



Influence of Socio-demographic Factors on Dietary Diversity among Pregnant Business Women in Tunduma Town Council, Tanzania

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Authors' contributions

This work was carried out in collaboration among all authors. Author SP designed the study, curated the data, and wrote the first draft of the manuscript. Authors TM and ZM managed the analyses of the study. Author ZM managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Background: Dietary diversity was a key factor in nutritional sufficiency particularly for business women who struggle to access diverse nutrients rich foods due to socio economic and occupational pressures that limited their access to nutrient-rich foods.

Methods: The panel longitudinal study examined the influence of socio demographic factors on dietary diversity of 223 pregnant business women attending antenatal clinics from their second trimesters to term. Data collected from November 2024 up to May 2025 at baseline (Socio demographic factors and dietary diversity) and dietary diversity was included during endline. The Minimum Dietary Diversity for women (MDD-W) was based on 10 food groups as recommended by

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Food and Agriculture Organization (FAO) and seven days food frequency questionnaire was used to assess dietary intake of pregnant women.

Results: The mean age of the women was 29.58 ± 6.96 (SD), among them 110 (49.3%) were aged between 20 and 35 years. The findings revealed that at baseline 55.6% of the pregnant business women had inadequate dietary diversity and slightly improved during endline with 65.5% exhibiting adequate dietary diversity. The consumption of cereal base foods was high at both baseline (100%) and endline (100%) while intake of other food groups show that vitamin A-rich fruits and vegetables rising from 49.7% to 66.4%, eggs from 39% to 63.2%, meat, poultry and fish from 43.5% to 62.2%. The increase of consumption occurred due to changes of meal when mothers delivery. Based on binary regression model the findings showed that at baseline and endline demographic factors particularly age (AOR=2.24, 95% CI: 2.04-2.44), education level (AOR=1.41, 95% CI 1.21-1.61, and income (AOR=1.82, 95% CI: 1.62-2.02), type of business (AOR=1.45 95% CI: 1.25-1.65), marital status (AOR=1.32, 95% CI: 1.12-1.52) and household size(AOR= 1.45, 95% CI: 1.23-1.63) significantly influenced minimum dietary diversity among respondents.

Conclusion: Dietary pattern during pregnancy suggested potential risks for micronutrient deficiencies due to suboptimal consumption of diversified food groups. Government, health care providers, NGOs and other stakeholders should implement nutritional counseling before pregnancy, improve access to diverse local food markets and enhance fortification programs.

Keywords: Dietary diversity; business women; socio-demographic factors and food groups.

1. INTRODUCTION

Dietary diversity is a very important determinant of food quality and nutritional sufficiency particularly among women reproductive age. It reflects the variety of foods consumed across different food groups and is directly associated with improved maternal and child health outcomes (FAO, 2021). Poor dietary diversity is a public health issue in Tanzania and especially to women in peri-urban and rural environments. Business women including those who are pregnant, often face unique social economic and occupational pressures that can limit their ability to access and consume diverse, nutrient-rich diet (Getaneh et al., 2021). Recent studies have shown that only 46% of rural women in Tanzania meet the Minimum Dietary Diversity with diets typically dominated by starchy staples and limited in animal source foods, fruits and vegetable (Haug et al., 2023).

Social-demographic factors such as education level, income, type of business and marital status have been consistently identified as strong predictor's dietary diversity. Women with higher education and formal employment are more likely to achieve adequate dietary diversity due to greater nutritional knowledge, access to food resources and structured daily routines (Hasham & Manji, 2016). In contrast women involved in informal business or with lower income levels may struggle with time constraints, food insecurity and lack of dietary awareness, limiting

their intake of essential nutrients (Miele et al., 2021).

Pregnant women are particularly vulnerable as their nutritional needs are increased to support fetal growth and maternal wellbeing. Poor maternal dietary diversity is associated with adverse pregnancy outcomes such as low birth weight, preterm birth and impaired infant growth and development (Potenzieri et al., 2024). In Tunduma Town Council a rapidly growing border town with a large population engaged in small scale business, understanding the dietary behaviors of pregnant business women is vital for improving maternal and child health outcomes. Despite their economic activity, many still face dietary challenges due to socio-economic inequalities, occupational stress and limited access to health information (Li et al., 2021).

This study examining the influence of socio-demographic factors on dietary diversity of pregnant business women in Tunduma Town Council. Specifically, the study assesses the socio-demographic characteristics of the pregnant business women and the factors that influence their dietary diversity. The findings of this study was served as a basis for developing targeted nutrition interventions and policy strategies aimed at improving maternal nutrition and promoting better health outcomes among pregnant women.

2. MATERIALS AND METHODS

2.1 Study Area Description, Design and Population

The study was conducted in Tunduma Town Council, Songwe Region in Tanzania. Tunduma is busy urban center situated near Zambia border. The town serves as a key commercial center, attracting business activities and diverse population including business women engaged in various trades (Tyson, 2022). It has 23 health facilities including 1 hospital, 8 health centers and 14 dispensaries (District Health Information System [DHIS]). The study was conducted in the Tunduma health centers because it is near to business center make it accessible to most of pregnant business women. The centers also offers a range of essential health facilities including antenatal and postnatal care services.

