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Research Article

Factors associated with diet adequacy among women attending antenatal care in the conflict-affected Kumba Municipalities, Cameroon

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Highlights/Key Messages

- Only 24.4 % of the pregnant women managed to eat a diverse diet, which is essential for the maintenance of their health and that of their children against malnutrition.
- The majority of the pregnant women consumed highly calorie-dense foods such as grains, roots and tubers while rarely eating nutrient-rich foods such like eggs, fruits and dairy products.
- The pregnant women who received antenatal care consumed more healthy and diverse diets.

Background
Pregnant women require adequate, balanced nutrient intake for their own health and to support healthy fetal growth. Studies assessing the factors affecting nutritional outcomes among pregnant women in Cameroon remain scarce.

Objective
This study aimed to assess the dietary practices, nutritional adequacy, and factors associated with diet quality among women attending antenatal care in the main hospitals of Kumba.

Methods
A cross-sectional study was conducted in the main hospitals of Kumba where 135 women attending ANC were recruited to participate in the study. The dietary diversity of respondents was assessed through a 24-h dietary recall survey, and mid-upper arm circumference was measured. Data were analyzed using SPSS version 26.0. Independent determinants of minimum dietary diversity (MDD) were identified using a two-stage approach: binary logistic regression screening followed by multivariable logistic regression analysis. Statistical significance was set at $P < 0.05$.

Results
The prevalences of underweight and overweight were 12.5 and 3.7%, respectively. The MDD was low, with only 24.4% of respondents having a high MDD. The staple food of the majority consisted of grains, white roots and tubers. Compared to the recommended dietary allowances, fiber, iron, folate, and vitamin A intakes were inadequate for most participants. Higher educational attainment, attending at least three ANC follow-ups during the first trimester of pregnancy, having a paid job, and high nutrition knowledge were significantly associated with MDD.

Conclusions
Pregnant women in Kumba exhibited poor diet quality and risk for micronutrient deficiencies largely driven by heavy reliance on starchy staples. Effective interventions must prioritize early nutritional counseling during antenatal visits and socioeconomic empowerment to ensure diversified diets and optimal fetal development.

Keywords: dietary diversity scores, nutrient intakes, antenatal care, pregnant women.

Introduction

All human beings require optimal nutrition and a balanced intake of nutrients for essential metabolic processes and proper health. This is particularly important for pregnant women, as pregnancy is a dynamic and anabolic state, characterized by a series of modifications to permit the development of the fetus while maintaining maternal homeostasis and preparing for breastfeeding (King 2000). To facilitate these modifications, nutritional uptake may be improved by increasing dietary intake, increasing nutrient assimilation, decreasing renal clearance, and/or reducing excretion via the gastrointestinal tract. These modifications in nutrient metabolism are complex and occur continuously throughout pregnancy. An inadequate or poor-quality diet during pregnancy can have serious consequences on both the fetus and the mother. Maternal consequences include inadequate weight gain, the risk of complications, including severe bleeding during delivery, anemia, and progression toward suffering from high blood pressure, communicable diseases, stillbirths and fetal deaths during pregnancy, pre-term delivery, gestational diabetes, preeclampsia, and maternal mortality (Engle-Stone et al, 2018). It is difficult for a malnourished pregnant woman to give birth, and labor tends to be long, may be premature, and the need for cesarean sections tends to increase (Waryana, 2010). In the fetus or child, poor nutritional status during pregnancy can lead to miscarriage, premature birth, growth problems, abnormal birth weight; intra-uterine fetal growth retardation may have long-term consequences on newborn development or even the death of the newborn (Marmi, 2013).

Globally, nearly 10% of pregnant women are affected by malnutrition (Black et al, 2013), affected not only by poor dietary habits but also by social and psychological factors, dietary knowledge of mothers, and biological variations that affect perceptions of eating habits during pregnancy (Temesgen et al., 2015). Many other factors, such as place of residence, gestational age, antenatal visits, eating habits, intestinal infections, and dietary diversity, are also associated with the nutritional status of pregnant women (Shiferaw & Husein, 2019; Sserwanja & Kawuki).

