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Assessment of Nutritional Status of Pregnant Women by Mid Upper Arm Circumference Indicator and Related Different Epidemiological Variables in Al-Samawah City

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Abstract

Background: Nutrition is essential during pregnancy, affecting maternal and child health. Mid- Upper Arm Circumference is a low-cost measure of nutritional status.

Objective: To assess the nutritional status of pregnant women in Al-Samawah City using Mid-Upper Arm Circumference, the association between pregnant women nutritional status Mid Upper Arm Circumference and socio-demographic factors. **Methods:** A cross-sectional study was conducted among 400 pregnant women. sample distributed throughout (Al-Hussein Teaching Hospital, Maternity and Children's Teaching Hospital, and Samawah Primary Healthcare Sector). The data collection period started on 21, December 2025 to 1, March 2026. The questionnaire reliability was assessed.

Result: The results showed that there was no significant association between age and nutritional status (P=0.284), and maternal education and MUAC categories did not significantly correlate (P=0.367), Furthermore, shorter intervals <2 years were more common in the at-risk/malnourished group (60.0%), there was significant association with inter-pregnancy interval (P=0.016). BMI and MUAC categories were significantly correlated (P=0.0001).There was a significant association (p=0.022) between MUAC and a history of ectopic pregnancy or miscarriage. were more likely to be overweight or have normal MUAC. Furthermore, gestational weight increase and MUAC had a significant association (p=0.006).Hematological markers, biochemical indicators, physical activity level, did not substantially associated with MUAC.

Conclusion: Sociodemographic factors did not significantly correlate with maternal MUACbased nutritional risk. On the other hand, BMI and gestational weight gain and a history of ectopic pregnancy or

miscarriage had statistically significant correlations with MUAC categories, and short inter-pregnancy intervals (<2 years) were strongly related with at-risk nutritional status.

Keywords: Assessment; Nutritional Status; Pregnant; Women; Mid Upper Arm Circumference

Introduction

The issue of nutrition in pregnant women is of concern to the international community as formulated in one of the goals of the Sustainable Development Goals (SDGs) is to end hunger, achieve better food security and nutrition, and support sustainable agriculture, precisely in the formulation of the second target, stop all forms of malnutrition in 2030, in addition to achieving internationally agreed goals on sustainable agriculture. Malnutrition and neglect in children under five, also address the nutritional needs of adolescent girls, pregnant women &breastfeeding, and the elderly (Castillo-Matamoros & Poveda, 2021; Roy & Sekher, 2022).

Inadequate nutrition during pregnancy can put expectant moms at risk for nutritional status issues, which can have a negative impact on both the mother and the newborn (Indriyani et al., 2023).

Mid-Upper Arm Circumference (MUAC) is one anthropometric measure that is frequently used to evaluate pregnant women's nutritional health. It can be used to assess the nutritional status of pregnant women. Pregnant women who experience chronic energy deficiency (CED) have a Mid-Upper Arm Circumference (MUAC) of less than 23.5 cm (Fitria et al., 2024).

Assessment of nutritional condition throughout pregnancy can be used to predict birth weight.

One technique is anthropometric measurements of the Mid-Upper Arm Circumference (MUAC). Socioeconomic position and body mass index (BMI) are two variables that may increase the risk of maternal MUAC. Low MUAC may have an impact on maternal wellbeing as it is linked to working moms, underweight mothers, and low educational attainment (Miele et al., 2021).

MUAC indicates the body's nutritional state and protein reserve. When tested for nutritional status, regardless of the trimester of pregnancy, it is comparatively constant and can be a useful screening tool. Therefore, it can be an easy, fast, and useful technique for evaluating nations with late pregnancy registrations and a lack of baseline or pre-pregnancy weight data (Dias et al., 2026).

The advantages of MUAC and NC as low-cost, straightforward, practical, reliable, and acceptable measuring instruments that may be used in primary care settings are encouraging. The main goal of this study was to determine appropriate cut-offs of MUAC to identify underweight and obesity in pregnant women coming for institutional delivery in the third trimester, given the difficulties in evaluating maternal nutrition, particularly in the second and third trimesters (Hasan, 2025).