A panel longitudinal study was conducted to investigate influence of socio-demographic factors on dietary diversity among pregnant business women. The study was involved business women aged between 15 to 49 years who are currently pregnant specifically in their second trimesters until given birth. Eligible pregnant business women attending antenatal care (ANC) visits at the Tunduma Health center were identified with the help of health care providers.

2.2 Sample Size and Sampling Procedures

The total number of pregnant business women who participated in the study was determined using the sample size formula developed by (Fisher et al., 1991). Based on the proportion of women in Songwe Region who met the minimum dietary diversity (15.8%) as reported in the TDHS (2022), a 95% confidence level (standard normal distribution) and an absolute error margin of 5% were used to calculate sample size, resulting in 202 pregnant business women. To compensate for a potential 10% non-response rate, the sample size was increased accordingly following the methodology described by (Fisher et al., 1991).

Tunduma health center was purposely chosen for the study due to high concentration of business women around the center. Simple random technique was used to select participants involved in the study ensuring that

the sample was representative of the target population. The list of all eligible pregnant women was established from antenatal clinic register and each name was assigned a unique identification number. These numbers were placed into a container and thoroughly mixed after which numbers were randomly drawn one at a time until the desired sample size was obtained.

2.5 Data Collection

The pre-test was conducted with 20 pregnant business women in Mwanjelwa health center at Mbeya then necessary adjustments were made to the study tools and procedures before the main study began. Data for the study was collected at Tunduma health center from November 2024 to May 2025 with the help of a research team that included nurses, doctors and nutritionist. Data were collected in two phases i.e. during baseline and endline whereas information was collected using structured questionnaire through face-to-face interviews.

In phase one (baseline-Time1) participants were recruited and provided information on their dietary diversity and socio demographic characteristics including age, education, income, marital status, parity, family size and type of business. In phase 2 (endline-Time2) the same women from phase 1 were followed up to collect comprehensive information on their dietary diversity. Data collection for phase 2 was conducted during their first postnatal clinic visit after childbirth. To ensure data linkage while maintain anonymity participants were asked during the pre-survey to create a personal memorable code such as a combination of their birth month and the first letter of their mother's name that they could easily recall and use in both surveys.

2.5.1 Dietary diversity

Information on dietary diversity was collected using standard questionnaire with 10 food groups commonly recommended for assessing dietary diversity, as recommended by FAO (FAO, 2021). During the assessment period pregnant women were asked to mention all foods consumed for the past 24 hrs. If the food group consumed a one score was written in the respective food group and zero score was given to the food group which was not consumed over the past 24 hrs. The minimum dietary diversity score was

computed as the sum of the scores across all 10 food groups and the total was used to determine whether the participant's dietary diversity was adequate or inadequate based on the established cut off points. The cut-off values for dietary diversity were determined by analyzing the distribution of dietary diversity scores using measures of central tendency (mean and median) among the pregnant business women. For each participant, the points from all consumed food groups were summed to generate a Dietary Diversity Score (DDS). A DDS of <5 was classified as inadequate dietary diversity while a DDS of ≥ 5 as adequate dietary diversity.

2.5.2 Food frequency

Food frequency questionnaire was used to capture habitual food intake. A 7-day Food Frequency Questionnaire was used, focusing on the types and frequency of food consumed, meal frequency and how they accessed their meals. A list of common foods was established and pregnant women were asked on the frequency of consumption of the particular food. Responses were recorded as 1. Never consumed, 2. Occasionally consumed (1-3 days) 3. Frequently consumed (4-6 days) and 4. Daily consumed (7 days). One score was given to each respondent that consumed a specific group and zero score to a respondent who did not consume a specific group. The FFQ also explored how they got their meals in order to understand the challenges they faced.

2.6 Data Analysis

Data analysis was conducted using SPSS Version 27.0 where descriptive and inferential statistics were computed. For categorical variables (e.g. age group, education levels, income categories, type of business, marital status, parity, household size, dietary diversity

categories) descriptive statistics measures frequency and percent to describe the socio-demographic and reproductive characteristics of the participants as well as their dietary diversity, food group consumption frequency and the dietary diversity score (DDS) at both baseline and endline. On the other hand, continuous variables (e.g. age in years and DDS score) descriptive statistics included mean, standard deviation, minimum and maximum values.

Inferential statistics measures Chi-square test used to show changes in frequency of food group consumption among pregnant business women at baseline and endline. Then Related-Samples Wilcoxon signed Rank Test was used to compare individual dietary diversity scores between baseline and endline. A binary regression model was applied to examine the association between dietary diversity score (dependent variable) and various socio-demographic factors (independent variables). The analysis was conducted at a 95% confidence level.

3. RESULTS

3.1 Socio-Demographic Characteristics of the Respondents

A total of 223 pregnant business women were recruited for the study and completed all two rounds. About 49.3% were aged between 25-34 years, 50.7% had attained Secondary education, and 1.3 % (n=3) had no formal education (Table 1). The results also indicated that 86.5 % were married, 66.8% of women had 1-2 previous pregnancies and 75.3% of were shop owners. In terms of income 30.9% earned less than 500,000 TZS monthly, while only 3.6% earned more than 5,000,000 TZS. Regarding family size 60.5% had less or equal to four children (Table 1).