In Sub-Saharan Africa, approximately 24% of pregnancies are affected by malnutrition (Yifru & Asres, 2014). Undernutrition, high-energy expenditure, micronutrient-deficient diets, and the demands of pregnancy and lactation contribute to maternal malnutrition. In Cameroon, 7% of children weigh less than 2.5 kg at birth, and in the northern part of the country, children with low birth weight represent 63.2% of children under 5 years old suffering from long-term malnutrition (INS, 2020).

Kumba Municipalities are located in the South West region of Cameroon, which is still facing the so-called Anglophone Crisis, an armed uprising which is drastically affecting the nutritional status of the population. There is a lack of data on the status of malnutrition and its associated factors, particularly for pregnant women. Hence, this study was conducted to assess the dietary practices, nutritional adequacy, and factors associated with diet quality among pregnant women attending antenatal care in the main hospitals of Kumba, South West Region, Cameroon.

Methods

Study Area

Kumba is a cosmopolitan city in the Meme Division, South West Region, Cameroon (Figure 1). The largest city in the Meme Division, Kumba has a population of about 327,000 (Melle & Ewane, 2015). Since 2016, the regions of the North West and South West of the country, including Kumba Municipalities, have been faced with an armed secessionist insurgency. The resulting violence has triggered a severe and escalating crisis, affecting food security in those regions. According to the World Bank Group (2021), this crisis has amplified poverty levels, damaging livelihoods and human capital conditions in both affected and bordering regions.

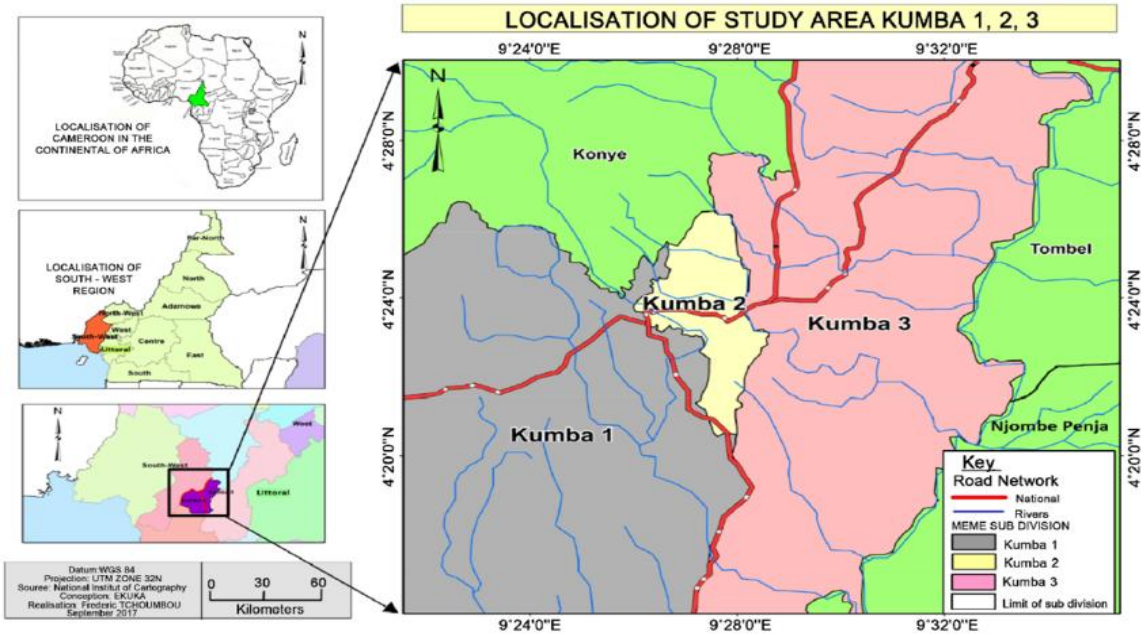


Figure 1: Location of Kumba I, II, and III (study areas) in the Meme Division, Southwest Cameroon

Study Design

A facility-based, cross-sectional, and analytical study was conducted to assess the dietary intake and nutritional status of pregnant women attending antenatal care at the three main hospitals in Kumba: the Kumba Regional Hospital Annex and the Kumba District Hospital, which are public hospitals and the St. John's Integrated Health Centre Fiango, which is a private hospital. The study was carried out in March 2023.

