AFRICAN JOURNAL OF NUTRITION AND DIETETICS

https://doi.org/10.58460/ajnd.v4i01.144

Open Access

RESEARCH ARTICLE

MJM BIOLABS

Evaluation of Nutrition Knowledge and Dietary Practices of Pregnant and Lactating Adolescents in Turkana South Sub- County

Namuya Benjamin[1*], Charlotte Serrem[1], Heka Kamau[1]

Authors' Affiliation

[1] Department of Consumer Sciences, University of Eldoret, Kenya

*Corresponding Author: namuyab@gmail.com

Article History
Submitted: 29th March 2025
Accepted: 16th April 2025
Published Online: 9th August 2025

To read this paper online, please scan the QR code below:

ABSTRACT

Pregnant and lactating adolescents have increased nutritional needs due to physiological changes and fetal or neonatal demands. Despite the nutritional implications of pregnancy among adolescents, most of them often do not meet their daily requirements due to various factors, especially among marginalized communities such as the Turkana community. Despite these challenges, limited studies have examined the factors influencing dietary practices in marginalized populations such as the Turkana County. The current study, therefore assessed the nutrition knowledge, dietary practices, and factors affecting pregnant and lactating adolescents in Turkana South sub-county. The study adopted a cross-sectional design and multistage sampling technique to select 384 pregnant and lactating adolescents. Data were collected using questionnaires evaluating mothers' nutrition knowledge about breastfeeding practices, complementary feeding, consistency of meals, dietary diversity, and feeding practices, and analysed using GenStat version 18.0. The results indicated that most respondents were unemployed (62.3%), and their households were in the poorest quintile (71.5%), negatively affecting their dietary diversity. It was also noted that most of the respondents had no formal education (44.4%) and had low nutrition knowledge (67.3%), which directly affected their dietary diversity ($p < 0.05$). Most respondents did not meet their daily caloric intake (725.06 and 805.29 kcal for pregnant and lactating women, respectively) and other vital minerals including calcium and iron, vital during pregnancy and lactation. Improving general and nutrition-specific education among adolescent mothers may enhance dietary practices, supporting maternal and infant health.

Keywords: Nutrition knowledge, dietary practices, pregnant and lactating adolescents

How to Cite this paper: Namuya, B., Serrem, C., & Kamau, H. Evaluation of Nutrition Knowledge and Dietary Practices of Pregnant and Lactating Adolescents in Turkana South Sub-county. African Journal of Nutrition and Dietetics, 4(01). https://doi.org/10.58460/ajnd.v4i01.144

INTRODUCTION

Maternal nutrition, especially during reproductive age, is a key determinant of pregnancy outcomes are based since it helps strike a balance between a child's growth and the optimal health of the mother (Marshall et al., 2022). Dietary deficiency during this stage could result in pregnancy and birth-related complications (Barger, 2010; Weerasekara et al., 2020). The situation is even more critical for pregnant adolescents for their own growth and fetal development. Suboptimal dietary practices are prevalent among adolescent girls who engage in unhealthy eating habits such as consumption of nutrient-deficient foods, skipping meals, and lacking a proper eating pattern (Weerasekara et al., 2020). Cultural practices can also influence the nutritional health of pregnant women because certain societies prescribe or restrict certain foods based on cultural norms (Lokossou et al., 2021).

Numerous physiological changes during pregnancy and lactation, particularly during the second and third trimesters, the calorie need rises by around 300 kcal/day (Kominiarek & Rajan, 2016). However, the Recommended Dietary Allowance (RDA) for proteins during pregnancy is 60 g/day, which is an increase from 0.8 g/kg/day for women who are not pregnant, due to increased metabolic demands of pregnancy (USDA, 2020; Jouanne et al., 2021). Carbohydrates and fats during this state should constitute 45-64% and 20-25% of the daily caloric content, remain largely unchanged from non-pregnant levels (Abebe et al., 2014). Furthermore, various micronutrients are crucial during pregnancy, including iron, folic acid, calcium, vitamin B complex, and vitamin A (Jouanne et al., 2021). These micronutrients are essential for the growth and development of the foetus (Kominiarek & Rajan, 2016). Numerous variables influence food choices, and knowledge about and attitudes toward healthy nutrition play a significant role. Pregnant adolescent girls are at a crucial time in their reproductive lives; therefore, they must eat healthily to support favorable birth outcomes (Stewart et al., 2007).

The Kenya Demographic and Health Survey [KDHS] (2022) indicates that teenage pregnancy (TP) and motherhood rates are at 18%. The most affected age group is the 15- to 19-year-olds. An estimated 15% had been pregnant, 12% had given birth, and 3% were pregnant by 2022. The number of pregnancies increases with age, from 3 to 31% among 15- and 19-year-olds, respectively. Generally, 40% of teenagers who have been pregnant have no education compared to only 5% with higher than secondary education. Furthermore, adolescent girls from low-income households had a higher risk (21%) of becoming pregnant than their peers from affluent families, who had a lower (8%) risk (KDHS, 2022), thought the situation varies disproportionately by county.

One of the counties in Kenya with a high teenage pregnancy rate is Turkana, where around 18% of pregnant teens between the ages of 15 and 19 have been reported, above the national average of 12% (KDHS, 2022). Of these, 15% had a live birth and 4.4% were pregnant by 2022, which is well above the national estimate. Importantly, despite being the largest county in Kenya, Turkana is frequently affected by severe drought and famine (Oduor, 2012). Therefore, acute food and nutritional insecurity (81% of households experience food poverty) is experienced due to the wide gap between food requirements and supply (Frankenberger & Verduijn, 2011). Cultural practices and beliefs about food that have been associated with low socio-economic status and low school attendance (Mutea et al., 2022) exist in Turkana County, where 68.7% of persons aged three years and older have not received formal education (KNBS, 2019b). All of these factors can aggravate the nutritional status of vulnerable pregnant teens. This study examined how socio-economic factors, cultural practices, and nutrition knowledge influence dietary practices among pregnant and lactating adolescents in Turkana South Sub-County.