Table 1. Socio-demographic and reproductive characteristics of the respondents

Variable	n = 223	%
Age		
≤19	57	25.60
20 – 35	110	49.30
≥ 36	56	25.10
Education level		
Non-formal	3	1.30
Primary	76	34.10
Secondary	113	50.70
College/University	31	13.90

Variable	n = 223	%
Parity (number of previous pregnancies)		
Nulliparous	0	0.00
1-2	149	66.80
≥ 3	74	33.20
Marital status		
Single	30	13.5
Married	193	86.50
Income (monthly)		
Less than 500,000 TZS	69	30.90
1,000,000 - 2,000,000 TZS	52	23.30
2,000,000 - 5,000,000 TZS	42	18.80
500,000 - 1,000,000 TZS	52	23.30
More than 5,000,000 TZS	8	3.60
Type of business		
Agricultural produce trader	45	20.20
Shopkeepers	168	75.30
restaurant operators	10	4.50
Family size (number of children)		
≤ 4	135	60.50
≥ 5	88	39.50

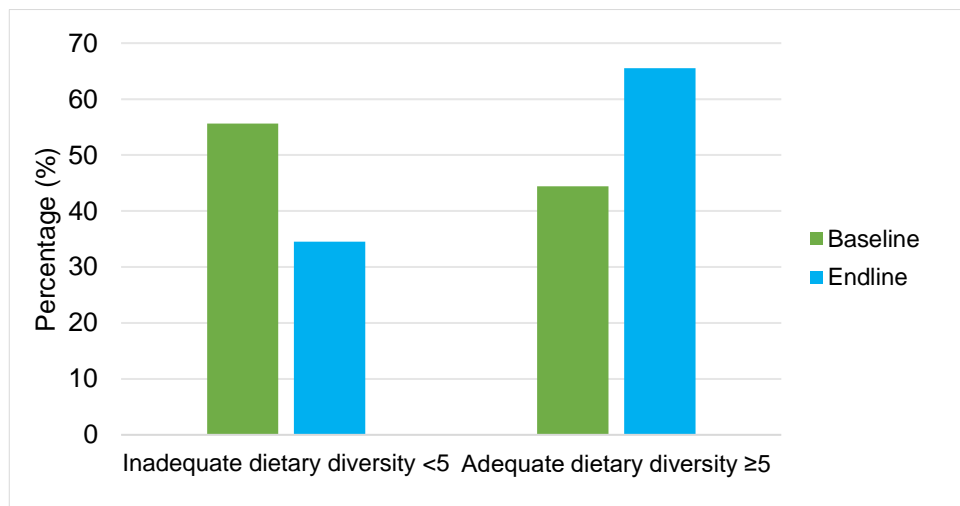


Fig. 1. Dietary Diversity Score classification

3.2 Dietary Diversity Score

An average of 4.4 and 6.5 food groups were consumed by pregnant women during baseline and endline respectively. About that 55.6% of pregnant business women consumed 4 Food groups at baseline compared to 34.5% who consumed 6 food groups at the endline (Fig. 1). Further, results from Wilcoxon signed rank whereas the median DDS was 5 (IQR: 4.0–6.0) at baseline and 6 (IQR: 5.0–7.0) at endline. This change was statistically significant, $Z = -7.69$, $p < 0.001$.

3.3 Food Group Consumption

Higher consumption of cereal-based foods was observed at both during baseline (100%) and endline (100%). About 39% consumed eggs during baseline compared to other animal source foods such as milk and meat. Green leafy vegetables and vitamin A rich foods were consumed by 47.1% and 49.7% of pregnant women respectively during the baseline. However, the consumption of all food's groups was slightly higher during endline (Fig. 2).

