper arm circumference (MUAC). Maternal height, weight, age, hemoglobin level, and pregnancy months were rectified from antenatal care cards. Maternal occupation was classified as not working or working.

Independent and dependent variables: MUAC measured the nutritional status of pregnant women, a dependent variable. The dietary diversity score of individuals measured dietary quality, an independent variable. The control variables included maternal age, weight, height, birth interval, pregnancy month, education, household members, household income, socioeconomic status, and occupation.

Assessment of MDD for women: The MDD for pregnant women was used to evaluate the overall dietary quality of Participants. Nutrient adequacy is measured by an indicator, MDD-W, among pregnant females. 10 food groups participate in MDD-W, such as starch staples, vegetables, fruits, dark green leafy vegetables, meat and meat products, legumes/pulses, nuts, and milk byproducts (Wen et al., 2010). The 3-day dietary recall was taken from the food groups mentioned earlier, from the women. Responses were documented as ‘yes’ or ‘no’. A ‘yes’ was scored as ‘1’, and ‘no’ was given a score of ‘0’. The W-DDS was found by adding up the scores. Based on W-DDS, the dietary score was classified into less than 5 (low dietary diversity) and scores of 5-10 (high dietary diversity).

Dietary diversity score of 7 days, to quantify dietary intake of the mother FFQ was used containing 11 food groups. The frequency of each food group consumption was measured by giving a score of ‘0’ if not consumed, 1 if consumed on 1-3 days, 2 if consumed on 4-6 days, and 3 if consumed daily during the past 7 days. The eleven food groups were starch, meat and meat products, fruits, milk and milk products, legumes, tubers, roots and cereals, leafy vegetables, fried and baked products, beverages, and oil and fat.

Assessment of MDD of pregnant women: Fat-free mass was measured by MUAC, an indicator of nutritional status, using a measuring tape, and is not affected by pregnancy months. Based on MUAC, values below 25 cm indicate underweight and values above 25 cm indicate normal.

Determination of household economic status: The household economic status, which was classified as low, middle, or high, was assessed by household income (less than 30k, 30k-50k, 50k-100k, 100k or more).

Data analysis: SPSS version 23 was used to analyze the data. Descriptive and inferential statistics were used to analyze data. Bivariate analysis was performed to determine factors linked to women's minimum dietary diversity (MDD-W) and the association of certain determinants with maternal underweight (MUAC) during the gestation period.

3. Results

Socio-Demographic Characteristics of Respondents: All the 400 participants were married and Muslims. All of the households were headed by males. The mean age of the participants was 25.88 + 5.5 (years), with the minimum and maximum ages of 18 and 40 (years), respectively. 40.5% (162) of the participants have an education less than matric. 28.5% (114) have done matric.17% (68) attended college, and 14% (56) were graduates. 12.3% (49) of the households had 1-3 members, 53% (212) had 4-7 members, and 34.8% (139) had 8 or more members (Table 1).

Table 1: Socio-demographic characteristics of respondents (N=400)

Variables	Frequency	Percentages (%)
	Age groups (years)	
Up to 20	39	9.8
21 to 35	355	88.6
35+	6	1.6
Total	400	100
	Occupation	
Working	22	5.5
Nonworking	378	94.5
Total	400	100
	Education level	
Less than matric	162	40.5
Matric	114	28.5
College	68	17.0
University	56	14.0
Total	400	100.0
	Household members	
1 to 3	49	12.3
4 to 7	212	53.0
8 or more	139	34.8
Total	400	100.0

Variables determining MDD-W: Analysis showed that the mean MDDS of the study population was 6.69 out of 10 food groups. MDD-W dietary score was classified into two groups, low (<5) and high (>5) diversity. Out of 400 respondents, 88.75% met the women's minimum dietary diversity score. Bivariate analysis was conducted to determine the relationship of socio-demographic and other factors with women's minimum dietary diversity score. Household food consumption score and maternal education level have shown a positive association ($p<0.05$) with MDD-W. Household wealth index and household size have shown a negative association ($p>0.05$) with MDD-W (Table 2).

Table 2: Bivariate analysis of factors associated with women's minimum dietary diversity (MDD-W)

Characteristics	N	MDD-W (<5) n (%)	MDD-W (>5) n (%)	Test Statistics
	Household food consumption score			
Poor	109	53.3	23.9	X2=20.251 P= 0.00
Borderline	245	46.7	63.1	
Acceptable	46	0	13	
	Household wealth index			
Low	235	75.6	56.6	X2=5.999 P=0.050
Middle	163	24.4	42.8	
Upper	2	0	0.6	
	Educational level			

Less than matric	162	60	38	
Matric	114	20	29.6	X2=8.395
College	68	13.3	17.5	P=0.039
University	56	6.7	14.9	
		Household size		
1-3	49	13.3	12.1	X2=-19.325
4-7	212	42.2	54.4	P=0.394
8 or more	139	44.4	33.5	

According to the Regression analysis, low household wealth index was a determinant of MDD-W. Participants belonging to a low household wealth index had twice the chance of meeting MDD-W (AOR 2.368, CI 1.163, 4.824), while others with poor food consumption scores were unable to achieve MDD-W. However, women with fewer family members were one time more likely to meet MDD-W (AOR 1.204, Cl 0.454, 3.199) (Table 3).