The World Health Organization estimates that at least 120 million women (60%) in Southeast Asia suffer from chronic energy deficit. Southeast Asian countries, in particular, are emerging nations with a chronic energy shortage rate of over 815 million in 2018 (Indriyani et al., 2023).

Methodology

2.1 Study Design and Setting

A cross-sectional study was conducted to assess the nutritional status of pregnant women in Al- Samawah city. The study conducted at Al- Samawah City which includes two main government hospitals: Al-

Hussein Teaching Hospital and the Maternity and Children's Teaching Hospital. It also has two primary healthcare sectors: Samawah Primary Healthcare Sector 1 and Samawah Primary Healthcare Sector 2.

2.2 Sample Size

400 samples of pregnant women were collected. They ranged in age from 15 to 45 years.

The Sample Size Was Calculating Using The Formula : (Sadiq et al., 2025) $n = Z^2 \times P\ (1 - P) / d^2$ Where:

n = sample size (= 385)

Z = Z-score corresponding to the level of confidence (for a 95% confidence level ,Z = 1.96) P = Expected prevalence or proportion. Since no recent population-based

prevalence data for Assessment of Nutritional status of pregnant women in Al-Samawah city , a conservative estimate of 50% (0.5) was used to obtain the maximum sample size.

d = Precision or margin of error (0.05), representing the maximum allow able difference between the sample proportion and the population proportion.

The calculated minimum sample size was 385 women. To enhance the statistical power and Reliability of the study, the final sample size was increased to 400 women.

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2.3 Inclusion Criteria

Pregnant women aged 15 to 45 residing in Samawah, and pregnant women attend the Maternity and Children's Hospital and health centers affiliated with the Samawah First and Second Sectors only.

2.4 Exclusion Criteria

Pregnant women over 45 years of age, and pregnant women who visited the hospital and health centers from outside the city of Samawah.

2.5 Data Collection

After confirming the validity and reliability of the study instrument, the researcher used an approved questionnaire by structured interview technique with pregnant women, the first step was to get a diagnosis from the specialist physician that this woman is pregnant to collect Sociodemographic Information, and Clinical Examination. The laboratory team has completed the biochemical tests (Blood group, Hemoglobin level, Blood Glucose level, GUE) for pregnant women as a final step. Data were collected 21, December 2025 to 1, March 2026.

2.6 Statistical Analysis

The collected data were coded, entered, presented, and analyzed by computer using the available data base software program statistical package of IBM SPSS-29 (IBM Statistical Packages for Social Sciences-version 29, Chicago, IL, USA). Data were presented in simple measures of frequency, percentage, mean, standard deviation, and range (minimummaximum values). The Pearson's Chi-square (χ^2) test was used to evaluate the relationship between categorical variables. Statistical significance was defined as a p-value of less than

0.05.

2.7 Ethical Consideration

Ethical considerations are among the researcher's most crucial actions. The Middle Technical University/Medical Ethics Committee granted ethical approval with reference number (MEC: 176). One of the most fundamental precepts prior to data collection is protecting participants' values and dignity.

Result

Table (1): Association Between Socio-Demographic Characteristics and Nutritional Status Assessed by Mid-Upper Arm Circumference (MUAC)

		Mid-Upper Arm Circumference				P value
		Normal (n=371)		At Risk/Mod.Malnutrition (n=29)		
		No.	%	No.	%	
Age (years)	<20years	24	6.5	3	10.3	0.284
	20---34	301	81.1	25	86.2	
	=>35years	46	12.4	1	3.4	
Educational level of mother	Illiterate	79	21.3	5	17.2	0.367
	Read & Write	20	5.4	-	-	
	Primary	85	22.9	4	13.8	
	Intermediate	31	8.4	3	10.3	
	Secondary	33	8.9	5	17.2	
	College & Higher	123	33.2	12	41.4	
Educational level of husband	Illiterate	52	14.0	4	13.8	0.438
	Read & Write	24	6.5	1	3.4	

	Primary	78	21.0	4	13.8	
	Intermediate	50	13.5	2	6.9	
	Secondary	34	9.2	2	6.9	
	College & Higher	133	35.8	16	55.2	
Occupation of mother	Employee	93	25.1	6	20.7	0.317
	Free work	2	.5	-	-	
	Student	13	3.5	3	10.3	
	Housewife	263	70.9	20	69.0	
Occupation of husband	Professional	137	36.9	11	37.9	0.065
	Skilled labour	195	52.6	11	37.9	
	Unskilled labour	39	10.5	7	24.1	

*Significant difference between percentages using Pearson Chi-square test (c^2-test) at 0.05 level.