METHODS

Study Design

The study adopted a cross-sectional study design according to Tesfaye et al. (2024). The study was conducted from June to August 2023. All respondents were interviewed where their socio-demographic characteristics, nutrition knowledge, cultural practices and anthropometric measurements (weight, height and MUAC) were captured concurrently at the same time.

Study Location

The study was conducted in Turkana South Sub-County. The Kenya Housing Census of 2019 reports that the Turkana South sub-county covers an extensive area of 7,045 Km^2 with an estimated population of 153,736 (KNBS, 2019a). The sub-county has about 24,552 households, averaging 6 persons per household. The study involved all the five major wards namely Kalapata, Katilu, Kaputir, Lobokat and Lokichar in Turkana South Sub – County.

Study Population

The target population consisted of all teenage girls in the sub-county between the ages of 15 and 19, totaling 9,361 (KNBS, 2019a). A sample of 384 adolescent mothers was selected based on Fisher's (1999) formula. The study included all girls aged 15 and 19 years with pregnancy or lactation status who attendance at selected health facilities, and gave consent to participate.

Sampling Framework

The study adopted a multistage sampling technique (Sedgwick, 2015). The first technique

used was purposive sampling, where Turkana County was deliberately selected due to its high incidence of teenage pregnancy and acute food and nutrition insecurity. Turkana sub-County was preferred as the area of the study since most change-oriented programs such as the promotion of kitchen gardening and establishment of irrigation schemes have been initiated in this sub-County in the recent past by governmental and non-governmental organizations. Disproportionate sample distribution was used to divide the sample across the five wards. The health facilities in each ward were selected following simple random sampling and used as the entry points to get the study participants. Simple random sampling was also used to identify all adolescent girls falling within the inclusion criteria were identified to be part of the study.

Data collection tools and procedure

Primary data was collected using structured questionnaire, which was coded and hosted on the Kobo toolbox (Harvard, USA) platform for ease of administration by research assistants. Ten (10) enumerators with an understanding of nutrition and the local dialect were recruited and trained. The validity and reliability of the data collection instruments were piloted in Turkana Central before the actual data collection using 5% of the target population (Gezimu et al., 2022). The questionnaire contained seven questions that evaluated mothers' nutrition knowledge about breastfeeding practices, complementary feeding, consistency of meals, dietary diversity, and feeding practices. The responses to the questionnaires were converted to binary numbers; '1' and '0', where '1' represented the correct answer and '0' the wrong answer, denoted as 'I do not know' in the questionnaire (Matsumoto et al., 2020). Therefore, the mother's nutrition knowledge score was the total of her correct answers, which adds up to 7, her overall score. The nutrition knowledge of teen mothers was classified into two categories, low and high nutrition knowledge as scores of <3 and ≥4, respectively (Kajjura et al., 2019; Matsumoto et al., 2020). A semi-quantitative Food Frequency Questionnaire (FFQ) (Walter Willet, Harvard University) was used to evaluate adolescents' dietary habits and intake information. The enumerators recorded all the foods taken by the adolescents, portion sizes, and frequency.

Data Management and Analysis

Socio-economic and nutritional knowledge data was coded and analyzed using GenStat version 18.0. Fishers exact test was used to assess the association between the different variables in the study. Household wealth index of the respondents was determined using the principal component analysis (PCA), due to its ability to uncorrelated principal component through reduction of correlated factors (Tareq et al., 2021). All PCA assumptions were assessed using the Kaiser-Meyer-Olkin (KMO = 0.79) and Bartlett's test (p = 0.017). Wealth indicators such as electrical ownership of the home, animal ownership, energy sources, fuel, water, and sanitation facilities were incorporated into the model. The indicators were first analysed to exclude variables with a prevalence below 3-5% or higher than 95-97%. The factor analysis was then carried out, and the scores ranked into five quintiles describing the household's wealth status, with the first quintile representing the poorest and the fifth quintile representing the wealthiest (Shaukat et al., 2020). Results from the Household Dietary Diversity Score (HDDS) questionnaire were categorized into nine significant groups, as proposed by FAO (2007), to create the Women Dietary Diversity Score (WDDS). The semi-quantitative food frequency questionnaire results were grouped into the seven food categories proposed by the FAO (Kennedy et al., 2011). Microsoft Excel was used to categorize the participants' food group values and dietary diversity scores. Minimum dietary diversity was defined as consuming no more than 4 of the seven food groups specified in the previous month (Moura et al., 2020). Data on measuring portion sizes consumed from the FFQ was entered and analyzed using Nutri-Survey software (Version 20) to calculate the energy and nutrient intake for the pregnant and lactating mothers.

Ethical Considerations

The study sought ethical clearance from the Institute of Research and Ethics Committee (IREC), Mt. Kenya University, approval number **2003**. A research permit was also issued by the National Commission for Science, Technology and Innovation (NACOSTI), permit number **NACOSTI/P/23/28458**. Informed consent was sought from the mothers of the adolescents before the start of data collection.

RESULTS

Socio-economic Characteristics of Pregnant and Lactating Mothers

The respondents' socio-economic characteristics, including their education level, income level, and occupation, were recorded, and the results are presented in Table 1. Most respondents (44.4%) had no formal education, and only 6% had completed some tertiary training. Most respondents were also earned less than Ksh. 10,000 monthly (90.8%) and unemployed (62.3%).

