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Research Article

Dietary Diversity and Household Income Status Among Pregnant Women in Mbulu District, Tanzania

Paul Hudson*, Happiness Muhimbula, Theobald Mosha

Department of Human Nutrition and Consumer Sciences, Sokoine University of Agriculture, Chuo Kikuu, Morogoro, Tanzania

Abstract

Introduction: Dietary diversity ensures that pregnant women consume the necessary range of nutrients from various food groups for the best possible outcomes for maternal health. Maternal health and fetal development are weakened by nutrient deficits caused by inadequate dietary diversity, typified by income constraints, and frequently restricted consumption of varied food categories. This study aimed to assess pregnant women's dietary diversity and household income status in Mbulu district, Tanzania. *Methods:* A cross-sectional study design was used among 384 pregnant women. Pregnant women were selected by using a systematic random sampling method. Eight health facilities were selected using a purposive sampling method. Face-to-face interviews were conducted by trained enumerators using a structured questionnaire that was divided into three sections to collect information on (i) socio-demographic characteristics, (ii) Dietary diversity, and (iii) Household income status. The Pearson Chi-square test and Logistic regression analysis were used to compare and test the association of dietary diversity and household income status to pregnant women's characteristics. Dietary diversity was evaluated using the Minimum Dietary Diversity Score (MDDS), while household income status was measured through income and expenditure data. *Results:* The findings revealed that about 43% of pregnant women had inadequate dietary diversity, while 57% had adequate dietary diversity. Dietary diversity was significantly associated with residential location areas ($p = 0.016$), education level ($p = 0.045$), and family size ($p= 0.041$). Results from logistic regression analysis showed that dietary diversity was associated with having residence in rural Mbulu district areas (OR = 0.357, p-value < 0.003), having a secondary education level (OR = 3.958, p-value < 0.007) and no formal education (OR = 1.122, p-value < 0.02), having average monthly household Income (OR = 4.934, p-value < 0.000) and husband (male partner) support (OR = 3.713, p-value < 0.001). Additionally, results from Chi-square test an average monthly household income ($p = 0.001$), food budget expenditure ($p = 0.018$), and food expenditure ability ($p =0.000$) were significantly associated with dietary diversity among pregnant women ($p < 0.05$). *Conclusion:* In this study, forty-three pregnant women had inadequate dietary diversity due to lower-income household level restricting access to diverse and nutritious food groups. Therefore, policymakers should encourage more dietary diversity and general maternal health requirements to raise sustainable household income-generating activities and improve nutrition education programs.

Keywords

Dietary Diversity, Household Monthly Income, Pregnant Women, Maternal Health, Mbulu District Tanzania

*Corresponding author: paulmbonile@gmail.com (Paul Hudson)

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1. Introduction

Globally, millions of pregnant women face barriers to accessing diverse and nutritious diets, leading to widespread malnutrition and adverse health outcomes [1, 2]. Income constraints, joined with limited access to essential nutrients, perpetuate the cycle of malnutrition among pregnant women in low- and middle-income countries (LMICs) [3]. About 45% of deaths among children under 5 years of age are linked to undernutrition [4], and 95% of all maternal deaths occurred in low- and middle-income countries in 2020 [5, 6]. Approximately 37% of pregnant women were affected by anaemia in sub-Saharan Africa [7]. Consumption of various foods from different food groups before and during pregnancy can save the lives of pregnant women and newborns [8, 9].

Dietary diversity during pregnancy refers to consuming various nutritious foods from different recommended food groups within a specific time frame [10]. It is an essential indicator of nutritional adequacy. It ensures maternal health, fetal growth, and development by providing necessary nutrients from 10 food groups [11, 12]. Still, pregnant women in LMICs, including Tanzania, often face significant barriers to adequate intake of diverse food groups [13]. Income constraints limit access to various nutrient-rich foods [14, 15].

Insufficient consumption of a variety of food groups leads to a dietary diversity score of < 5 food groups for pregnant women, which can result in adverse pregnancy outcomes such as low birth weight, preterm birth, miscarriage, maternal anaemia, neonatal and infant mortality, cognitive and behavioral impairments [16, 17]. Adequate consumption of various food groups prevents adverse pregnancy outcomes [18, 19]. This balanced diet helps to ensure that pregnant women receive all the necessary nutrients, which can lead to positive outcomes for both the pregnant mother and her baby [20]. Studies have shown that pregnant women from high-income households often have greater access to various food groups, including fruits, vegetables, and protein-rich foods [21, 22]. In contrast, pregnant women from low-income households may face income constraints that limit their ability to purchase nutrient-rich foods, leading to a less diverse diet [23, 24]. In Tanzania, urban pregnant women tend to consume a more varied diet, including high intakes of fruits, vegetables, and animal proteins, compared to rural pregnant women, who mainly consume staple foods with limited diversity [25].

The Tanzanian government has undertaken various initiatives to improve pregnant women's dietary diversity and household incomes by enhancing agricultural productivity, supporting supplementary feeding programs and reducing poverty [26, 27, 17]. Despite the efforts, there is inadequate dietary diversity for pregnant women. studies have shown that many pregnant women in Tanzania consume diets that lack diversity, primarily composed of staple foods like maize and cassava with insufficient fruits, vegetables, and animal-source foods [12]. Poor dietary diversity leads to deficiencies in essential nutrients such as iron, folate, calcium, and vitamins, which are critical for preventing complications like anaemia, intrauterine fetal death, preterm birth, low Apgar score, pre-eclampsia, and infections [28].