Table (1) illustrated the association between selected socio-demographic characteristics and nutritional status as assessed by Mid-Upper Arm Circumference (MUAC). The results show that there was no statistically significant correlation between age and nutritional status (P=0.284), with the majority of participants in both the normal (81.1%) and at-risk/malnourished (86.2%) groups being between the ages of 20 and 34. In regards to maternal education, women with normal nutritional status had a high proportion of college or higher education (33.2%), whereas the at-risk/malnourished group had a somewhat larger number (41.4%). Maternal education and MUAC categories, however, did not significantly correlate (P=0.367). Similarly, the educational level of husbands showed no statistically significant association (P=0.438), although the majority in both groups had college or higher education (35.8% in normal vs. 55.2% in at-risk group). The majority of participants in both groups were housewives (70.9% normal vs. 69.0% at-risk), with no significant distinction (P=0.317). For husbands' occupation, skilled labor

represented the highest proportion in the normal group (52.6%), while both professional and skilled labor were equally represented in the at-risk group (37.9% each). Despite this fluctuation, the correlation was close to significance but not statistically significant (P=0.065).

Table (2): Association Between Obstetric and Health-Related Factors and Nutritional Status Assessed by Mid-Upper Arm Circumference (MUAC)

		Mid-Upper Arm Circumference				P value
		Normal (n=371)		At Risk/Mod. Malnutrition (n=29)		
		No.	%	No.	%	
Gravidity	Primigravida	76	20.5	10	34.5	0.077
	Multigravida	295	79.5	19	65.5	
Number of parity for multigravida	P2	116	39.5	11	55.0	0.122
	P3	67	22.8	6	30.0	
	P4 & more	111	37.8	3	15.0	
Inter-pregnancy interval (years)	<2	98	33.3	12	60.0	0.016*
	=>2	196	66.7	8	40.0	
GA Trimester	First trimester	97	26.1	9	31.0	0.085
	Second trimester	109	29.4	13	44.8	
	Third trimester	165	44.5	7	24.1	
History of miscarriage \ectopic	Yes	128	34.5	4	13.8	0.022*
	No	243	65.5	25	86.2	
History of still birth	Yes	25	6.8	-	-	0.148

	No	345	93.2	29	100	
History of preterm labour	Yes	16	4.3	-	-	0.254
	No	355	95.7	29	100	
History of cesarean section	Yes	118	31.9	8	27.6	0.631
	No	252	68.1	21	72.4	
Have a twin pregnancy or more	Yes	8	2.2	-	-	0.424
	No	363	97.8	29	100	
History of antenatal care visits at a primary health center	Yes	198	53.4	12	41.4	0.213
	No	173	46.6	17	58.6	
History vaccine injected during this pregnancy	Yes	231	62.3	17	58.6	0.697
	No	140	37.7	12	41.4	
History of health problem or medical condition not related to pregnancy	Yes	73	19.7	4	14.3	0.486
	No	298	80.3	24	85.7	
History of allergy or medication	Yes	56	15.1	2	6.9	0.227
	No	315	84.9	27	93.1	
Diet preference	Vegetarian	27	7.3	4	13.8	0.206
	Non-vegetarian	344	92.7	25	86.2	
History of problem menstruation cycle	Yes	106	28.6	4	13.8	0.085
	No	264	71.4	25	86.2	

*Significant difference between percentages using Pearson Chi-square test (c^2-test) at 0.05 level.