Study Population

All pregnant women attending antenatal visits at any of the three main hospitals in Kumba in March 2023 were eligible to be invited to participate in the study if selected, if they expressed their willingness to participate by providing written informed consent, if they indicated that they were at least in their second trimester of pregnancy, and if they had resided in Kumba for at least the last six months. The study excluded participants with chronic illnesses and those enrolled in supplementary feeding programs, as these interventions could be associated with nutritional status and dietary habits, thereby biasing the results.

The Cochran formula was used to estimate a single population proportion (Israel, 1992), based on an estimate of 89.6% for the proportion of pregnant women who are malnourished. Though this is based on women with malaria (Jugha et al, 2021), it is the only estimate available. According to the heads of the ANC units at the participating hospitals, the total monthly attendance was estimated at 529, comprising 196 from Kumba Regional Hospital Annex, 176 from St John Catholic Health Centre, and 157 from Kumba District Hospital. This results in a desired sample size of 123, increasing to 135 when a 10% contingency is added. The sample size was allocated to each health center proportionally based on their average monthly patient volume: that is, 50 from Kumba Regional Hospital Annex, 45 from Kumba District Hospital, and 40 from St John Catholic Health Centre. A systematic sampling interval of 3 was set for samples at each hospital. The first respondent was selected by lottery, and then every third attendee was chosen until the target sample size was met.

Ethical Considerations

The study protocol was approved by the ethics review committee of the Faculty of Health Sciences Institutional Research Board of the University of Buea, Cameroon, under reference 2022/1866-01/UB/SG/IRB/FHS. All participants provided informed consent. The study was conducted in accordance with the Declaration of Helsinki. Administrative authorization from the directors of all three hospitals was also obtained.

Assessment of nutritional status

To determine nutritional status, mid-upper arm circumference (MUAC) was measured. These measurements were taken in triplicate to the nearest 0.1 cm at the mid-point between the tips of the shoulder and elbow of the left arm using non-stretchable standard MUAC tape. Participants were classified as undernourished when their MUAC was <23 cm. They were considered well-nourished when their MUAC value was 23-33 cm, and obese or overweight when their MUAC value was >33 cm (Okereke et al., 2013).

Assessment of socioeconomic characteristics, dietary intake, and dietary diversity

Each pregnant woman who met the eligibility criteria was invited to a face-to-face interview with trained interviewers. The questionnaire was divided into three sections. Section "A" contained questions on socioeconomic characteristics (age, level of education, marital status, main occupation, and income level). Section "B" focused on 24-h recall and dietary diversity, and Section "C" assessed the nutritional knowledge of participants.

Current dietary intake was assessed using a 24-hour dietary recall administered on weekdays during ANC follow-up visits. The participants were asked to recall and report, in chronological order, the quantities of all foods and beverages consumed during the previous 24 hours, using local household measurements. Local household utensils were presented to participants to facilitate estimating the portion sizes of the food consumed. Nutrient and energy intakes were determined using the West African Food Composition Table (Vincent et al., 2020). The nutrient values were compared with the RDAs for pregnant women for energy and each nutrient, as outlined in the dietary reference intakes recommended by the US Institute of Medicine (IOM) (Iglesias et al., 2019). Since antenatal micronutrient supplements (e.g., iron and folic acid) were excluded from this analysis, our findings reflect dietary nutrient intake only, rather than total nutrient exposure. The following categories were defined to assess the adequacy of the RDA: excessive intake when the percentage RDA was >120%, adequate intake when the percentage RDA was 80-120% and inadequate intake when the percentage RDA was <80%.