It is vital to tackle the obstacles of financial and nutritional education to enhance the variety of diets pregnant women consume [29, 30, 8]. Policymakers may significantly improve maternal dietary diversity and health outcomes by implementing comprehensive measures integrating nutrition education with economic support [31, 32]. In LMICs, including Tanzania, pregnant women's health and that of their unborn children are seriously threatened by inadequate dietary diversification with low income and high food prices frequently limiting access to a wide variety of essential nutrients [33, 30]. However, the precise socioeconomic factors influencing these dietary diversifications are still poorly understood, especially in resource-constrained environments in LMICs [34, 22]. This study aimed to assess dietary diversity and household income status among pregnant women. The study objectives are 1) to assess the dietary diversity of pregnant women and 2) to determine the household income status of pregnant women in both rural and urban areas of Mbulu district.

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted in Mbulu District, Manyara region, Tanzania. Mbulu has a total population of 376,865 (Male 193,494: Female 183,371) according to the National Census [35]. It was selected for this study because of high levels of nutritional vulnerability [36] and socioeconomic challenges- low income and high unemployment rates [37]. The district has eight selected health facilities namely, Mbulu Hospital, Hydom Lutheran Hospital, Dongobesh Health Centre, Daudi Health Centre, and four dispensaries (Labay, Bargish, Gehandu, and Muslur). Which ones were chosen for the study because of adequate sample representation, diversity in service delivery, and geographical coverage.

2.2. Study Design and Sample Size

This health-based cross-sectional design was conducted with 384 pregnant women attending antenatal clinics in Mbulu district from March to April 2024. Purposive sampling was used to select health facilities: two hospitals, namely Mbulu Hospital and Hydom Lutheran Hospital, two health centres, namely Dongobesh and Daudi, and four dispensaries, namely Labay, Bargish, Gehandu, and Muslur, due to their high rates of antenatal clinic attendance. The study population comprised all pregnant women who consented to

participate in this study. Pregnant women aged 15-49 years who were permanent residents in the area were randomly selected. Pregnant women with known physical and mental disabilities, chronic diseases such as diabetes and non-resident pregnant women were excluded from the study. The study participants were selected using systematic random sampling techniques. The total number of pregnant women attending antenatal care clinics was unknown. Therefore, the required sample size was determined by using a formula [38]. $N= z^2 P (1-P) / d^2$ whereby n = desired sample size, z = standard normal deviation, set at 1.96 corresponding to 95% confidence interval, P = prevalence of dietary diversity among pregnant women set as 50%, d = degree of accuracy desired (0.05). Therefore, $n = (1.96)^2 \times 0.5 (1-0.5) / 0.05^2$ n = 384. Three hundred eighty-four pregnant women were randomly selected to participate in the study.

2.3. Data Collection

Before data collection, the structured questionnaire was pre-tested on ten pregnant women who attended antenatal clinic services in Morogoro Regional Hospital outside the study area. Based on the pre-test, necessary adjustments were made to the questionnaire. Four enumerators were trained on this study, including purpose, the data collection process, research ethics, and how to administer the pre-tested structured questionnaire for two days.

A structured questionnaire was used to collect information on pregnant women's dietary diversity and household income. The questionnaire was divided into three sections. Section one established the socioeconomic and demographic characteristics of the respondents (age, education level, occupation, family size, and husband support). Section two solicited information about maternal dietary diversity, e.g., the number of food groups consumed for the past 24 hours, and section three solicited information about the household income of pregnant women towards dietary diversity. Trained enumerators conducted face-to-face interviews with pregnant women in selected health facilities.

Measuring haemoglobin levels (MHL). The Homocue photometer was used to measure haemoglobin levels using a sterile lancet. A finger prick was used to capture capillary blood samples after the middle fingertip was cleansed with an alcohol swab. After adding the drop of whole blood to the micro cuvette, the haemoglobin was analyzed by the Homocue photometer. Results were recorded from the digital display. Pregnant women who were expecting and had a haemoglobin level of less than 11 g/dl were classified as anaemic.

2.4. Statistical Analysis

The data were collected, coded, and entered into the Microsoft Excel program before analysis using Statistical Package for Social Sciences (SPSS) software, version 25. Categorical variables were summarized using frequencies (n) and percentages (%). The Pearson Chi-square test was used to examine the association between dietary diversity (dependent variable) and characteristics of pregnant women. Variables significantly associated at a 5% level (p-value < 0.05) from the Chi-square test were run in logistic regression analysis. Logistic regression analysis was used to determine the relative odds of having adequate dietary diversity as opposed to inadequate dietary diversity; the first level of each independent variable [Location, average monthly household income, and husband (male partner) support] was controlled statistical significance for all analyses set at $p < 0.05$.

2.5. Ethical Considerations

Permission to conduct the study in the Mbulu district was sought from Mbulu district authorities, and research approval was obtained from the Sokoine University of Agriculture (SUA). Verbal consent was obtained from all pregnant women who attended antenatal care clinics after they were informed of the study objectives. Participants were assured that their participation was voluntary and that the information they provided would remain confidential.

3. Results

3.1. Socio-Demographic Characteristics of the Pregnant Women in Mbulu District

Table 1 presents the socio-demographic characteristics of pregnant women in Mbulu district, Tanzania. 100% (n=384) of respondents participated in this study in the Mbulu district. 50.5% (n=194) of respondents lived in Mbulu Town Council (Urban), while 49.5% (n=190) of respondents lived in Mbulu Rural Council. 57% (n=219) of respondents were age groups represented 25-40 years. The majority 79.2% (n=304) of respondents were married. 64.1% (n=246) of respondents had a primary school education level. 84.1% (n=323) of respondents were farmers. 48.4%(n=186) of respondents had 3-5 members in the family. 39.6% (n=152) of respondents had low average monthly income (< 250,000 TZS), and 41.1% (n=158) of respondents had medium average monthly income (250,000- 500,000 TZS). In comparison, 19.3% (n=74) had a high average monthly income (> 500,000 TZS), and 87% (n=334) of respondents had their husband (partner) support.