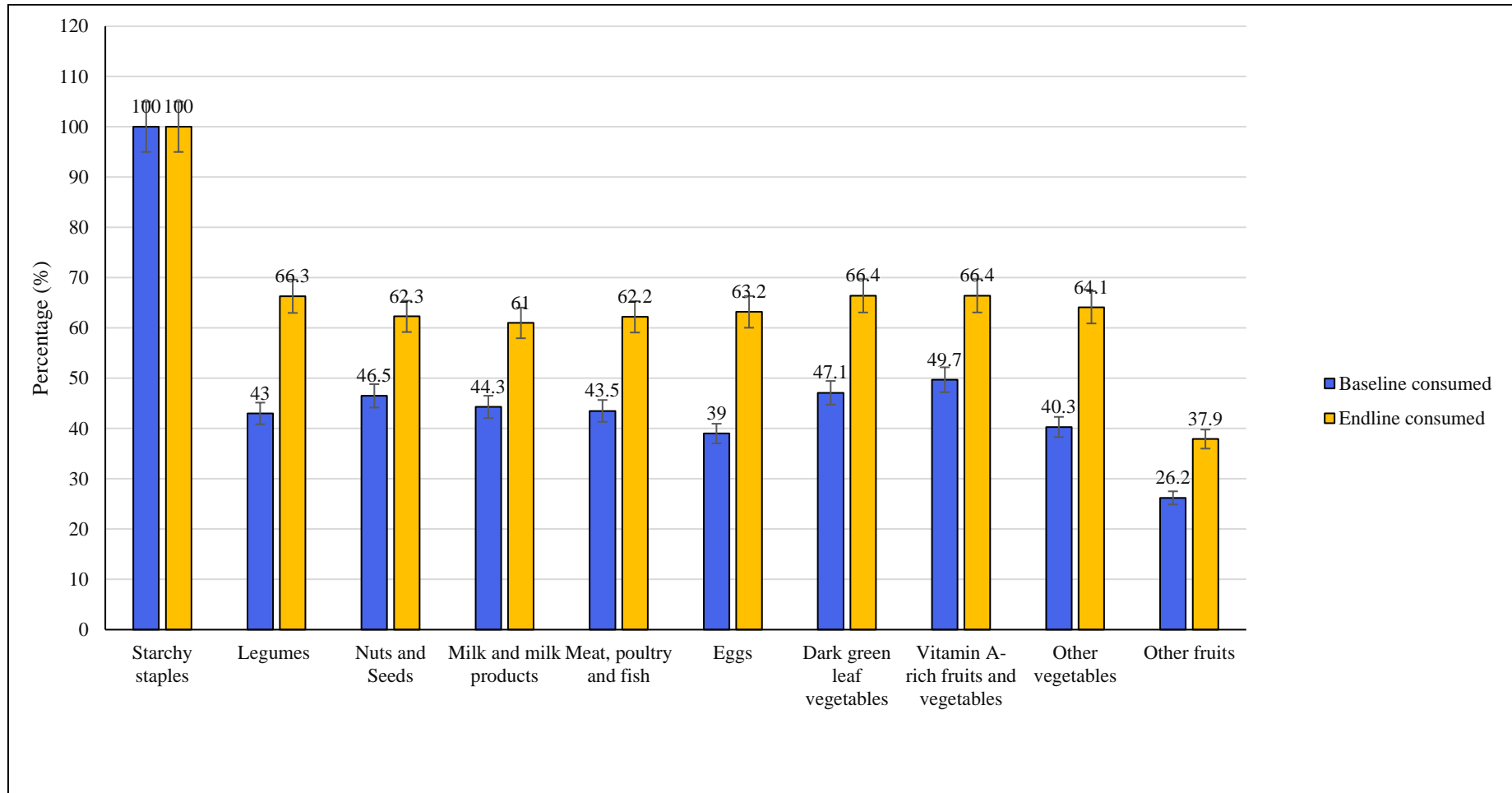


Fig. 2. Food group consumption

3.4 Frequency of Consumption

The present study showed that at baseline consumption of staple starchy foods was high by 100% of respondents consuming them daily, reflecting their status as the main dietary staple. Vitamin A-rich foods were less frequently consumed with 50.2% of women never consumed and 1.3% consumed them daily. Meat, poultry and fish consumption was limited as 56.5% never consumed and only 1.3% consumed them daily. Milk and milk products followed a similar pattern.

On the other hand at endline there were improvements across all these food groups,

staple food remain consistently high at 100% daily consumption. Intake of vitamin A-rich foods improved with never consumption decrease from 50.2% to 33.6% and occasional consumption increase from 42.1% to 57.9%. Egg consumption increased as never consumption dropped to 36.85, occasional intake arose to 55.6%, frequently and daily consumption increased to 15.0% and 7.2% respectively. Similarly, meat, poultry and fish consumption improved with never consumption falling to 37.7% and occasional intake rising to 57.8%. Milk and milk products also improved with never consumption decreased from 55.6 to 39.0 while occasional intake increased from 38.5% to 57.4% (Table 2).

Table 2. Changes in frequency of food group consumption among respondents at baseline and endline

Variable	Category	Status		Test statistics	
		Baseline (%)	Endline (%)	Chi-square	Sig.
Grain, white roots and tubers and plantains	Never	0.0	0.0	20.408	<0.001
	Occasionally (1-3 days)	0.0	0.0		
	Frequently (4-6 days)	0.0	0.0		
	Daily (7 days)	100.0	100.0		
Dark green leafy vegetables	Never	22.9	13.6	20.663	<0.001
	Occasionally (1-3 days)	41.3	59.7		
	Frequently (4-6 days)	32.7	25.4		
	Daily (7 days)	3.1	1.3		
Legumes (e.g. Beans, pigeon peas, cowpeas, lentils, chickpeas, black beans)	Never	27	13.6	25.862	<0.001
	Occasionally (1-3 days)	35.4	56		
	Frequently (4-6 days)	22.4	28.5		
	Daily (7 days)	15.2	1.9		
Nuts and Seeds (e.g. Pumpkin seed, groundnuts, almonds, walnuts, chia seeds)	Never	53.4	37.7	13.441	0.009
	Occasionally (1-3 days)	25.2	40.6		
	Frequently (4-6 days)	17.8	19.9		
	Daily (7 days)	3.6	1.8		
Other vitamin A-rich fruits and vegetables	Never	50.2	33.6	14.74	0.005
	Occasionally (1-3 days)	42.1	57.9		
	Frequently (4-6 days)	6.3	5.4		
	Daily (7 days)	1.3	3.1		
Other vegetables	Never	39.6	15.9	27.381	<0.001
	Occasionally (1-3 days)	34.5	55.6		
	Frequently (4-6 days)	25.4	27.6		
	Daily (7 days)	0.4	0.9		
Milk and milk product (e.g., Milk, yogurt and other dairy)	Never	55.6	39	19.072	0.001
	Occasionally (1-3 days)	38.5	57.4		
	Frequently (4-6 days)	4.9	1.8		
	Daily (7 days)	0.9	1.8		