Minimum dietary diversity (MDD) was derived from the 24-h recall questionnaire. MDD was calculated by accounting for the different food groups consumed by participants over a 24-hour period (FAO, 2021). Each food and beverage consumed in the past 24 hours was recorded only when the consumed amount exceeded 15 g. Foods were classified into 10 distinct groups according to FAO recommendations: (i) grains, white roots and tubers, and plantains; (ii) pulses; (iii) nuts and seeds; (iv) milk and milk products; (v) meat, poultry, and fish; (vi) eggs; (vii) dark green leafy vegetables; (viii) carotene-rich fruits and vegetables; (ix) other vegetables; and (x) other fruits. Food groups consumed received a score of 1. The MDD was estimated by summing the food groups consumed. The cumulative Dietary Diversity Score was then used to create a dichotomized outcome variable: high dietary diversity (≥5 food groups) and low dietary diversity (<5 food groups) (Saaka et al., 2021).

Assessment of nutrition knowledge

Nutrition knowledge was evaluated using questions drawn from comparable studies on "nutrient requirements",

"dietary adjustments", "weight management and physical activity", "maternal diet and fetal health connection", and "food safety and symptoms". Participants indicated whether each statement was true or false, and their scores were computed to determine their overall nutrition knowledge. Participants were classified into three categories according to their total scores. Pregnant women were considered to have "low knowledge" when the percentage of correct answers was <60%, "moderate knowledge" when 60-79%, and "high knowledge" when >80% (Kitaw et al., 2023).

Data Analysis

All data collected were entered into Microsoft Excel (MS Excel 2016) and cleaned for entry errors. Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 20.0. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to describe socioeconomic characteristics and nutritional status. To identify the independent determinants of MDD, we employed a two-stage modelling approach. First, we conducted a crude binary logistic regression to screen all potential factors individually. Variables demonstrating a statistically significant association with dietary diversity ($p < 0.05$), along with established covariates from the literature, were subsequently dichotomized and entered into a multiple logistic regression model.

Results

Socioeconomic Characteristics, Nutritional Knowledge, and Nutritional Status

Table 1 presents the socio-economic characteristics, nutritional knowledge, and nutritional status of the study participants. Economically, the cohort is highly diversified; educational attainment is relatively high for Cameroon. MUAC indicated that most participants had normal nutritional status.

Table 1. Socio-economic characteristics of the participant women attending antenatal care in three major hospitals in the Kumba Municipalities (N=135)

	Frequency	Percentage
Age (years)		
15-19	14	10.3
20-24	41	30.3
25-29	33	24.4
30-34	22	16.2
35-39	18	13.3
⩾40	7	5.1
Main occupation		
Student	17	12.5
Housewife	46	34.0
Government employ	16	11.8
Merchant	37	27.4
Farmer	19	14.0
Education		
Primary education	44	32.5
Secondary education	62	45.9
Higher education	29	21.4
Marital status		
single	43	31.8
Married	92	68.1
Level of income (x 1000 F.CFA*)		
< 50,000	23	17.0
50000 – 150,000	41	30.3
150000-250,000	32	23.7
250000-350,000	28	20.7
⩾350000	11	8.14
Number of ANC visits at 3 months of pregnancy		
ANC visits < 3	98	72.5
ANC visits ⩾ 3	37	27.4
Nutritional knowledge		
Low knowledge	53	39.2
Moderate knowledge	62	45.9
High knowledge	20	14.8
Nutritional status		
Undernourished (MUAC<23cm)	17	12.5
Well-nourished (MUAC 23 - 33cm)	113	83.7
Overweight or obese (MUAC >33 cm)	5	3.7

* 1 USD= 567 F.CFA at the time of the survey

Minimum Dietary Diversity

Table 2 shows the proportion of pregnant women consuming different food groups daily. This table also displays the status of those pregnant women according to their MDD. Out of the 10 food groups, all participants reported daily consumption of grains, white roots, and tubers. The second most commonly eaten foods were the dark green leafy vegetables group, with 52.6% of participants consuming them daily. Only 9 pregnant women consumed foods in the "milk and milk products" group. The study also revealed that the MDD was 4 ± 0.09, with scores ranging from 1 to 6 food groups daily. Minimum dietary diversity (⩾5 food groups) was achieved by 24.4% of respondents, while the rest were in the low MDD category (<5 food groups).