Table 1. Socio-demographic characteristics of the pregnant women in Mbulu district.

Variable Category		Number of Respondents	Percent
Location	Rural	190	49.5
	Urban	194	50.5
Age (years)	18-24	158	41.1
	25-40	219	57.0
	≥41	7	1.8
Marital Status	Cohabiting	23	6.0
	Divorced	2	0.5
	Married	304	79.2
	Single	53	13.8
	Widowed	2	0.5
Education Level	No formal education	11	2.9
	Primary school	246	64.1
	Secondary school	109	28.4
	College or University	18	4.7
Occupation	Employed for wage	10	2.6
	Farmer	323	84.1
	Pastoralist	2	0.5
	Self-employed	42	10.9
	Unemployed	7	1.8
Family Size (members)	<2	57	14.8
	3-5	186	48.4
	>5	141	36.7
Monthly Household Income (TZS)	< 250,000/=	152	39.6
	250,000-500,000/=	158	41.1
	>500,000/=	74	19.3
Religion	Christian	374	97.4
	Muslim	10	2.6
Husband (Partner) Supports	No	50	13.0
	Yes	334	87.0

TZS: Tanzanian shillings

3.2. Maternal Characteristics of Pregnant Women

Figure 1 shows the maternal characteristics of pregnant women. More than half (n=205, 53.4%) of pregnant women were multiparous, 95.6% (n=367) of respondents gave birth in less than 37 weeks, and (n=184, 47.9%) of respondents had a maternal status of 3rd trimester. Further, the Hemoglobin (HB) cut-off level majority (n=282, 73.4%) of respondents was ≥11 g/dl. More than half (n=225, 58.6%) of respondents received nutritional counselling on dietary diversity during pregnancy.

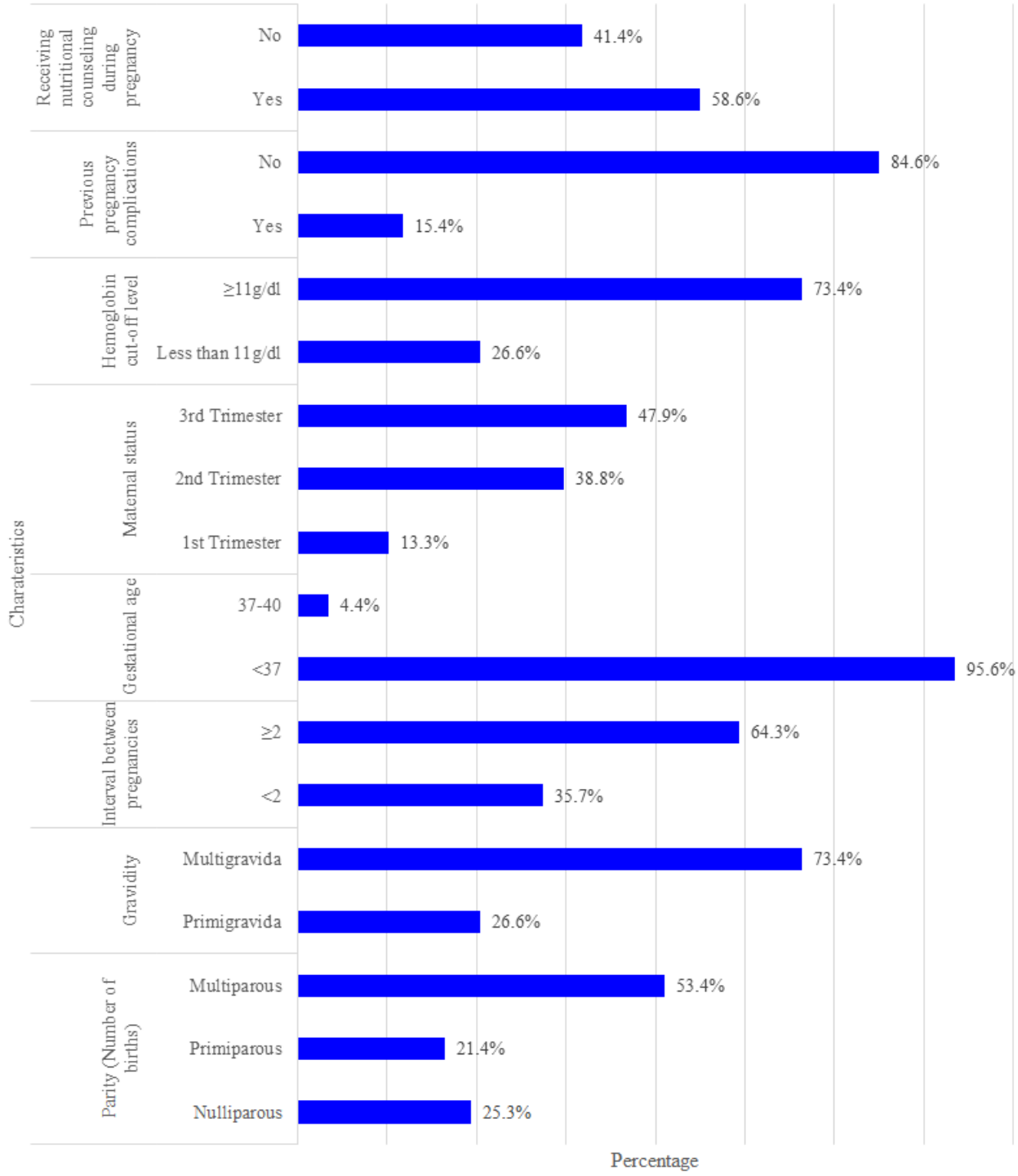

Figure 1. *Maternal Characteristics.*

3.3. Association of Socio-demographic Characteristics and Dietary Diversity of Pregnant Women

Table 2 shows a statistically significant association between dietary diversity and location (residents), education level, and family size ($p<0.05$). Areas of residence, education level, and family size are more likely to have adequate dietary diversity. Age, marital status, occupation, parity, religion, and husband (partners) support were not associated with pregnant women's dietary diversity categories ($p > 0.05$). However, there was a relatively higher tendency for pregnant women who were older, married, occupation, parity, religion, and husband (partner) support to have adequate dietary diversity.