Table (2) demonstrated the association between obstetric and health-related factors and maternal nutritional status as assessed by MUAC. Multigravida women made up the majority in both the normal (79.5%) and at-risk (65.5%) groups, according to the results, and there was no statistically significant correlation (P=0.077). Similarly, there was no significant difference in the distribution of parity across the groups (P=0.122), but women with adequate nutritional status were more likely to have higher parity (P4 and above) (37.8%) than those in the at-risk group (15. 0%).Shorter intervals (<2 years) were more common in the at-risk/malnourished group (60.0%) than in the normal group (33.3%), according to a statistically significant association with inter-pregnancy interval (P=0.016). This suggests that insufficient time between pregnancies may have a detrimental effect on maternal nutritional status. Gestational age trimester showed no significant association (P=0.085), although a higher proportion of at-risk women were in the second trimester (44.8%). Women without a history of miscarriage or ectopic pregnancy made up a larger percentage of the at-risk group (86.2%), suggesting a possible indirect or complex relationship. A significant association was also detected with these conditions (P=0.022). Nutritional status was not significantly correlated with other obstetric factors, such as history of stillbirth (P=0.148), preterm labor (P=0.254), cesarean section (P=0.631), or many pregnancies (P=0.424). Furthermore, there were no significant differences between groups in healthcare-related characteristics including prenatal care visits (P=0.213) and vaccinations during pregnancy (P=0.697). Similarly, there was no significant correlation found between MUAC and history of medical conditions (P=0.486), allergy or drug use (P=0.227), food choice (P=0.206), or menstruation issues (P=0.085).

Table (3): Association Between Body Mass Index (BMI), Gestational Weight Gain, and Nutritional Status Assessed by Mid-Upper Arm Circumference (MUAC)

		Mid-Upper Arm Circumference				P value
		Normal (n=371)		At Risk/Mod. Malnutrition (n=29)		
		No.	%	No.	%	
BMI (Kg/m2)	Normal (18.5-24.9)	80	21.6	26	89.7	0.0001*
	Overweight (25-29.9)	186	50.1	3	10.3	
	Obese (=>30)	105	28.3	-	-	
Weight gain during pregnancy	Not	253	68.2	28	96.6	0.006*
	Adequate (N;11.5-16/OW;7-11.5/Ob;5-9)	87	23.5	1	3.4	
	Over gain	31	8.4	-	-	

*Significant difference between percentages using Pearson Chi-square test (c^2-test) at 0.05 level.

Table (3) showed the relationship between BMI, gestational weight gain, and maternal nutritional status as assessed by MUAC. BMI and MUAC categories were shown to be extremely statistically significantly correlated (P=0.0001). Compared to just 21.6% of women in the normal MUAC group, the majority of women in the at-risk/malnourished group (89.7%) had BMIs within the normal range. On the other hand, the normal MUAC group had a higher percentage of overweight and obese women (50.1% and 28.3%, respectively), whereas the at-risk group had nearly none. This implies that while higher BMI does not always reflect optimal dietary quality, it may have a protective link against poor MUAC. There was also a statistically significant correlation (P=0.006) with weight growth during pregnancy. Compared to 68.2% of women in the normal group, the majority of women in the at-risk group (96.6%) reported no weight gain. Women with normal MUAC were more likely to gain adequate weight (23.5%) than those in the at-risk group (3.4%). Furthermore, only women with normal nutritional status (8.4%) showed abnormal weight gain.

Table (4): Association Between Physical Activity Level (IPAQ Score) and Nutritional Status Assessed by Mid-Upper Arm Circumference (MUAC)

		Mid-Upper Arm Circumference				P value
		Normal (n=371)		At Risk/Mod. Malnutrition (n=29)		
		No.	%	No.	%	
IPAQ Score	No	18	4.9	2	6.9	0.204
	Low (MET<600)	14	3.8	3	10.3	
	Moderate (600-3000 MET)	339	91.4	24	82.8	
	High (>3000 MET)	-	-	-	-	
*Significant difference between percentages using Pearson Chi-square test (c^2-test) at 0.05 level.						