Table 1:

Socio-economic Characteristics of the Respondents

Variable		Percentage (%)
Level of education	Complete primary	4.1
	Complete secondary	16.8
	Incomplete primary	17.9
	Incomplete Secondary	10.8
	No formal education	44.4
	Tertiary	6.0
Level of income	Below Ksh.10,000	90.8
	Ksh.11,000 - 20,000	4.9
	Ksh.21,000 - 30,000	0.8
	Don't know	3.5
Occupation	Self-employed	23.8
	Casual worker	12.2
	Formal employment	1.4
	Full-time student	0,3
	Unemployed	62.3

Household Wealth Index

The results of the household wealth index are presented in Figure 1. Most respondents (71.5%) were in the lowest quintile compared to only 1.6%, who were in the highest.

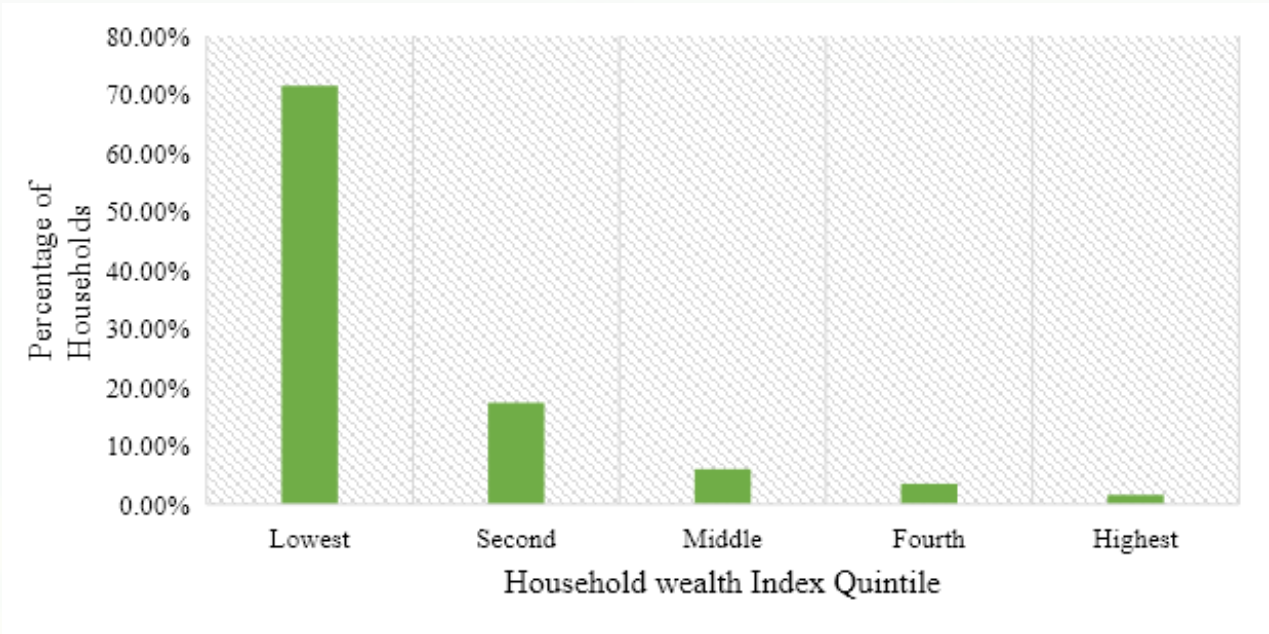

Figure 1:

Household Wealth Index of the study participants

Nutrition knowledge of pregnant and lactating mother

The results presented in Figure 2 show that most of the lactating adolescent mothers (67.3%) had low nutrition knowledge, while almost half of the pregnant adolescents (43.5%) had moderate nutrition knowledge. Fewer respondents in both categories had high nutrition knowledge, with 15.5% and 25.8% for lactating and pregnant adolescent mothers, respectively.

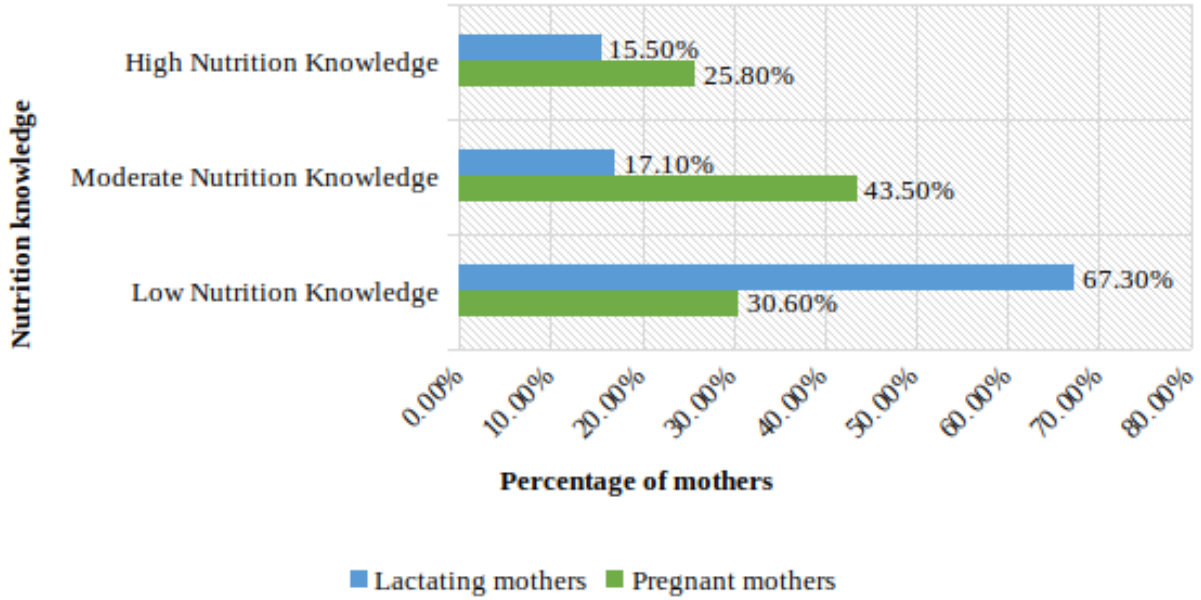

Figure 2:

Nutritional Knowledge amongst pregnant and lactating adolescent mothers

Relationship Between Nutrition Knowledge and Education Level

The majority of lactating and pregnant mothers with no formal education were had low nutrition knowledge (31.0% and 21.8%, respectively). From the results, there was a statistically significant relationship between the education levels of the respondents and their knowledge of nutrition, indicated by p=0.03148 and p=0.002 for pregnant and lactating mothers, respectively (Table 2).

Table 2:

Relationship between Nutrition Knowledge and Education Level

Variable (Level of education)	Low nutrition knowledge	Moderate nutrition knowledge	High nutrition knowledge	Fisher's exact test value	p-value
Lactating Women (N=245)					
No formal education	31.0%	6.5%	5.7%	**18.686**	**0.03148***
Incomplete primary	13.9%	3.7%	2.4%		
Complete primary	3.7%	0.8%	0.8%		
Incomplete Secondary	6.5%	1.6%	1.2%		
Complete secondary	11.8%	2.9%	2.9%		
Tertiary	0.4%	1.6%	2.4%		
Pregnant Women (N=124)					
No formal education	21.8%	20.2%	4.8%	**24.814**	**0.002***
Incomplete primary	1.6%	6.5%	5.6%		
Complete primary	0.8%	0.8%	0		

Incomplete Secondary	0.8%	7.3%	5.6%		
Complete secondary	4.0%	4.8%	6.5%		
Tertiary	1.6%	4.0%	3.2%		

**Statistical significance at $p < 0.05$*

Dietary diversity of pregnant and lactating adolescent mothers

The pregnant and lactating women consumed items from different food groups (Figure 3). Further analysis ranked the consumption based on groups consumed within 24 hours, with 1-3 groups of low diversity, 4-6 groups of medium diversity, and those with more than seven groups in a day of high diet diversity (Figure 4). Most respondents had a low diversity of diets, with 56.7% and 77.42% representing lactating and pregnant adolescent mothers, respectively. Fewer respondents (11.4% and 6.45% for lactating and pregnant adolescent mothers, respectively) were recorded to have a high diet diversity.

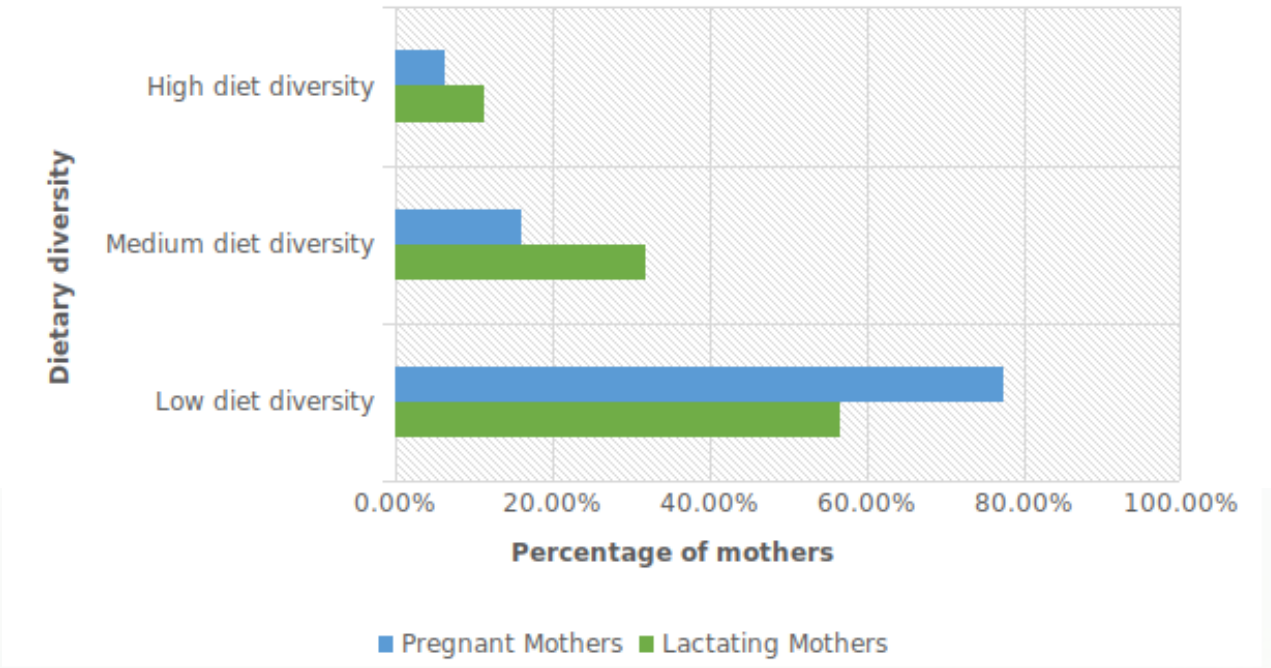

Figure 3:
Dietary Diversity of Pregnant and Lactating Adolescent Mothers

Relationship between Diet Diversity and Wealth Index

From the results obtained, it was observed that majority of poorest lactating (38.4%) and pregnant mothers (72.6%) had low diet diversity. The results also showed that there is a statistically significant relationship between dietary diversity and the wealth index of the respondents, represented by p=0.004 and p=0.025 for lactating and pregnant adolescent mothers, respectively (Table 3).