Table 2. Association of Socio-demographic characteristics and dietary diversity of pregnant women in Mbulu district, Tanzania.

Variable Category		Dietary Diversity Status		Total (N= 384)	χ2	Df	p-value
		Adequate =n (%)	Inadequate =n (%)				
Location	Rural	120 (63.2)	70 (36.8)	190	5.761	1	0.016
	Urban	99 (51)	95 (49)	194			
Age (years)	18-24	76 (48.1)	82 (51.9)	158	3.355	2	0.19
	25-40	123 (56.2)	96 (43.8)	219			
	≥41	5 (71.4)	2 (28.6)	7			
Marital Status	Cohabiting	12 (52.2)	11 (47.8)	23			
	Divorced	1 (50)	1 (50)	2	0.081	4	0.90
	Married	161 (53)	143 (47)	304			
	Single	29 (54.7)	24 (45.3)	53			
	Widowed	1 (50)	1 (50)	2			
Education Level	No formal education	4 (40)	6 (60)	10	7.738	4	0.045
	Primary school	125 (49.4)	128 (50.6)	253			
	Secondary school	61 (59.2)	42 (40.8)	103			
	College or University	14 (77.8)	4 (22.2)	18			
Occupation	Employed	7 (70)	3 (30)	10			
	Farmer	163 (50.5)	160 (49.5)	323			
	Pastoralist	2 (100)	0 (0.00)	2	6.965	4	0.138
	Self-employed	28 (66.7)	14 (33.3)	42			
	Unemployed	4 (57.1)	3 (42.9)	7			
Family Size	<2	39 (68.4)	18 (31.6)	57			
	3-5	95 (51.1)	91 (48.9)	186	6.355	2	0.041
	>5	70 (49.6)	71 (50.4)	141			
Religion	Christian	198 (52.9)	176 (47.1)	374	0.195	1	0.658
	Muslim	6 (60)	4 (40)	10			
Husband (Partner) Support	No	25 (50)	25 (50)	50	225	1	0.635
	Yes	179 (53.6)	155 (46.4)	334			

χ2 – Chi-square, df- degree of freedom, a Statistically significant association between dietary diversity among pregnant women and the variable at $p < 0.05$

3.4. Dietary Diversity of the Pregnant Women Attending Antenatal Care Clinics in Mbulu District, Tanzania (N=384)

Figure 2 shows that, overall, 57% of pregnant women had adequate dietary diversity scores meeting the minimum dietary diversity, and 43% had inadequate dietary diversity and consumed less than five recommended food groups. Regarding the food groups consumed by pregnant women in the previous 24 hours, from Table 3 shows that the most frequently consumed food groups were grains, white roots, tubers, and plantain (n=374, 97%) and dark green leafy vegetables (n=302, 78.6%). The meat, poultry, and fish (n=138, 35.9%) and eggs (n=87, 22.7%) were the least consumed food groups.

In Mbulu district, dietary diversity scores among pregnant women showed variations between urban and rural areas. In

urban areas, 45.2% (n=99) of pregnant women achieved adequate dietary diversity, compared to 54.8% (n=120) in rural areas. Conversely, inadequate dietary diversity was observed in 57.6% (n=95) of urban pregnant women and 42.4% (n=70) of rural pregnant women. Regarding specific food groups, the consumption of grains, white roots, tubers, and plantain was 50.3% in urban areas and 49.7% in rural areas. Egg consumption showed a marked difference, with 32.2% among pregnant women in urban areas and 67.8% in rural areas. More details are provided in (Table 3).

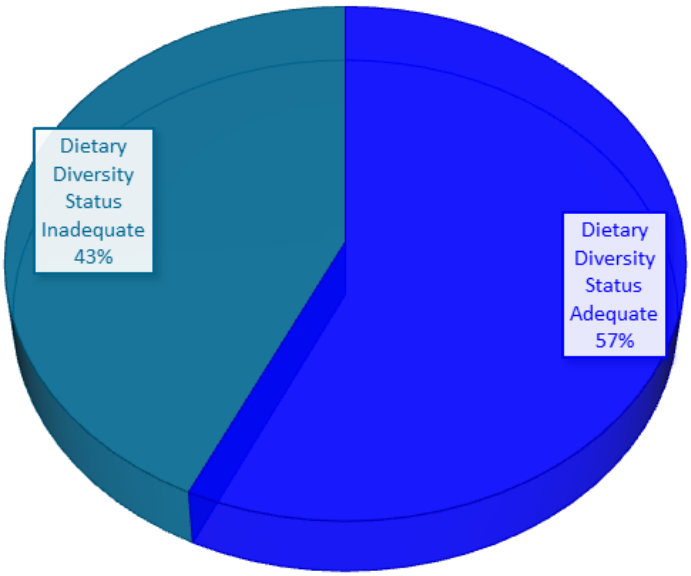

Figure 2. *Dietary diversity level.*

Table 3. *Pregnant women in rural and urban areas of the Mbulu district of Tanzania consumed a variety of food groups.*