Table 3: Factors influencing MDD-W

	Wald	**Sig.**	**Exp (β)**	**95 % Cl for Exp (β)**	
				Lower	**Upper**
Household size (Reference: >8)	2.493	0.288			
1-3	0.139	0.709	1.204	0.454	3.199
4-7	2.462	0.117	1.707	0.875	3.330
Low household wealth index	5.640	0.018	2.368	1.163	4.824
Food consumption score (Reference: Acceptable)	11.520	0.003			
Poor	0.000	0.997	0.000	0.000	.
Borderline	0.000	0.997	0.000	0.000	.
Constant	0.000	0.997	1615470615		

Predictors of maternal thinness: The prevalence was indicated as 28.2% for maternal thinness (MUAC <25cm) in pregnant women. As evident by the analysis, the association between nutritional status and MDD-W of pregnant women was measured by MUAC. Household food consumption score was negatively associated with MUAC (p=0.095, x2=4.715).

Table 4: Association of different variables with the maternal thinness (MUAC) in pregnancy

Characteristics	**N**	**Classification of MUAC**		**Test statistics**
		Underweight (<25cm) n (%)	**Normal (at least 25 cm) n (%)**	
Women's minimum dietary diversity				
<5	45	44.4	55.6	X2=5.038
At least 5	355	28.2	71.8	P=0.025
House hold food consumption score				
Poor (0 – 21)	109	20	30.4	X2=-4.715
Borderline (21.5 – 35)	245	68.3	58.2	p=0.095
Acceptable (>35)	46	11.7	11.4	

Household wealth index				
Low	235	74	161	X2=5.616 P=0.060
Middle	163	44	119	
High	2	2	0	
Education level				
Less than matric	162	38.3	41.4	X2=-0.568 P=0.904
Matric	114	30	27.9	
College	68	18.3	16.4	
University	56	13.3	14.3	
Age of mother				
Up to 20	39	14.2	7.9	X2=6.166 P=0.046
21 – 35	355	85.8	90	
35+	6	0	2.1	

Maternal underweight during pregnancy had risk factors, young age (21-35), and poor to borderline FCS indicated by regression analysis in **Table 5**. Low household wealth index was not the risk factor because its significance value is 0.438 which is greater than 0.05. 2 to 3 times increase in maternal age (21-35) more likely showed protection from being underweight (AOR 1.936, CI 0.988, 3.793).1 to 2 times increase in low household wealth index not likely showed protection from being underweight (AOR 1.189, CI 0.768, 1.84). An increase in poor to borderline food security led to 44% protection from being underweight (AOR 0.561, CI 0.332, 0.949). Low educational levels were 1 to 2 times more likely to be underweight compared with women of high educational levels (AOR 1.009, CI 0.515, 1.977).

Table 5: Determinants of malnutrition (thinness)

	Wald	**Sig.**	**Exp (β)**	**95 % Cl for Exp (β)**	
				Lower	**Upper**
Age of mother (years) reference 0-20					
21-35	3.7	0.054	1.936	0.988	3.793
Constant	0.637	0.425	1.294		
Food consumption score (reference: poor)	4.649	0.098			
Borderline	4.648	0.031	0.561	0.332	0.949
Acceptable	1.228	0.268	0.645	0.298	1.400
Household wealth index (ref low)	0.601	0.438	1.189	0.768	1.842
Maternal educational level (Reference: high))	0.567	0.904			
Primary	0.001	0.980	1.009	0.515	1.977
Secondary	0.160	0.689	0.867	0.432	1.748
College	0.206	0.650	0.836	0.387	1.808

4. Discussion

This survey looks into the predictors of MDD-W and its link to malnutrition in pregnant women. This study shows that about 89% of the respondents met the MDD-Food consumption score (borderline) shows a positive association with maternal undernutrition.

Nutritional Level and diversity in diet during pregnancy

In the sample population, 30% of the respondents were underweight (MAUC less than 25cm). This study was conducted in three different government hospitals of Lahore; hence, variation may

be shown in the rural population. Previous studies showed that the prevalence of MDD-W is generally low among pregnant women in low and middle-income countries (LMICs), an indication of poor quality diets consisting largely of starchy staples (Custodio et al., 2016).

Factors associated with MDD-W:

As a result of research, there were many confounding factors in multivariable analysis, but food consumption score, household wealth index, education level, and members of the household (4-7) were the main factors to achieve MDD-W. When there is food insecurity means there is a lack of food diversity (less consumption of fruits, vegetables, micro and macronutrients).

Household wealth index and household size have shown a negative association ($p>0.05$) with MDD-W, indicating there was no significant association between household food insecurity and women's minimum dietary diversity.

Women of low household wealth index had two times greater chances of meeting MDD-W (AOR 2.368, Cl 1.163, 4.824), and middle household wealth index were less likely to achieve MDD-W means they have fewer resources to buy different variety of food.

Determinant of maternal underweight:

Various possible factors contributing to the maternal underweight were the young age of mothers and poor to borderline FCS, while low household wealth index was not a risk factor for maternal underweight.

Household food consumption score and maternal educational level were significant factors affecting the nutritional status of pregnant women. The result of the present study is in agreement with and confirms that of earlier studies, those women of low socio-economic status are generally underweight (Dinsa et al., 2012).

Low household wealth index was not a risk factor for maternal underweight during pregnancy in the present study. A study done in Pakistan (Nguyen et al., 2013) reported that dietary diversity had no significant difference based on economic status.

The association between diversity in diet and the nutritional status of the mother remains indecisive, as there is no significant association between the two. A poor food consumption score was positively associated with maternal underweight. The woman who has poor dietary diversity may have difficulty fulfilling her daily energy needs.

The recent study suggested that a low education level has a positive association with maternal underweight. Women of low education were more likely to be underweight than women of high education level. Women of low education level have no room for good employment and will therefore be poorer and have less access to food resources that are essential for nutritional status**.**

5. Conclusion

The outcomes of this study demonstrated that food insecurity was associated with maternal underweight during pregnancy (measured by food consumption score and not poor MDD-W) in different government hospitals of Lahore, Pakistan.

Supplementary Materials: None

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