Variable	Category	Status		Test statistics	
		Baseline (%)	Endline (%)	Chi-square	Sig.
Meat, poultry and fish (e.g., Fish, Beef, goat, poultry, pork, eggs)	Never	56.5	37.7	20.328	<0.001
	Occasionally (1-3 days)	36.8	57.8		
	Frequently (4-6 days)	5.4	4		
	Daily (7 days)	1.3	0.4		
Eggs	Never	61	36.8	31.3	<0.001
	Occasionally (1-3 days)	34.1	55.6		
	Frequently (4-6 days)	10.0	15.0		
	Daily (7 days)	5.0	7.2		
Other fruits	Never	53.8	42.1	85.872	0
	Occasionally (1-3 days)	14.4	25.7		
	Frequently (4-6 days)	28.2	26.3		
	Daily (7 days)	4.0	5.9		

3.5 Cultural and Dietary Challenges

The findings indicate that (92.4%) of pregnant women reported no cultural or traditional dietary influences. About 3.1% of them had access to health food options during work and 4.5% reported challenges in maintaining balance diet during pregnancy (Table 3).

3.6 Factors Influencing Consumption of MDD-W

The multivariate logistic regression output (Table 4) showed that at baseline several factors were found to be significantly influence Minimum Dietary Diversity. Respondents with aged 19-35 years being more than twice as likely to have adequate dietary diversity compared to other age groups (AOR=2.24, 95% CI: 2.04-2.44). Education also influenced dietary diversity with those having secondary education showing significantly higher odds of adequate dietary diversity compared to other education levels (AOR=1.41, 95% CI 1.21-1.61). Income between 1,000,000 and 2,000,000 TZS was positively associated with adequate dietary diversity (AOR=1.82, 95% CI: 1.62-2.02). Type of business was also a significant factor,

with restaurant operators having 1.45 times higher odds of adequate dietary diversity compared to other business types (AOR=1.45 95% CI: 1.25-1.65). Additionally respondents from household with fewer members were more twice as likely to achieve adequate dietary diversity compared to those from large households (AOR=2.33, 95% CI 2.13-2.53). On the other hand variable like parity, marital status and certain income and education were not significant associated with dietary diversity.

At the endline factors influencing Minimum Dietary Diversity among respondents (Table 5) indicated several significant predictors. Age was a key factor with respondents aged ≥ 36 years showing significantly higher odds of achieving adequate dietary diversity compared to younger age groups (AOR=2.24, 95% CI: 2.04-2.44).

Education level played an important role as respondents with college/university education had almost twice the odds of adequate dietary diversity compared to those with lower education levels (AOR=1.99, 95% CI: 1.79-2.19).

Table 3. Cultural and dietary challenges among pregnant business women

Variable	Yes	%	No	%
Dietary restrictions or preferences	4	1.8	219	98.2
Consume any fortified foods	17	7.6	206	92.4
Cultural or traditional dietary practices	1	0.4	222	99.6
Access to healthy food options at work	7	3.1	216	96.9
Challenges in maintaining a balanced diet	10	4.5	213	95.5

Table 4. Factors influencing Minimum Dietary Diversity among respondents at baseline

Variables	Minimum dietary diversity		Crude OR (95% CI)	Adjusted OR (95% CI)
	Adequate N (%)	Inadequate N (%)		
Age				
≤19	37 (64.9)	20 (35.1)	0.96 (0.76–1.16)	0.6 (0.4–0.8)
20 – 35	35 (31.8)	75 (68.2)	2.98 (2.78–3.18)	2.24 (2.04–2.44)*
≥ 36	26 (46.4)	30 (53.6)	1.11 (0.91–1.31)	0.55 (0.35–0.75)
Education level				
Non-formal	2 (66.7)	1 (33.3)	1.24 (1.04–1.44)	0.59 (0.39–0.79)
Primary	52 (68.4)	24 (31.6)	0.69 (0.49–0.89)	1.22 (1.02–1.42)
Secondary	47 (41.6)	66 (58.4)	1.6 (1.4–1.8)	1.41 (1.21–1.61)*
College/University	11 (35.5)	20 (64.5)	1.11 (0.91–1.31)	0.96 (0.76–1.16)
Parity				
1–2	50 (33.6)	99 (66.4)	1.38 (1.18–1.58)	0.95 (0.75–1.15)
≥ 3	39 (52.7)	35 (47.3)	0.82 (0.62–1.02)	0.61 (0.41–0.81)
Marital status				
Single	16 (53.3)	14 (46.7)	0.68 (0.48–0.88)	0.82 (0.62–1.02)
Married	111 (57.5)	82 (42.5)	0.66 (0.46–0.86)	0.97 (0.77–1.17)
Income (monthly)				
Less than 500,000 TZS	37 (53.6)	32 (46.4)	0.84 (0.64–1.04)	0.58 (0.38–0.78)
500,000 - 1,000,000 TZS	33 (63.5)	19 (36.5)	0.76 (0.56–0.96)	1.26 (1.06–1.46)
1,000,000 - 2,000,000 TZS	24 (46.2)	28 (53.8)	2.3 (2.1–2.5)	1.82 (1.62–2.02)*
2,000,000 - 5,000,000 TZS	18 (42.9)	24 (57.1)	0.91 (0.71–1.11)	0.61 (0.41–0.81)
More than 5,000,000 TZS	4 (50.0)	4 (50.0)	0.7 (0.5–0.9)	0.5 (0.3–0.7)
Type of business				
Agricultural produce trader	25 (55.6)	20 (44.4)	0.91 (0.71–1.11)	0.87 (0.67–1.07)
Shopkeepers	90 (53.6)	78 (46.4)	1.19 (0.99–1.39)	0.73 (0.53–0.93)
Restaurant operators	5 (50.0)	5 (50.0)	1.16 (0.96–1.36)	1.45 (1.25–1.65)*
Family size				
≤ 4	40 (29.6)	95 (70.4)	1.82 (1.62–2.02)	2.33 (2.13–2.53)*
≥ 5	39 (44.3)	49 (55.7)	0.74 (0.54–0.94)	1.0 (0.8–1.2)