Type of food group	Category	Frequency (N)	Percentage (%)	Location		p-value
				Rural =n (%)	Urban =n (%)	
Dietary Diversity Status	Adequate	219	57.0	120 (54.8)	99 (45.2)	0.016
	Inadequate	165	43.0	70 (42.4)	95 (57.6)	
Pulses (beans, peas and lentils)	No	153	39.8	80 (53.3)	73 (47.7)	0.370
	Yes	231	60.2	110 (47.6)	121 (52.4)	
Nuts and seeds	No	215	56	76 (35.3)	139 (64.7)	0.000
	Yes	169	44	114 (67.5)	55 (32.5)	
Milk and milk products	No	111	28.9	41 (36.9)	70 (63.1)	0.002
	Yes	273	71.1	149 (54.6)	124 (45.4)	
Meat, poultry, and fish	No	246	64.1	113 (45.9)	133 (54.1)	0.064
	Yes	138	35.9	77 (55.8)	61 (44.2)	
Eggs	No	297	77.3	131 (44.1)	166 (55.9)	0.000
	Yes	87	22.7	59 (67.8)	28 (32.2)	
Dark green leafy vegetables	No	82	21.4	39 (47.6)	43 (52.4)	0.695
	Yes	302	78.6	151 (50)	151 (50)	
Other fruits	No	134	34.9	75 (56)	59 (44)	0.063
	Yes	250	65.1	115 (46)	135 (54)	

Type of food group	Category	Frequency (N)	Percentage (%)	Location		p-value
				Rural =n (%)	Urban =n (%)	
Other vegetables	No	181	47.1	71 (39.2)	110 (60.8)	0.000
	Yes	203	52.9	119 (58.6)	84 (41.4)	
Other vitamin A-rich fruits and vegetables	No	205	53.4	124 (60.5)	81 (39.5)	0.000
	Yes	179	46.6	66 (36.9)	113 (63.1)	
Grains, white roots and tubers, and plantain	No	10	3	4 (40)	6 (60)	0.544
	Yes	374	97.4	186 (49.7)	188 (50.3)	

A statistically significant association between food groups consumed by pregnant women in both rural and urban

3.5. Household Income and Dietary Diversity Among Pregnant Women in Mbulu District

Table 4. More than half (52.6%) of the rural respondents had a main source of household income in agriculture compared to 47.4% of the urban respondents. 48% of the urban respondents had a low average monthly household income (< 250,000/=) compared to 52% of the rural respondents. 61.1% of urban respondents had a daily average household expenditure (of < TZS 5,000/=) compared to 38.9% of rural respondents. 63.7% of rural respondents had allocated monthly income > 50% to food expenditure compared to 36.3% of urban respondents. 57% of rural respondents had experienced a financial change in households compared to 33% of urban respondents. 35.2% of rural respondents had followed a specific food budget compared to 64.8% of urban respondents. 49.6% of rural respondents had adjusted to the food budget for pregnancy, while 50.4% of urban respondents. 53.4% of rural respondents had purchasing power that affected their ability to maintain a diverse diet compared to 46.6% of urban respondents. 43.5% of rural respondents had IFA assistance from the government compared to 56.5% of urban respondents.

A proportional analysis from the Chi-square test showed a statistically significant association between location (rural and urban) and main source household income, average monthly household income, average daily household income, percentage monthly household income, followed-specific budget expenditure, financial change experience, and support programs/government assistance. This showed that the main source household income, average monthly household income, average daily household income, percentage monthly household income, followed-specific budget expenditure, financial change experience, and support government assistance are more likely to have a rural location. Food budget adjustment and economic factors that affect the ability to maintain a diverse diet during pregnancy were found not to have any associations with pregnant women's urban location ($p > 0.05$). However, there was a relatively higher tendency for pregnant women who made food budget adjustments and affected economic factors to have rural locations.

A comparative analysis from the Chi-square test showed a statistically significant association between dietary diversity and economic factors, average monthly household income, followed by specific budget expenditure, financial change experience, and support programs/government assistance (Table 5). This suggests that economic factors, average monthly household income, followed specific budget expenditure, financial change experience, and support programs/government assistance were more likely to have an adequate dietary diversity. Food budget adjustment, main source household income, percentage monthly household income, parity, religion, and partner support were found not to have any associations with pregnant women's dietary diversity categories ($p > 0.05$). However, there was a relatively higher tendency for pregnant women who were older, married, occupation, parity, religion, and partner support to have an inadequate dietary diversity.

Table 4. Influence of the Household Income Status on Dietary Diversity among Pregnant Women in rural and urban areas in the Mbulu District, Tanzania.

Household Income Status	Category	Location (Residents)		p-value	Dietary Diversity Status		Total	p-value
		Rural =n (%)	Urban = n (%)		Adequate =n (%)	Inadequate =n (%)		
The main source of household income	Government employment	(20)	(80)	0.022	(70)	(30)	10	0.138
	Agriculture	171 (52.6)	154 (47.4)		16 (50.8)	16 (49.2)	325	
	Business	15 (35.7)	2 (64.3)		2 (66.7)	1 (33.3)	42	
	Others	2 (28.6)	5 (71.4)		(57.1)	(42.9)	7	
Average monthly household income (TZS)	250,000-500,000/=	67 (42.4)	9 (57.6)	0.039	7 (50.0)	7 (50)	158	0.001
	<250,000/=	79 (52)	7 (48)		10 (68.4)	4 (31.6)	152	
	>500,000/=	4 (59.5)	3 (40.5)		3 (48.6)	3 (51.4)	74	
Household Food expenditure per day	<5000	7 (38.9)	11 (61.1)	0.000	10 (56.8)	8 (43.2)	185	0.169
	>5000	11 (59.3)	8 (40.7)		9 (49.7)	10 (50.3)	199	
Monthly income percentage for food expenses	10-25%	(14)	3 (86)	0.000	2 (62.8)	1 (37.2)	43	0.352
	26-40%	(15)	3 (85)		2 (57.5)	1 (42.5)	40	
	unknown	(19.2)	2 (80.8)		1 (53.8)	1 (46.2)	26	
	< 10%	(20)	(80)		(20)	(80)	5	
	> 50%	17 (63.7)	9 (36.3)		13 (51.5)	13 (48.5)	270	
Household Food budget expenses	No	15 (55.1)	124 (44.9)	0.000	15 (56.9)	11 (43.1)	276	0.018
	Yes	3 (35.2)	7 (64.8)		4 (43.5)	6 (56.5)	108	
Household Income Experience	No	105 (44.7)	130 (55.3)	0.018	14 (59.6)	9 (40.4)	235	0.001
	Yes	85 (57)	6 (43)		6 (43)	8 (57)	149	
Food budget adjustments	No	12 (49.4)	13 (50.6)	0.974	15 (58.3)	10 (41.7)	259	0.003
	Yes	62 (49.6)	63 (50.4)		5 (42.4)	7 (57.6)	125	
Food expenditure ability to purchase	No	104 (46.6)	119 (53.4)	0.19	13 (62.3)	8 (37.7)	223	0.000
	Yes	86 (53.4)	75 (46.6)		6 (40.4)	9 (59.6)	161	
The government assistance (IFAS)	No	47 (85.5)	8 (14.5)	0.000	3 (67.3)	1 (32.7)	55	0.023
	Yes	143 (43.5)	186 (56.5)		16 (50.8)	16 (49.2)	329	