Table 3:
Relationship between Dietary Diversity and Wealth Index

Variables (Wealth index)	Low diet diversity	Medium diet diversity	High diet diversity	Fisher's exact test value	p-value
Lactating Women (N=245)					
Poorest	38.4%	18.4%	5.3%		
Second	12.7%	7.8%	2.0%		
Middle	4.1%	2.9%	0.8%	**20.934**	**0.004***

Fourth	0.8%	1.6%	2.9%		
Wealthiest	0.8%	1.2%	0.4%		
Pregnant Women (N=124)					
Poorest	72.6%	13.7%	4.0%	**9.902**	**0.025***
Second	4.0%	1.6%	1.6%		
Middle	0.8%	0.8%	0.8%		

**Statistical significance at p < 0.05*

Relationship Between Nutrition Knowledge and Dietary Diversity

The results revealed that 37.5% and 42.7% of lactating and pregnant mothers with low nutrition knowledge had low diet diversity. However, no statistically significant relationship was observed between the diversity of lactating and pregnant mothers' diet and nutrition knowledge ($p > 0.05$) (Table 4).

Table 4:

Relationship Between Nutrition Knowledge and Diet Diversity

Variable (Nutrition knowledge)	Low diet diversity	Medium diet diversity	High diet diversity	Fisher's exact test value	p-value
Lactating Women (N=245)					
Low nutrition knowledge	37.6%	18.0%	7.8%	**3.036**	**0.556**
Medium nutrition knowledge	10.2%	6.1%	1.6%		
High nutrition knowledge	9.0%	7.8%	2.0%		
Pregnant Women (N=124)					
Low nutrition knowledge	42.7%	5.6%	0.8%	**8.193**	**0.066**
Medium nutrition knowledge	22.6%	6.5%	3.2%		
High nutrition knowledge	12.1%	4.0%	2.4%		

**Statistical significance at p < 0.05*

Energy and Nutrient Intake for Pregnant and Lactating Adolescent Mothers in Turkana South Sub-County

The mean daily energy intake for pregnant mothers was 725.06 kcal, while for lactating mothers, it was 805.29 kcal, as shown in Table 5. Pregnant and lactating mothers' mean daily energy intake was less than their RDA of 2300 Kcal and 2640 Kcal, respectively. Carbohydrates contributed 62.4% of pregnant mothers' total daily energy intake, with a mean of 452.08 Kcal (113.02 g). Similarly, among lactating women, carbohydrates provided 60.3% of the total energy intake, with a mean of 485.56 Kcal (121.39). The average daily protein intake was only 58%, and 55% of the RDA was 71g for pregnant and lactating mothers, respectively. This inadequacy puts mothers at risk of protein deficiency. The mean daily intake of vitamin A for pregnant and lactating mothers was 102.93% and 51.26% of their RDA (770 µg & 1300 µg), respectively. Pregnant and lactating mothers' mean daily folic acid intake was 36.40% and 41.39% of the RDA (600 µg), respectively. The mean daily intake of iron for the pregnant and lactating mothers was 32.30% and 89.11% of their RDA (27 mg & 9 mg) respectively.

Table 5:

Health-Related Characteristics Significance on Adherence to Nutrition Counseling Sessions

	Pregnant Women				Lactating Women			
Nutrient	**RDA**	**Mean (N=124)**	**SD**		**RDA**	**Mean (N=245)**	**SD**	
Energy (Kcal)	2300	725.06	357.40		2640	805.29	352.01	
Protein (g)	71	41.19	23.16		71	38.77	20.73	
Carbs. (g)	290.7	113.02	73.71		290.7	121.39	51.00	
Vit. A (µg)	770	792.54	662.72		1300	666.42	505.79	
Vit. E (Eq.) (Mg)	15	2.16	1.85		19	2.26	1.61	
Vit. B6(Mg)	1.9	0.69	0.41		2	0.67	0.36	
Sodium (Mg)	2000	426.42	262.58		2000	319.33	225.23	
Potassium (Mg)	3500	1428.00	658.15		3500	1425.28	677.73	
Calcium (Mg)	1000	208.71	144.84		1000	220.67	130.63	
Phosphorus (Mg)	700	457.42	243.70		700	475.17	240.21	
Iron (Mg)	27	8.72	3.94		9	8.02	3.78	
Zinc (Mg)	11	4.95	3.47		12	4.47	2.62	

Figure 3 showed that majority of pregnant and lactating adolescent mothers took starch staples (96% vs 97.1%), dark green leafy vegetables (76.6% vs 88.2%), respectively. However, only 6.5% and 9% of pregnant and lactating mothers took eggs.