Table (4) presented the relationship between physical activity level, as measured by the IPAQ score, and maternal nutritional status assessed by MUAC. The results show that most individuals in both the at-risk/malnourished (82.8%) and normal (91.4%) groups participated in moderate levels of physical exercise (600–3000 MET). While a small percentage of participants in both groups reported no physical activity (4.9% in normal vs. 6.9% in at-risk), low physical activity was slightly more common in the at-risk group (10.3%) than in the normal group (3.8%). Interestingly, none of the subjects met the criteria for high levels of physical exercise (>3000 MET). Despite these differences, there was no statistically significant correlation (P=0.204) between MUAC categories and physical activity level. This implies that maternal nutritional status may not be directly or significantly impacted by physical activity as measured in this study.

Table (5): Association Between Mid-Upper Arm Circumference (MUAC) and Selected Hematological and Biochemical Parameters Among Pregnant Women

		Mid-Upper Arm Circumference				P value
		Normal (n=371)		At Risk/Mod. Malnutrition (n=29)		
		No.	%	No.	%	
ABO blood group	A	72	19.4	4	13.8	0.395
	B	56	15.1	2	6.9	
	AB	57	15.4	4	13.8	
	O	186	50.1	19	65.5	
Rh group	Rh +ve	343	92.5	26	89.7	0.587
	Rh -ve	28	7.5	3	10.3	
Hemoglobin level	Anemia (<11 g/dL)	274	73.9	20	69.0	0.566
	Normal (=>11 g/dL)	97	26.1	9	31.0	
Blood glucose level	High (>=95mg/dl)	66	17.8	2	6.9	0.13
	Normal (< 95mg/dl)	305	82.2	27	93.1	
*Significant difference between percentages using Pearson Chi-square test (c^2-test) at 0.05 level.						

Table (5) demonstrated the association between Mid-Upper Arm Circumference (MUAC) and selected hematological and biochemical parameters among pregnant women. Blood type does not affect nutritional status as determined by MUAC, according to the results, which showed no statistically significant correlation between MUAC categories and ABO blood group distribution (p=0.395). The majority of participants in both groups were Rh positive, and there was no significant correlation found between the Rh factor and MUAC categorization (p=0.587). Although anemia was quite common in both the normal and malnourished groups in terms of hemoglobin level, the difference was not statistically significant (p=0.566), indicating that anemia occurs regardless of MUAC status. The majority of participants in both MUAC groups had normal blood glucose levels, and there was no statistically significant correlation between blood glucose status and MUAC categories (p=0.13). This suggests that there is no significant relationship between blood glucose levels and nutritional status in this study population.

2. Discussion

The current study shows no statistically significant association between socio demographic characteristics, such as maternal age, occupation, or educational attainment and MAUC. The majority of women in the At Risk (86.2%) and Normal (81.1%) categories were in the 20–34 age range. Which is

similar to other studies (Alkalash et al., 2021) and (Akinsanya et al., 2024) in Nigeria ,which found that although peak reproductive age is a common factor among pregnant women, it does not directly affect arm circumference. Additionally, the absence of association with education is agree with other study (Salih et al., 2023) in Sudan which found that due to consistent dietary restrictions within the community, maternal socio demographic markers frequently fail to predict true nutritional status in many resource-limited contexts. This lack of diversity is explained by the nutritional transition (Miele et al., 2021) , in Brazil which states that regardless of a person's educational or professional background, poor diet quality and calorie-dense, nutrient-poor meals result in similar anthropometric outcomes

In terms of obstetric history, there were typically no statistically significant correlations between gravidity/parity and MUAC categories (P=0.077 for gravidity; P=0.122 for parity distribution among multigravida women). Higher parity (P4 and above) was more common in the normal group (37.8%) than in the at-risk group (15.0%), although there was no discernible nutritional disadvantage with increasing parity in this sample. This results consistent with study (Dhar, 2025). This might be due to differences in the nutritional resilience of mothers, differences in nursing techniques, varied spacing, or the impact of other unmeasured factors such pre-pregnancy baseline nutritional status.