*indicate significant at p value less than 0.05 in multivariable logistic analysis

Table 5. Factors influencing Minimum Dietary Diversity among respondents at endline

Variables	Minimum dietary diversity		Crude OR (95% CI)	Adjusted OR (95% CI)
	Adequate N (%)	Inadequate n (%)		
Age				
≤19	17 (29.8)	40 (70.2)	0.96 (0.76–1.16)	0.84 (0.64–1.04)
20 – 35	74 (67.3)	36 (32.7)	0.82 (0.62–1.02)	0.5 (0.3–0.7)
≥ 36	23 (41.1)	33 (58.9)	2.64 (2.44–2.84)	2.24 (2.04–2.44)*
Education level				
Non-formal	2 (66.7)	1 (33.3)	0.96 (0.76–1.16)	0.87 (0.67–1.07)
Primary	43 (56.6)	33 (43.4)	0.7 (0.5–0.9)	1.23 (1.03–1.43)
Secondary	50 (44.2)	63 (55.8)	1.05 (0.85–1.25)	0.84 (0.64–1.04)
College/University	19 (61.3)	12 (38.7)	1.79 (1.59–1.99)	1.99 (1.79–2.19)*
Parity				
1–2	62 (41.6)	87 (58.4)	1.13 (0.93–1.33)	0.61 (0.41–0.81)
≥ 3	46 (62.2)	28 (37.8)	0.89 (0.69–1.09)	1.27 (1.07–1.47)
Marital status				
Single	15 (50.0)	15 (50.0)	0.82 (0.62–1.02)	0.53 (0.33–0.73)
Married	68 (35.2)	125 (64.8)	1.18 (0.98–1.38)	1.32 (1.12–1.52)*
Income (monthly)				
Less than 500,000 TZS	32 (46.4)	37 (53.6)	1.14 (0.94–1.34)	1.12 (0.92–1.32)
500,000 - 1,000,000 TZS	30 (57.7)	22 (42.3)	1.07 (0.87–1.27)	0.59 (0.39–0.79)
1,000,000 - 2,000,000 TZS	30 (57.7)	22 (42.3)	1.01 (0.81–1.21)	1.22 (1.02–1.42)*
2,000,000 - 5,000,000 TZS	29 (69.0)	13 (31.0)	1.35 (1.15–1.55)	1.45 (1.25–1.65)*
More than 5,000,000 TZS	4 (50.0)	4 (50.0)	0.96 (0.76–1.16)	0.79 (0.59–0.99)
Type of business				
Agricultural produce trader	17 (37.8)	28 (62.2)	0.94 (0.74–1.14)	1.03 (0.83–1.23)
Shopkeepers	87 (51.8)	81 (48.2)	1.62 (1.42–1.82)	2.06 (1.86–2.26)*
Restaurant operators	4 (40.0)	6 (60.0)	0.73 (0.53–0.93)	1.24 (1.04–1.44)*
Family size				
≤ 4	49 (36.3)	86 (63.7)	1.97 (1.77–2.17)	1.43 (1.23–1.63)*
≥ 5	58 (65.9)	30 (34.1)	0.66 (0.46–0.86)	0.94 (0.74–1.14)

*Indicate significant at p value less than 0.05 in multivariable logistic analysis

Marital status was significant with married women more likely to achieve adequate dietary diversity than single women (AOR=1.32, 95% CI: 1.12-1.52). Monthly income influenced dietary diversity in two categories; respondents earning 1,000,000-2,000,000 TZS (AOR=1.22, 95% CI: 1.02-1.42) and 2,000,000-5,000,000 TZS (AOR=1.45, 95% CI: 1.25-1.65) were more likely to have adequate diversify reflecting the role of economic capacity in accessing a variety of foods.

Type of business was significant associated with dietary diversity, shopkeepers (AOR=2.06, 95% CI: 1.86-2.26) and restaurant operators (AOR=1.24 95% CI: 1.04-1.44) had higher adds of achieving adequate dietary diversity compared to agricultural produce traders.