A statistically significant association between household economics and dietary diversity among pregnant women in both rural and urban

3.6. Socio-demographic Factors Associated with Dietary Diversity Among Pregnant Women

Table 5 shows the binary logistic analysis results. District (Rural), education level, average monthly household income, and husband (male partners) support were all found to have significant associations with the dietary diversity among pregnant women. Location: rural pregnant women were more likely to have significantly lower odds of achieving adequate dietary diversity than urban pregnant women, implying a statistically significant difference in dietary diversity (OR = 0.357, 95% CI [0.182-0.701], p = 0.003). Pregnant women having secondary school education level demonstrated increased odds of consuming adequate dietary diversity (OR = 3.958, 95% CI [1.457, 10.752], p = 0.007) as compared to pregnant women having no formal education (OR = 0.122, 95% CI [0.02, 0.726], p = 0.021). The wide range of the CI indicates considerable uncertainty around the OR estimate, and the actual value of the OR could be anywhere within this

range. Furthermore, pregnant women with a Monthly Household Income TZS less than 250,000/= were more likely to have an inadequate dietary diversity by about 0.003 times less (OR = 4.934, 95% CI [2.283, 10.662], p = 0.000) as compared to pregnant women with a monthly Household Income higher than 250,000/=. Additionally, pregnant women who had husband (partner) support with OR = 3.713, 95% CI [1.722, 8.006], p = 0.001; it was positively significantly associated with adequate dietary diversity.

Table 5. *Binary logistic regression and odds ratio were associated with socio-demographic factors and pregnant women's dietary diversity status.*

Variable	Odds ratio	df	Sig.	95% C.I.for Odds	
				Lower	Upper
Location (District -Rural)	0.357	1	0.003	0.182	0.701
Age group		2	0.865		
18-24 years	0.775	1	0.812	0.094	6.377
25-40 years	0.898	1	0.919	0.113	7.105
Marital status		4	0.107		
Cohabiting	0.87	1	0.878	0.147	5.156
Divorced	4.162	1	0.435	0.116	149.165
Married	1.132	1	0.873	0.247	5.183
Single	2.668	1	0.221	0.555	12.833
Education Level for Pregnant Women		4	0.000		
No formal education	0.122	1	0.021	0.02	0.726
Primary school	0.918	1	0.866	0.343	2.458
Secondary school	3.958	1	0.007	1.457	10.752
High school/Certificate/Diploma	0.75	1	0.529	0.307	1.835
Occupation		4	0.000		
Employed	1.25	1	0.840	0.144	10.859
Farmer	0.67	1	0.694	0.091	4.938
Pastoralist	3.599	1	0.272	0.367	35.329
Self-employed	3.823	1	0.202	0.487	29.997
Average monthly household income		2	0.000		
< 250,000/=	4.934	1	0.000	2.283	10.662
250,000/= - 500,000/=	1.009	1	0.978	0.521	1.957
Parity		2	0.077		
< 2	1.364	1	0.535	0.512	3.637
3-5 parities	0.584	1	0.207	0.253	1.347
Family Size		2	0.216		
< 2	0.581	1	0.081	0.316	1.069
3-5 members	0.674	1	0.373	0.283	1.606
Religion (Christian)	0.637	1	0.246	0.298	1.364
Husband (Male Partner) Support (Yes)	3.713	1	0.001	1.722	8.006

Variable	Odds ratio	df	Sig.	95% C.I.for Odds	
				Lower	Upper
Constant	0.534	1	0.709		

AOR Adjusted Odds Ratio; CI Confidence interval, a Statistically significant association between dietary diversity among pregnant women and the variable at p < 0.05

4. Discussion

This study aimed to assess the dietary diversity and household income status among pregnant women (n=384) who attended antenatal care clinics in Mbulu District, Tanzania. The major finding of this study was less than half (43%) of pregnant women had inadequate dietary diversity criteria of consuming less than five food groups out of 10 in the previous 24 hours due to household monthly income constraints, large family size, location (rural areas), low maternal education level, and lack of husband (male partners) support were factors which statistical significantly associated with pregnant women's dietary diversity.