However, there was a statistically significant correlation (P=0.016) between the inter-pregnancy interval and MUAC-based nutritional risk. Compared to the normal group (33.3%), women with shorter intervals (<2 years) were more prevalent in the at-risk/malnourished group (60.0%). This result similar to previous study which stated that the majority of multiparous women weigh more at the beginning of their pregnancies. The lowest risk of beginning a second pregnancy with a greater body weight is linked to an interval of 12–23 month (Ziauddeen et al., 2019). Short intervals between pregnancies (less than two years) cause "maternal depletion syndrome," which lowers MUAC because the body does not have enough time to rebuild food stores (such protein and iron) depleted during prior pregnancy and breastfeeding.(Glosz et al., 2018)

and this study shows association between a history of miscarriage or ectopic pregnancy and MUAC. These findings agree with other study (Ziauddeen et al., 2019) ,in England who found that maternal depletion syndrome occurs from repeated reproductive strain without adequate recuperation time. This pattern is explained by the high metabolic and physiological demands of pregnancy, which can deplete the muscle mass and subcutaneous fat evaluated by MUAC if sufficient recovery time is not given to replenish tissue reserves.(Hasan, 2025) (Uwase et al., 2024)

The present study shows significantly association between Body Mass Index and MUAC with (100%) of obese women having a normal MUAC and (89.7%) of women at risk by MUAC falling within the normal BMI range. Which is similar to other studies (Salih et al., 2023) in Sudan and (Indriyani et al., 2023) ,in Indonesia that found a substantial positive association between the two measurements. Additionally, this study shows a strong association between weight increase during pregnancy and MUAC. Is similar with other studies (Fakier et al., 2017) ,in Africa and (Fathurrachman, 2023), in Indonesia which suggested MUAC as a reliable substitute for BMI, especially in late pregnancy when fetal mass and physiological edema frequently complicate BMI computations. This association is explained by the fact that, in contrast to BMI, which is significantly impacted by rapid weight growth and fluid retention, MUAC represents the mother's true energy stores (muscle and fat), which are more constant during the third trimester.

The present study shows no statistically significant association between IPAQ scores and

MUAC with more than (82%) of women in both groups maintaining moderate activity levels .These results are agree with other study (Hasan, 2025) in Iraq which found that pregnant women tend to maintain baseline movement levels regardless of their weight status and, although they may have some understanding of diet, they frequently lack particular counsel on physical activity.

The present study shows no significant association between hemoglobin levels , Rh status , or ABO blood groups and MUAC. Which is similar to other study (Al-Kuran et al., 2023),in Jordan that found that blood group distribution was independent of maternal physical indicators. This is explained by the fact that blood antigens are inherited genetic characteristics that are set at birth and are unaffected by environmental or dietary factors that affect a person's MUAC during pregnancy. Additionally, the high percentage of anemia (>69%) in all MUAC groups agree the idea of the "double burden of malnutrition" in other studies (Killeen et al., 2022) ,in Dublin, Ireland and (A. Assaf et al., 2023) , in Palestinian which mothers may have adequate caloric reserves but continue to be severely undernourished in terms of micronutrients like iron. This pattern, which can lead to low hemoglobin independent of arm circumference, is explained by the natural expansion of maternal plasma volume and high fetal iron needs.(Gubta et al., 2024) (Habeeb et al., 2024).

Conclusion

The majority of obstetric/health service variables and other sociodemographic factors did not significantly correlate with maternal MUAC-based nutritional risk. On the other hand, BMI and gestational weight increase had strong statistically significant correlations with MUAC categories, and short inter-pregnancy intervals (<2 years) were strongly related with at-risk nutritional status. In order to reduce mother nutritional vulnerability throughout pregnancy, our findings highlight the significance of monitoring nutrition, especially prenatal weight gain, and reproductive health measures like birth spacing.

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Ta. Ja.: Conceptualization of the study, literature search, data collection, and statistical analysis.

At. Sa: manuscript writing and editing, contributed to the conceptualization of the study.

Ka Gh. assisted in data collection and analysis, participated in drafting and revising the manuscript, provided critical feedback throughout the research process and helped shape the final version of the article.

All authors equally contribute to this study.

Data Availability

The numerical data generated during this research is available with the authors.

Conflict of Interest Statement

The authors declare no conflict of interest.

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