Table 2. Food groups consumed during the previous 24 hours and minimum dietary diversity scores of pregnant women attending antenatal care in three major hospitals in the Kumba Municipalities (n = 135)

Food groups	Frequency (n)	Percent (%)
Grains, white roots and tubers, and plantains	135	100.0
Pulses	22	16.3
Nuts and seeds	25	18.5
Milk and milk products	9	6.6
Meat, poultry, and fish	68	50.3
Eggs	15	11.1
Dark green leafy vegetables	71	52.5
Vitamin A-rich fruits and vegetables	15	11.1
Other vegetables	20	14.8
Other fruits	22	16.3
Minimum dietary diversity scores		
Low MDD	102	75.5
High MDD	33	24.4
Mean ±SD		4 ± 0.09

MDD=minimum dietary diversity; Low MDD=An MDD score of <5 food groups, High MDD=An MDD score of ⩾5 food groups

Nutrient intakes based on 24-hour recall

Table 3 presents the mean energy and macronutrient intakes and their adequacy during pregnancy, expressed as percentages of the RDAs. Among all the variables assessed,

only the mean carbohydrate intake (267.3 g/day) exceeded the RDA (175.0 g/day).

Table 3. Total 24-hour intake of energy, water, and macronutrients of pregnant women attending antenatal care in three major hospitals in the Kumba Municipalities (n = 135)

Energy and macronutrient intake	Mean ±SD	RDA	Excessive intake n(%)	Adequate intake n(%)	Inadequate intake n(%)
Energy (kcal/day)	1972 ±637.5	2300	19(14.1)	49(36.3)	67(49.6)
Water (ml/day)	2214±681.7	2500	15(11.1)	64(47.4)	56(41.4)
Protein (g/day)	50.4±23.6	71	46(34.1)	40(29.6)	49(36.3)
Fat (g/day)	74.5±32.8	ND			
Carbohydrate (g/day)	267.3±101.7	175	91(67.4)	34(25.1)	10(7.4)
Fiber (g/day)	26.0±20.1	28	23(17.0)	62(45.9)	50(37.0)

RDA: recommended dietary allowance. SD: standard deviation; Excessive intake: >120% of RDA; Adequate intake: 80- 120% RDA; Inadequate intake: <80% RDA.

As detailed in Table 4, our sample of pregnant women attending antenatal care in Kumba faced widespread, severe risks of micronutrient deficiencies, particularly for calcium, iron and folic acid. (However, many were taking iron/folic acid tablets.)

Table 4. Micronutrient intake of pregnant women attending antenatal care in the main hospitals in the Kumba Municipalities based on a 24-hour recall (n = 135)

Micronutrient intake	Mean±SD	RDA	Excessive intake n(%)	Adequate intake n(%)	Inadequate intake n(%)
Calcium (mg/day)	350.2±204.7	1000	0(0.0)	3 (2.2)	132(97.7)
Iron (mg/day)	11.3±4.2	27	0(0.0)	0(0.0)	135(100.0)
Magnesium (mg/day)	285.1±145.5	350	20(14.8)	36(26.6)	79(58.5)
Phosphorus (mg/day)	812.8±474.8	700	50(37.0)	43(31.8)	42(31.1)
Potassium (mg/day)	2766.9±1800.7	4700	17(12.5)	18(13.3)	100(74.0)
Zinc (mg/day)	7.4±3.7	7	52(38.5)	35(25.9)	48(35.5)
Vitamin A (µg/day)	647.1±472.9	800	41(30.3)	4(2.9)	90(66.6)
Vitamin D (µg/day)	11.7±16.5	5	47(34.8)	4(2.9)	84(62.2)
Vitamin E (mg/day)	5.7±4.0	15	6(4.4)	15(11.1)	114(84.4)
vitamin B1 (mg/day)	0.8±0.7	1.4	18(13.3)	17(12.5)	100(74.0)
Vitamin B6 (mg/day)	1.1±0.7	1.6	42(31.1)	26(19.2)	67(49.6)
Folic acid (µg/day)	76.7±57.3	600	0(0.0)	0(0.0)	135(100.0)
Vitamin B12 (µg/day)	3.4±2.9	2.6	48(35.5)	3(2.2)	84(62.2)
Vitamin C (mg/day)	66.4±47.5	55	60(44.4)	22(16.3)	53(39.2)