4.1. Dietary Diversity Among Pregnant Women

In Tanzania and other sub-Saharan African countries, economic factors have been shown to limit dietary diversity among pregnant women. In this study, the prevalence of inadequate dietary diversity during pregnancy was 43%, which was consistent with previous studies conducted, 45% in the Western Hill region of Nepal [39] and 49% in Southwest Ethiopia [13] and while less than 78.4% in West Arsi Zone, Central Ethiopia [40], 69.2% in Lagos Nigeria [41], 57.4% in Southern Ethiopia [42], 57% in Dire Dewa, Eastern Ethiopia [43], and Ethiopia [44]. Also, this finding was sThisy the studies conducted inzania [45, 12]. Studies have reported much lower dietary diversity scores of 16.9% in Kenya [46] and 19.9% in Gojjam, Northwest Ethiopia [47]. Such disparities might be associated with the differences in time of investigations and population.

In this study, percentage of pregnant women who attained adequate dietary diversity (57%) was more significant than the proportion reported in studies in Coast region of Tanzania (28%) [12] and Dar-es-salaam, Tanzania [17] and was consistent with the proportion reported in studies conducted in Hosanna Town, Ethiopia (57.4%) [42], Nepal (55%) [39], Gurage Zone, Ethiopia (57.9) [48] and Addis Ababa, Ethiopia (60.9%) [49] and higher than East Gojjan Zone of Northwest Ethiopia (45%) [50], Jille Tumuga (31.4%) [51], Bale (44.8%) [52], Dire Daw city (43%) [43] and Shashemane town (25.4%) [53]. However, the percentage was consistent or higher than those reported in the studies conducted in different periods, geographical locations, and seasonal variation and differences in the measurement of dietary diversity. Some studies used nine food groups, while other studies used fourteen food groups. Those who consumed four or more food groups of the fourteen food groups were categorized as having minimum dietary diversity, which will result in a more significant score than this finding.

This study showed that 26.6% (n=102) of pregnant women were anaemic based on haemoglobin < 11 g/dl. In comparison with other studies, studies conducted in Tanzania, 25% [54], Mwanza, Tanzania, 68.8% [55], Southern Ethiopia [56], Accra, Ghana, more than 50% [57] and the prevalence of anaemia in pregnancy was less than 20%, or daily iron supplement is not acceptable due to side effect [22].

In this study Table 4, about 97.4% and 78.6% of the pregnant women had commonly consumed grain, white roots, tubers, and plantains (potatoes, wheat, maize, and rice can be in the form of bread or porridge) food group and dark green leafy vegetables (spinach and amaranth green) food group, respectively in the previous 24 hours. Conversely, the least consumed food groups were eggs (22.7%) and meat, poultry, and fish (35.9%). It was consistent with the other findings reported in studies in the Coast region of Tanzania [12], Dar-es-salaam, Tanzania [17], Tigray Region, Ethiopia [58] and Addis Ababa, Ethiopia [13]. However, there is a slight difference from the study conducted in the East Gojjam zone, where they often ate food groups such as seeds and nuts, legumes (85.5%) and starchy staples (64.7%) [50]. The possible could be attributed to their geographical location, sociodemographics, and seasonal differences.

4.2. Association of Socio-demographic Characteristics and Dietary Diversity of Pregnant Women

The factors of residence (urban vs. rural areas), education level, and family size are significantly associated with (p-value < 0.05) dietary diversity due to their influence on food availability, accessibility, and household decision-making.

In this study, residences (Rural and urban) had a higher prevalence of inadequate dietary diversity among urban pregnant women (46%) compared to their rural counterparts (36.8%), with a p-value of 0.016 due to income constraints, access to fresh foods, knowledge, and awareness. This study was supported by previous studies from Rwanda [30], Tanzania [12], and Rome, Italy [22].

In this study, maternal education was statistically associated with dietary diversity with a p-value of 0.045, which was supported by the studies from Ghana [59], Kenya [60], Tanzania [45], and Ethiopia [53] are more educated pregnant women had adequate dietary diversity compared to those of uneducated pregnant women that the more they had exposure to dietary diversity, the higher they tended to consume a variety of foods from different food groups. Respondents with high levels of education are more likely to have access to information about dietary diversity. They were also more likely to have the skills and resources to prepare and cook nutritious foods. This study finding was supported by the study conducted in Uganda [61]. Also, education improves nutrition knowledge and enables pregnant women to make educated food decisions. Better comprehension and application of dietary diversification recommendations are linked to higher educational attainment. An illustration of how education influences dietary diversity was found in a study conducted in Nairobi, Kenya, which found that women with secondary or higher education eat more food groups [62].

Family size, food distribution, and resource allocation within families are influenced by family size. While more prominent families may find it difficult to maintain food diversity due to their limited financial means, smaller families can allocate more resources per person. Nutritional diversity was much higher among pregnant women from households with fewer members [63]. Due to budgetary constraints, larger families typically favour starchy staple foods. It is especially noticeable in rural areas with high dependency ratios [64]. According to a study conducted in Southern Ethiopia, smaller families were better able to control their food budgets, allowing a wider variety of food groups in diets [48].

4.3. The Influence of Household Income on the Dietary Diversity of Pregnant Women

The average household monthly income was significantly associated with (p-value < 0.05) dietary diversity. Pregnant women from low-income households often allocate a significant portion of their incomes to staples like maize, rice or wheat, which lack dietary diversity. In contrast, pregnant women from families with higher monthly incomes can afford nutrient-rich foods, including other fruits, other vegetables, vitamin A from vegetables and fruits and animal-based products, fostering adequate dietary diversity. High income is associated with increased purchasing power, which can help promote dietary diversity. This study finding is comparable with that done in Nigeria [65], Rome [64], Ethiopia [13], and Kenya [29].

Dietary diversity was associated (p-value < 0.05) with food expenditure and purchasing power. Dietary quality is directly impacted by the percentage of income spent on food. Food price hikes brought on by inflation further limited access to diverse food groups for pregnant women in low-income households. Pregnant women from families with limited purchasing power prioritize calorie-dense but nutrient-poor foods, leading to insufficient dietary diversity. This study was supported by studies conducted in the Coast Region, Tanzania [12], Central Gondar, Ethiopia [66], Washington DC [67] and Rome [22].