Family size showed a significant effect, household with ≤ 4 members had higher odds of adequate dietary diversity (AOR= 1.45, 95% CI: 1.23-1.63) compared to large households, indicating that smaller families may have better capacity to access and consume a variety of foods.

4. DISCUSSION

4.1 Socio-demographic Characteristics of the Respondents

The study found that the majority of respondents are young adult females aged 20–35 years, a group commonly representing the reproductive age. This age group is more likely to be pregnant compared to women aged 36+ who may have completed their child bearing years or have fewer pregnancies due to biological, health or personal factors. This finding is consistent with (WHO, 2023), which identifies women in this age range as being at the peak of their reproductive year. Similarly Chipako (2024) reported that majority of pregnancies occur among women aged 20-35 years, reflecting both biological fertility patterns and sociocultural norms around marriage and childbearing.

Educational attainment among this population was moderate, with nearly half having completed secondary education; however, a notable minority lack formal education. This limited education access may be attributed to economic constraints, early marriage and cultural norms. Also education generally equips individuals with better nutritional knowledge and resource management skills. This finding was similar to

study conducted by Ameye (2023) suggesting that education equips women with nutrition knowledge and ability to make informed dietary decision.

The study revealed that most respondents are married and actively engaged in small-scale entrepreneurial activities, such as operating shops and agricultural produce trader. This can be possibly be explained by the fact that married women often assume a central role in ensuring household food security and meeting daily family needs. Small scale business provide them with flexible income generating opportunities that can be balanced with domestic duties. This align with study conducted by Habtemariam et al.(2021) show that married women are engaged in business as a driving factor for seeking additional income to cater for family needs.

Additionally, women were dominating small holder agriculture producer making them as a key player in trading their post-harvest produce. Despite this socioeconomic engagement, many earn less than 500,000 TZS per month, which falls below Tanzania's minimum wage indicating economic vulnerability. A study by Minja et al. (2021) highlights low profits and significant challenges faced by women entrepreneurs in Tanzania's informal sector limit their income potential hence reducing their ability to invest in improved livelihoods and better nutrition for their household.

4.2 Dietary Diversity Scores for Pregnant Business Women

The study showed that more than half of the pregnant business women had inadequate dietary diversity while less than half achieved adequate dietary diversity indicate that at the start of the study, the general DDS was relatively low, with the majority of women not meeting the recommended variety of food groups necessary for balanced nutrition, such pattern suggests potential risks of micronutrient deficiencies and poor maternal health outcomes which could affect both the mothers and their unborn children. The low baseline DDS linked to factors such as limited income, low nutrition awareness, cultural food preference, seasonal food availability and constraints related to women's economic roles in the informal sector. This is consistent with findings from Huang et al. (2018) who reported that about 40% of mothers in Dodoma lacked diverse diets due to limited access to variety of food and seasonal food availability.

On other hand the positive shift in dietary diversity categories among pregnant business women at endline with the majority demonstrating adequate dietary diversity for women. The reason was changed of mother meal when mothers delivery. Previously studies showed that an increase of adequate dietary diversity during postpartum period occurs because women's bodies are healing, and if they are breastfeeding, they need more energy and nutrients to produce sufficient milk. This naturally leads to eating more and possibly a wider range of foods, as long as they have access to them (Killel et al., 2024). Similarly study reported that postnatal period, women often get more support from family and have better access to health information through clinic visits (Rees & Brough, 2025).

4.3 Dietary Intake among Pregnant Business Women

The most respondents' dietary intake during the baseline were dominated by grains, white roots and tubers because these foods are affordable, easy to store and culturally accepted as the main meal base in many Tanzania household. A study by Haug et al. (2023) show that staples starch was dominated diets in the region due to their accessibility and low cost. The low consumption of nutrient dense food attributed by seasonal fluctuations in food supply and high market price. These trends align with previous research which showed that staple foods like maize and cassava, often eaten as stiff porridge (ugali) with leafy vegetables and legumes dominate Tanzanian diets (Habtemariam et al., 2021). Limited consumption of food group could be due to seasonal availability, affordability, and access. According to Zegeye et al. (2024) food price and related seasonality factors affect the dietary choices of low-income farm households in rural Tanzania. Similarly study supported by Killel et al. (2024) reports that economic constraints are a major barrier to accessing diverse and nutrient dense foods in low-income communities. Fruits and vegetable consumption was also limited because of seasonal availability and low awareness of their health benefits during pregnancy. These align with study found that seasonal production pattern influence the frequency of fruit and vegetable consumption among pregnant women (Lema, 2022).

On the other hand at endline show increase dietary intake of food, likely happened due to that women may have learned more about healthy

eating during their antenatal (pregnancy) care visits. Also, their bodies may have needed more nutrients after giving birth and they had better support from their families or community when it came to food. This line with previous study focusing on nutrition services offered in ANC clinics identified nutrition education and dietary assessment as commonly provided services (Saronga et al., 2020). This was due to that antenatal care provide a structured platform for health professional to delivery nutrition education, increasing women's knowledge and potentially influencing their food choices. Additionally improvement can be attributed to various factors, including increased access to diverse foods leading to more balance and varied diets among the participants. This supported by Lema (2022) women consumption of food increases significantly when there is greater access to a variety of food group particularly animal source foods, fruits and vegetables.