RDA: recommended dietary allowance. SD: standard deviation; Excessive intake: >120% of RDA; Adequate intake: 80-120% RDA; Inadequate intake: <80% RDA.

Factors associated with minimum dietary diversity

Minimum dietary diversity among sample women was significantly and positively associated with higher education levels [AOR=23.6, 95% CI (7.5-77.2)]. Those who had at least three antenatal care checkups during their first trimester were much more likely to have a diverse diet. Those with high nutrition knowledge had higher odds of attaining adequate dietary diversity [AOR=9.7, CI (2.0-45.9)]. Additionally, well-nourished participants had 9.7 times higher odds of eating more than 5 food groups per day compared with undernourished pregnant women [AOR=9.7, CI (1.2-78.3)].

Table 5. Factors associated with minimum dietary diversity among pregnant women attending antenatal care in the main hospitals in the Kumba Municipalities (n = 135)

Variables	Category	MDD		COR	AOR	*P* values*
		Low (n)	High (n)	(95% ; CI)	(95% ; CI)	
Education	Lower education	95	11	1.00	1.00	
	Higher education	7	22	27.1(9.4-77.9)	23.6(7.5-77.2)	0.000
Number of ANC visits	ANC visits < 3	84	18	1.00	1.00	
	ANC visits ⩾ 3	16	17	4.9(2.1-11.6)	7.6(2.1-26.9)	0.002
Nutritional knowledge	Low knowledge	54	7	1.00	1.00	
	High knowledge	48	26	4.1(1.6-10.4)	9.7(2.0-45.9)	0.004
Nutritional status	Undernourished	12	5	1.00	1.00	
	Well-nourished	90	28	0.7(0.2-2.3)	9.7(1.2-78.3)	0.031

* CI=Confidence Interval; COR=Crude Odds Ratio; AOR=Adjusted Odds Ratio; MDD=minimum dietary diversity, Low MDD=An MDD score of <5 food groups. High MDD=an MDD score of ⩾5 food groups

Discussion

Only 24% of the pregnant women achieved an adequate or high dietary diversity score. A similar MDD score of 3.5 ± 0.8 was reported by Jugha et al. (2021) in the conflict-affected Mount Cameroon area of the South West Region, Cameroon, and others elsewhere (Desta et al., 2019; Samuel et al., 2020), who respectively obtained the prevalence of adequate dietary diversity of 24.5 and 20.1% among pregnant women in different locations in Ethiopia. In contrast, studies conducted by Tolesa et al. (2022) in Ethiopia and by Kiboi et

al. (2017) in Kenya revealed a substantially higher proportion of the population (42.1%) meeting minimum dietary diversity standards. The differences in these results might be attributed to geographic location, study setting, sociodemographic characteristics of the study participants, seasonal and temporal factors, and the availability and affordability of foods. Furthermore, the population of the study area (Kumba) has been facing a socio-political crisis since 2017, which has disrupted agricultural activities, restricted market access, and reduced household purchasing power, thereby increasing food insecurity (World Bank Group, 2021).