Government assistance was also significantly associated with dietary diversity. In Tanzania, interventions such as distributing iron and folic acid supplements (IFAS) to pregnant women attending antenatal care clinics contributed to this association by improving dietary diversity at the household level. This study is supported by a study conducted in Tanzania [12].

Food budget adjustment during pregnancy was statistically associated with (p-value <0.05) dietary diversity. Most pregnant women did not adjust their food budget during pregnancy, leading to inadequate dietary diversity due to additional nutrients needed. This current study is comparable with the reported study in Rwanda [30] and Tanzania [12]. The dietary diversity of pregnant women was associated with financial change experience and followed specific food budget expenses. Pregnant women experienced financial change by increasing the food budget at the household level to purchase a variety of foods from different food groups to meet the additional nutrients demanded. After growing food budget expenses, respondents followed specific expenses to meet adequate dietary diversity (≥5 food groups) during the pregnancy. From this study, most pregnant women married; therefore, most headed households where men were supported by the study conducted in Mauritania [68], Central Nepal [69] and Tanzania [45].

4.4. Socio-demographic Factors Associated with Dietary Diversity among Pregnant Women

Binary logistic regression analysis showed that there was a statistically significant association (p < 0.05) between location (district rural residents), maternal education status, average monthly income, and husband (partner) support with dietary diversity for pregnant women.

In this study, the average monthly household income was positively associated with dietary diversity. Pregnant women with an average household monthly income less than TZSH 250,000/= had significantly higher odds of inadequate dietary diversity due to income constraints affecting food access such animal protein, dairy, fruits and vegetables led to poor dietary diversity, almost 4.9 times than those having an average monthly household income greater than TZSH 250,000 per month. Pregnant women with higher average monthly income were more likely to have adequate dietary diversity than their counterparts. This study was supported by studies from Kenya [60] and Addis Ababa, Ethiopia [49].

The residence of rural district pregnant women was negatively associated with dietary diversity in this study. Pregnant women who lived in rural Mbulu district council areas had

dietary diversity scores approximately 0.357 times lower odds of achieving adequate dietary diversity than those in urban Mbulu district council areas, indicating less access to nutritious food groups, which is crucial for maternal and fetal health. This trend aligns with findings in other low-income regions where limited market access, lower household income, and insufficient nutritional education impact rural dietary diversity. Similar to the previous studies conducted in Kenya [60], Southern Ethiopia [42], Nouakchott Mauritania [68], Oromia Ethiopia [70] and the Coast Region in Tanzania [12].

The education level of pregnant women was negatively associated with dietary diversity in this study. Pregnant women who learned informal education had 0.122 times less likely to achieve dietary diversity than the formal education pregnant women. In this study, also maternal education was positively associated with dietary diversity. Pregnant women with secondary education showed they had 3.958 times greater odds of achieving to consume adequate dietary diversity than those who had never attended school [71]. This study was supported by the reported study conducted in Kenya and Addis Ababa, Ethiopia [49], which identified that educational status has a strong statistical association with the dietary diversity of pregnant women. Those pregnant women with higher education had greater odds of attaining adequate nutritional diversity; they might have acquired essential information on appropriate feeding dietary diversity practices, gotten better employment opportunities, and have a regular income, which can directly or indirectly improve the purchasing power of different recommended food groups. Similarly, the impact of education on dietary diversity was also made in the study done in Rwanda [30], Paraná, Brazil [72], and Shashemane, Oromia Central Ethiopia [53].

In this study, also husband (male partners) support was positively associated with dietary diversity. Pregnant women supported by their husbands (male partners) were 3.713 times more likely to have significantly higher odds of achieving adequate dietary diversity than those with no husbands (partners), emphasizing the role of household to support in maternal nutrition. This study was supported by the study conducted in Bangladesh [73]. Financial and social support for pregnant women increases their ability to purchase a variety of nutritious food groups. It decreases the burden of home activities to promote maternal and fetal health [34].

4.5. The Limitations of the Study

The cross-sectional study design captures data at a single point in time, making it difficult to establish causal relationship between independent and dependent variables. Additionally focus on one district restricts the generalizability of the findings to other regions with different socioeconomic, cultural and environmental contexts.

5. Conclusions

The study in the Mbulu district revealed that nearly half of pregnant women had inadequate dietary diversity. It has also shown that fifty-seven per cent of pregnant women consume a diverse diet. Improving household income conditions is key to enhancing adequate dietary diversity for better maternal and fetal health outcomes. Government, policymakers and interventions should concentrate on raising household income through programs like income-generating activities, women's empowerment, community-based nutrition programs, financial assistance, and agricultural development, which have been shown to increase food security and economic resilience to meet adequate dietary diversity among pregnant women. Therefore, boosting by combining household income, nutritional education, and nutritional counselling for pregnant women should be emphasized to improve the practice of dietary diversity for maternal and unborn children.

Abbreviations

LMICs	Low and Middle-Income Countries
WHO	World Health Organization
FAO	Food and Agriculture Organization
MDD-W	Minimum Dietary Diversity for Women
NBS	National Bureau Statistics
MoHCDGEC	Ministry of Health, Community Development, Gender, Elderly and Children
TDHS-MIS	Tanzania Demographic Health Survey and Malaria Indicator Survey

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Author Contributions

Paul Hudson: Conceptualization, Funding acquisition, Resources, Software, Visualization, Writing – original draft, Writing – review & editing

Happiness Muhimbula: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Supervision, Validation, Writing – review & editing

Theobald Mosha: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Supervision, Validation, Writing – review & editing

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Conflicts of Interest

The authors declare no conflicts of interest.

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