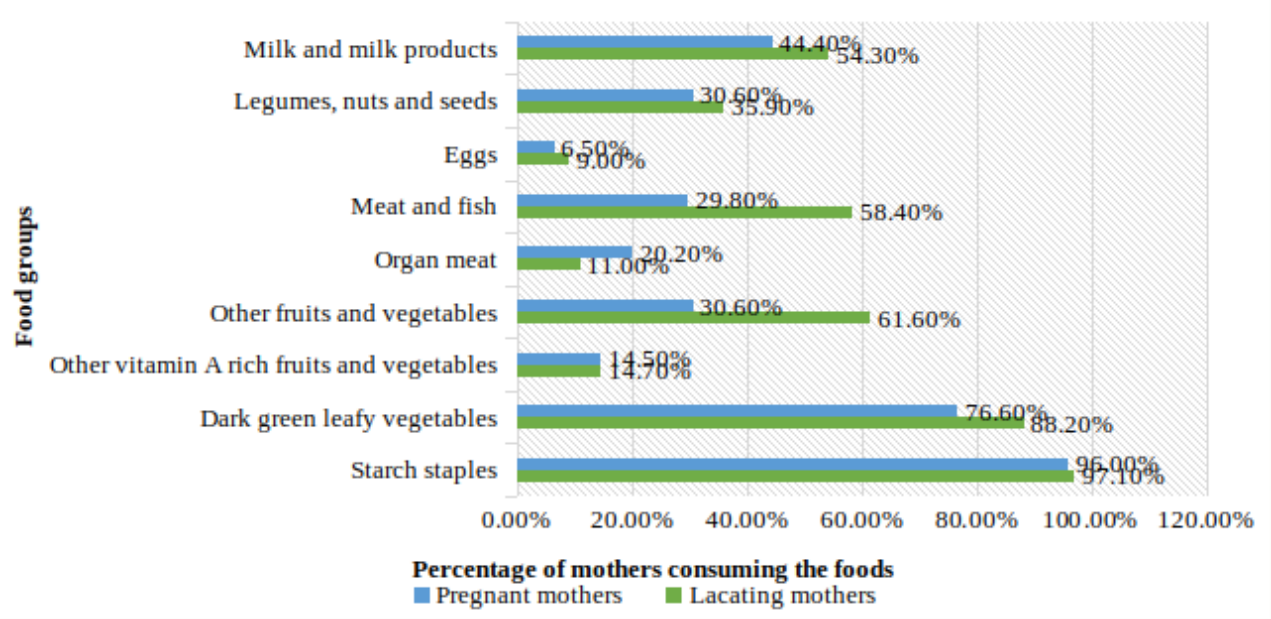

Figure 3:

Food Intake for Pregnant and Lactating Adolescent Mothers

DISCUSSION

This study found that majority of the respondents had no formal education, earned less than Ksh. 10,000 and were unemployed. The low level of education among girls in Turkana County was also highly documented by the KDHS (2022) report that 62.7% of women had no formal education, the second highest after Mandera County (65.2%). This affects women's ability to comprehend basic concepts of nutrition and adhere to diversification, as they will often rely on men to provide food for them. Their average a gross monthly income of less than Ksh. 10,000, hampering their ability to meet basic household needs including food. These findings confirm Shaukat et al. (2020) study, which reported that 90% of households sampled in Turkana County were food insecure and 57.1% depended on harvesting and consuming indigenous wild edible plants due to insufficient finances to buy other foods. The study also revealed that majority of households had lowest wealth quintile. The findings of this study confirm the report of the KDHS (2022) survey, which classified 75% of households in Turkana County in the lowest quintile and only 4.1% in the highest quintile, indicating that most of them are poor, and this affects their ability to access basic needs and commodities, including food.

The current study revealed that most of the lactating and pregnant adolescent mothers had low nutrition knowledge and moderate nutrition knowledge, respectively. Several study findings have also documented a lack of nutrition knowledge among pregnant and lactating adolescents from different countries, which is often attributed to a variety of reasons ranging from socio-economic to cultural technicalities. A study conducted in India among adolescents by Ravula and Kasala (2022) found that the nutrition knowledge of pregnant and lactating adolescent mothers was inadequate, scoring less than 50%. This is indicative of a gap in education and literacy regarding nutrition practices. Appiah et al. (2021) carrying out a study in an Urban Community in Ghana noted low nutritional knowledge (44%) among pregnant adolescents. Abdirahman et al. (2019) found that pregnant adolescent mothers in Mandera County, Kenya, had low nutritional knowledge. Consequently, their dietary practices and nutrition status are negatively affected, leading to poor health outcomes. These findings agree with the findings of the current study. Low nutrition knowledge, especially for pregnant and lactating mothers, directly impacts their dietary practices, consequently resulting in poor nutrition. Adolescent girls are often victims of poor nutrition knowledge, especially in ASAL regions such as Turkana County, where culturally, education for girls is not highly rated since they are viewed as a source of wealth and marry without completing their education. This assertion is corroborated by Lee et al. (2015), who concluded that pregnant adolescents in Korea were associated with low nutrition knowledge and poor understanding of contemporary social issues due to low access to education.

The study revealed that as the level of education increased, there was a corresponding increase in the proportion of adolescent mothers with high nutrition knowledge and a decrease in those with low nutrition knowledge. Education is crucial in shaping people's understanding of health-related topics, including nutrition (Tesfaye et al., 2024). This suggests that educational attainment positively influences nutrition knowledge among adolescent mothers. The current findings underscore the importance of education in improving nutrition knowledge among adolescent mothers. Similar findings were recorded by Odiwuor et al. (2020), who concluded that good education results in better behaviours and dietary practices among pregnant women, which positively affects their health and pregnancy outcomes. Abdirahman et al. (2019) also highlighted the pivotal role of education in improving dietary practices and health outcomes among pregnant and lactating women, while Rahmiwati (2015) demonstrated a strong association between nutrition knowledge and maternal dietary practices among adolescent mothers. According to a UNICEF (2014) report, inadequate access to good information on a healthy diet for pregnant adolescents can also lead to preterm deliveries, low-weight babies, and anemia. Findings from Tesfaye et al. (2024) in Ethiopia also indicated that the nutritional knowledge of pregnant adolescents was suboptimal, and factors such as educational status, Antenatal Clinic (ANC) visits, and nutrition education were associated with good nutritional knowledge. In contrast, food insecurity, low nutritional knowledge, and lack of nutrition education were predictors of poor nutritional status. A similar study by Akunor-Sackey (2022) in Ghana showed that pregnant adolescents had inadequate knowledge of the dietary requirements to ensure proper nutrition. They often ate anything they found, contributing

to their dietary practices and affecting their nutrition and health status. Addressing the nutritional knowledge gap among adolescent mothers in Turkana requires a multi-faceted approach that draws from successful initiatives implemented elsewhere.