The least consumed food group was "milk and milk products", with only 6.6% of the sample population eating it during the previous 24 hours. Starchy foods and dark green leafy vegetables were the most consumed food groups, with 100% and 52% of participants consuming those foods, respectively. This was similar to others reported in Ethiopia (Kiboi et al., 2017) and Kenya (Shenka et al., 2018). However, in Wondogenet, Ethiopia, only 41.8% of the pregnant women ate starchy foods daily (Desalegn et al., 2015). This discrepancy may be attributed to differences in traditional cuisine and regional disparities in cereal production.

The identification of factors associated with dietary diversity was another main objective of this study. Higher education level, attending at least three ANC follow-ups during the first trimester of pregnancy, high nutrition knowledge, being married, and having a normal MUAC were factors positively and significantly associated with minimum dietary diversity. Findings by Tolesa et al. (2022) and Shrestha et al. (2021) were similar among pregnant women in Ethiopia and Nepal, respectively. In theory, regular prenatal check-ups allow for monitoring of the mother's nutritional status and timely intervention if dietary diversity is found to be insufficient (Heri et al., 2024; Mohammed et al., 2023; Hidru et al., 2020), but we did not assess this. Single women may also have higher dietary diversity scores in some studies, highlighting the complexity of this relationship (Olatona et al., 2021).

Mean intakes for energy, water, protein, fiber, and most micronutrients were below the RDAs. This inadequate intake is likely related to low incomes, limited education, and food insecurity, all of which are exacerbated by the ongoing security crisis in the region. Inadequate intakes and nutritional deficiencies are widespread throughout sub-Saharan African countries (Zegeye et al., 2024; Janmohamed et al., 2024).

Requirements for all nutrients increase during pregnancy, as well as for water and fiber because of the increase in uterine weight and the reduction of bowel motility resulting from higher levels of progesterone (Armstrong & Johnson, 2018)

The low consumption of food groups such as milk and milk products (6.6%), eggs (11.1%), and Vitamin A-rich fruits and vegetables (11.1%) may contribute to low intakes of several vitamins and minerals. Our findings corroborate data from Kenya and Ethiopia, indicating widespread micronutrient deficiencies among pregnant women in sub-Saharan Africa, particularly in iron, calcium, and folate (Kiboi et al., 2017; Shenka et al., 2018).

Strengths and limitations of the study

The key strength of the study was the simultaneous collection of data on the minimum dietary diversity score, participants' socioeconomic characteristics, nutritional knowledge, nutritional status, and nutrient intake using validated, reliable questionnaires. Nevertheless, some limitations must be acknowledged. Dietary assessment through questionnaires is subject to recall and other biases, especially for unhealthy foods. As a cross-sectional analysis, the study may have limited ability to illustrate the current state of seasonal fluctuations in food supply in the study area, and it cannot establish a causal relationship between the determinants we identified and improved dietary diversity. Finally, the study faces sample size constraints that limit sub-analyses, leading to statistical imprecision and wide confidence intervals.

Conclusions

We found that the mean MDD of pregnant women attending ANC at the three main hospitals of the municipalities of Kumba was 4, with 75.5% suffering from inadequate dietary diversity practice. We found this to be associated with education level, the number of ANC visits during the first trimester of pregnancy, nutritional knowledge, and nutritional status, as measured by MUAC. This poor dietary diversity was in turn likely a major cause of the inadequate intakes of both macronutrients and micronutrients we found in a 24-hour recall. To improve maternal nutrition in a crisis-affected area like Kumba, interventions must focus on targeted nutritional education during early ANC visits, financial empowerment strategies, and accessible counseling to diversify diets beyond traditional locally available starchy staples.

Author Contributions

AGSK, FE and EF contributed to the conceptualization, overall study design, and provided supervision. AGSK, JIM and EMB contributed to the methodology. JIM and EMB conducted the investigation and field data collection, data curation, data analysis, and visualization of results. AGSK wrote the original draft of the manuscript, while EF, GA and FE contributed to the final draft and submission of the manuscript. All authors have read and approved the final version for publication.

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Data Availability Statement

Data are available upon reasonable request from the authors.

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Conflict of Interest

The authors declare that they have no conflicts of interest.

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