4.4 Factors Influencing Minimum Dietary Diversity

The findings of both baseline and endline logistic regression analyses revealed that several factors were found to significantly influence Minimum Dietary Diversity (MDD) among pregnant business women in Tunduma. These factors including age, education, income, type of business and family size while some factors such as parity and marital status at baseline, certain income categories and some education levels not significant association. The present study showed that respondents aged 19-35 years were more than twice likely to have adequate dietary diversity compared to other group at baseline data. This could be because this age is often in their most economically productive years enabling them to afford a wider variety of foods. On the other hand at endline older respondents showed higher odds this due to that could have benefited from long term financial security and household control over food purchase. This can be supported by a study Heri et al. (2024) found that age influenced dietary diversity with both young and older adults adopting better diversity when they had stable income and business engagement.

Additionally, the result of the current study indicated that, secondary education level were more likely to have adequate dietary diversity during baseline while at endline college/university education had nearly double the odds of achieving MDD. This finding aligns

with evidence that high education level correlates with greater health literacy and nutritional knowledge (Zegeye et al., 2024). Similarly, Ameye (2023) reported that pregnant women with secondary education or higher were significantly more likely to meet MDD, suggesting that formal education empowers women with the knowledge necessary to make healthier food choices.

Moreover, marital status was found to have an influence particularly at baseline. Married women were more likely to have adequate dietary diversity compared to unmarried women. This was attributed by the combined economic and social support provided within a marriage. A shared household income often increases the budget available for food purchases, thereby enabling access to a wider variety of items. Additionally, partners support during pregnancy can reduce the physical and emotional burden, indirectly improve access to and preparation of nutritious meals. It has also been documented that household structures and partner support significantly shape women's dietary Lema (2022), while Minja et al. (2021) further found that married women scored higher dietary diversity due to enhanced household economic stability and food security.

Furthermore income demonstrated strongly and consistent association with dietary diversity at both baseline and endline. Women with higher incomes can afford a greater variety of foods particularly animal source food, fruits and vegetable that are essential for a diverse and nutrient rich diet. This observation is consistent with Killel et al. (2024) who confirmed that women's household income has a significant effect on dietary diversity. Their study concluded that economic status is a primary driver of dietary diversity, while inadequate diversity is often a direct result of lower income which limit access to a wider range of nutritious food groups (Killel et al., 2024).

The study found that type of business influenced MDD. Restaurant operators had higher dietary diversity at baseline while at endline shopkeepers and restaurant operators were more likely to achieve adequate dietary diversity. This was because these women are directly involved in the food supply chain, giving them easy and affordable access to a diverse range of food items. This was supported by study suggest that women who work with food are more likely to have food availability (Minja et al., 2021).

Another study support that women working in food vending business consumed more diverse diets due to direct access to various food items (Ameeye, 2023).

The findings showed that family size also influencing dietary diversity at both baseline and endline, this can possibly be explained by the fact that smaller families may distribute food resources more effectively reducing per capital food constraints. Conversely large families tended to have lower dietary diversity as resources were stretched and staple foods were often prioritized over variety. This supported by study found that large households had lower dietary diversity due to the strain on resources and prioritization of staple foods over variety (Mesfin et al., 2023).

5. CONCLUSION

The study conclude that pregnant business women are at risk of micronutrients deficiency. This finding can be better understood in the context of limited availability and affordability of micronutrient rich foods during the baseline period. Seasonal fluctuations in food supply particularly for fresh fruits, vegetable and animal source food, may have restricted access to these essential food groups. Additionally high market prices for nutrient dense foods such as meat, eggs, dairy products and certain vitamin A rich fruits likely reduced consumption especially among women with lower income. This combination of market constraints and economic limitations contributed to inadequate dietary diversity thereby increasing the risk of micronutrients deficiencies in pregnant business women.

6. RECOMMENDATION

Healthcare providers particularly those offering antenatal and postnatal services, must integrate comprehensive nutritional education and counseling specifically on health eating before pregnancy. This counseling should empower women with practical strategies for achieving diverse diets. Government and community organizations should provide accessible, affordable and culturally appropriate food resources, while also offering educational nutrient dense foods and meal planning.

Ministry of Trade and Industry in Tanzania, Tanzania Bureau of Standards (TBS) and other stakeholders provide subsidies or regulate price

of nutrient dense foods such as eggs, milk, fish, meat and vitamin A rich food.

Also government should consider and improve fortification especially bio fortification and policies that support flexible work arrangements and access to healthy food options, development an environment conducive to optimal maternal nutrition before becoming pregnant, thereby ensuring the continued positive impact on both maternal and infant health.

7. LIMITATIONS

The study faces significant limitations due to seasonal variations and food shortages that limited food availability of some food groups during the study. The main challenge included non-availability of some foods during some seasons which affects the variety and quantity of food availability.

ETHICAL APPROVAL

Ethical approval was obtained from the National Institute for Medical Research (NIMR/HQ/R.8a/Vol.IX/5013) while permission to undertake the study was obtained from Sokoine University of Agriculture (SUA/ADM/R.I811346). Written informed consent was obtained for all subjects. Permission was also obtained from relevant administrative offices. Data confidentiality and privacy were maintained throughout the research process.

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DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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