Given the significant influence of education on nutrition knowledge, as highlighted by (Abdirahman et al. 2019; Rahmiwati, 2015; Adissu et al., 2024), investing in educational programs tailored to health and nutrition is crucial. One successful approach that can be adapted for Turkana is integrating nutrition education into school curricula. Studies have shown that school-based nutrition education programs can effectively improve adolescent nutrition knowledge and dietary practices (Odiwuor et al., 2020). By introducing nutrition education in schools across Turkana, many adolescent girls can be reached and equipped with the knowledge and skills needed for healthy eating during pregnancy and lactation. Furthermore, community-based interventions have proven effective in improving dietary practices and health outcomes among pregnant and lactating women (Abdirahman et al., 2019). Turkana could benefit from establishing community nutrition programs that offer workshops, cooking demonstrations, and counselling sessions focused on nutrition for adolescent mothers. Trained community health workers and nutritionists can facilitate these programs to ensure accurate and culturally appropriate information is provided. In addition to education and community-based interventions, improving access to nutritious foods is crucial for ensuring proper nutrition among adolescent mothers. Food insecurity has been identified as a predictor of poor nutritional status among pregnant adolescents (Akunor-Sackey, 2022; Tesfaye, Adissu, et al., 2024). Therefore, implementing agricultural initiatives that promote cultivating nutritious crops and livestock farming can help address food insecurity in Turkana.

This study found that majority of pregnant and lactating mothers had low diet diversity. These results corroborate the findings of the KDHS (2022) report, which noted a relatively higher proportion of households (28.3%) in Turkana County who were classified in the poor category for the consumption of different food groups based on the quantity and quality of meals in the country. Further, 80% of the households in the county reported lacking food or money to purchase food, and a majority (61.4%) relied on cash transfers and social assistance to access basic needs and food. Another study by Olimba (2018) also reported that dietary diversity among women aged 15-49 years in Turkana County was low, where only four food groups were consumed by about 50% of the women out of the ten recommended groups. They also noted that the energy and nutrient consumption among the women was critically below the Recommended Nutrient Intakes (RNIs). Measurement of dietary diversity has revealed various patterns of food consumption among pregnant or lactating adolescents. The foods consumed most frequently were starch staples and dark green leafy vegetables, while eggs, organ meats, and vitamin A-rich fruits and vegetables were found to be among the least consumed. In a study conducted in Ethiopia by Azene et al. (2021), similar to poor dietary diversity among adolescent mothers, it was discovered that pregnant women had insufficient nutritional diversity, with minimal consumption of fruits and foods derived from animals. In another study conducted by Gyimah et al. (2021) in Ghana, it was noted that pregnant adolescents in rural areas had poor scores in dietary diversity, mainly attributed to the limited availability of foods rich in essential nutrients, rural living, food insecurity, poverty, and food cravings. These studies support that adolescent mothers frequently experience difficulties attaining sufficient dietary variety, which could negatively affect their nutritional well-being. On the contrary, some studies have reported higher dietary diversity among pregnant and lactating adolescents. For instance, Gyimah et al. (2021) also noted that some pregnant adolescents had relatively higher dietary diversity scores, attributed to the availability of various food options in urban areas, unlike their peers in rural areas. Fernández-Gómez et al. (2020) in Bangladesh observed that pregnant adolescents had diverse dietary patterns influenced by cultural practices and food preferences. These findings suggest that the dietary diversity among adolescent mothers may vary depending on contextual factors such as geographical location and cultural norms which were commonly observed in Turkana South Sub- County. One of the primary reasons for the low dietary diversity could be the limited availability and accessibility of various foods in Turkana. As observed in the study, the reliance on starch staples and dark green leafy vegetables may reflect the limited options of affordable and accessible foods in the region. The lack of access to diverse foods, including animal-source foods and vitamin A-rich fruits and vegetables, can contribute to poor

dietary diversity among adolescent mothers (Azene et al., 2021; Gyimah et al., 2021).

This study found that significant association between dietary diversity and the wealth index of lactating and pregnant adolescent mothers. Results from other studies on the relationship between dietary diversity and socio-economic characteristics support the current finding. Bikila *et al.* (2023) found that higher household wealth was positively associated with dietary diversity among pregnant women in Ethiopia. Similarly, a study by Olatona *et al.* (2023) in Nigeria demonstrated that higher socio-economic status was associated with better dietary diversity among lactating adolescents, while Tesfaye *et al.* (2024) highlighted the dietary diversity among pregnant adolescent mothers, which was directly associated with the wealth index of their household and their level of education in central Ethiopia. Getacher *et al.* (2020), in their study to investigate factors associated with minimum diet diversity among lactating mothers, noted that low diversity was significantly related to education level, nutrition knowledge, food security status, and wealth status. These results elucidate how economic empowerment helps adolescent mothers have better access to various nutrient-dense diets. The present study established no significant association between dietary diversity and nutrition awareness among lactating and pregnant adolescent women. Studies by Azene *et al.* (2021) and Gebremichael (2023) in Ethiopia found no significant association between dietary diversity and nutrition knowledge among pregnant women. However, studies by Abdirahman *et al.* (2019), Shumayla *et al.* (2022), and Umallawala *et al.* (2022) concluded that nutrition knowledge is positively correlated with dietary diversity among pregnant and lactating mothers where low knowledge levels led to poor dietary practices, impacting nutrition status and health outcomes. This emphasizes the importance of awareness in promoting balanced food consumption for better health outcomes. These inconsistencies imply that dietary behavior among adolescent mothers may be influenced by variables beyond their knowledge of nutrition, underscoring the need for comprehensive interventions.

Pregnant and lactating adolescent mothers often have inadequate energy and nutrient intake (Serbesa et al., 2019). Different study findings have revealed that these young mothers face challenges in meeting the recommended daily allowances for various macro and micronutrients, including proteins, vitamin D, vitamin E, water-soluble vitamins, calcium, and iron (Agustina et al., 2023; Fikawati et al., 2014; Marvin-Dowle et al., 2016; Rah et al., 2017; Welch et al., 2024). A study by Villacís Calderón (2012) noted that adolescent mothers had lower caloric intake than adults during lactation. They initially showed poor protein intake, improving by the fourth month. However, both groups had suboptimal vitamins A, D, and calcium intakes. Similarly, Agustina et al. (2023), in their study in Indonesia and Malaysia, documented that the energy and macronutrient intakes of pregnant and lactating adolescent mothers were below recommended levels, with deficiencies in critical micronutrients such as vitamin D, E, and calcium. This agrees with the current study's findings, as does a study by Singh et al. (2017), who concluded that pregnant Latina adolescents had inadequate intake of folate, vitamins A and E, iron, zinc, calcium, magnesium, and phosphorus. Adolescent mothers, especially when pregnant or lactating, require adequate energy and nutrient intake to support their growth and that of their children. Pregnant and lactating adolescent mothers require increased nutrient intake, focusing on micronutrients such as folic acid, vitamin D, iron, and iodine, along with an additional 300 kcal during pregnancy (Robert-McComb et al., 2014). Adolescent mothers' inadequate dietary intake during pregnancy and lactation has been linked to various adverse outcomes for both mother and child. Previous studies have shown that inadequate nutrient intake can lead to low birth weight, preterm birth, and increased risk of maternal complications (Black et al., 2013; Seid et al., 2023). Similarly, the current study indicates that many pregnant and lactating adolescent mothers in Turkana South sub-county do not meet their daily caloric and micronutrient requirements. Factors contributing to low dietary energy consumption during lactation may include poor nutritional knowledge, time restrictions, reduced intake of essential nutrients, and inadequate nutritional guidance from healthcare providers. Cultural practices within the Turkana community, including restricted intake of eggs and organ meats, might also contribute to the low nutrient intake among pregnant and adolescent mothers. The community members believe that intake of these foods can jeopardize foetus health, making them grow big and consequently resulting in adverse pregnancy outcomes. The physiological demands of adolescents for energy and micronutrients are elevated during puberty, making it crucial to ensure adequate nutrition during pregnancy and

lactation to prevent adverse health outcomes for both mother and child.

Conclusion

Low education levels and poor economic status were associated with inadequate nutrition knowledge and poor dietary practices among pregnant and lactating adolescent mothers in Turkana South Sub-County. These adolescents did not meet the RDAs for macro- and micronutrients due to limited dietary diversity and economic constraints. This resulted in increased risk of malnutrition for both mother and child. Improving access to quality education and preventing teenage pregnancies are necessary.

Recommendations

1. The ministry of health should formulate and implement national policy guidelines on adolescent maternal nutrition targeting counties such as Turkana. The policy should incorporate aspects such as energy and micronutrient intake, inclusion of nutrition education in reproductive health programs, regulation of harmful cultural practices, and expansion of social safety nets.
2. Efforts to improve access to quality education for girls in the county could lead to improved nutrition knowledge, thus positively impacting diet practices during pregnancy and lactation. It is still essential to prevent teenage pregnancies, and cultural influences are pretty crucial in this regard.
3. Improving girls' access to high-quality education can decrease the number of adolescent pregnancies by providing them with the knowledge and skills they need to make decisions about their health and future. When teenage pregnancies do happen, it is vital to provide young mothers with self-care resources and sufficient nutrition knowledge.
4. Future longitudinal studies are recommended to investigate the long-term impact of adolescent maternal nutrition on both the mother and child including the infant's milestone development and future pregnancy implications for the mother.

Acknowledgements

The Authors acknowledges the positive contributions and encouragement of colleagues including Ms. Valentine Chebitok, Ms. Sheila Chebichii and Ms. Mercy Ngetich. The authors are indebted to Mr. Victor Musitia for his active role in developing digital data collection tools and data analysis. The authors are also grateful to the research assistants and study participants for their dedication to ensuring data collection is performed successfully. We are also grateful to the authorities both at the national and county levels for granting permission to carry out the research work.

Conflict of Interest

All authors declare no conflict of interest.

Authors' Contributions

BN conceptualized the research idea, developed the research protocol, collected data, and wrote the manuscript. CS and HK guided the ideation, conceptualization, and development of the protocol and manuscript. All authors have read and approved the final manuscript.

REFERENCES

Abdirahman, M., Chege, P., & Kobia, J. (2019). Nutrition Knowledge and Dietary Practices among Pregnant Adolescents in Mandera County, Kenya. Food Sci Nutr Res, 2(2), 1–8. http://dx.doi.org/10.33425/2641-4295.1018

Abdirahman, M. K. (2019). Nutrition knowledge, dietary practices and nutrition status of pregnant adolescents in Mandera County, Kenya. PhD Dissertation, Kenyatta University, Kenya. Retrieved from https://ir-library.ku.ac.ke/bitstreams/9558918d-6bfb-43b6-a485-69a33f40d2af/download

Abebe, H., Abebe, Y., Loha, E., & Stoecker, B. J. (2014). Consumption of vitamin A rich foods and dark adaptation threshold of pregnant women at Damot Sore District, Wolayita, Southern Ethiopia. Ethiopian Journal of Health Sciences, 24(3), 219–226. https://doi.org/10.4314/ejhs.v24i3.5

Agustina, R., Rianda, D., Lasepa, W., Birahmatika, F. S., Stajic, V., & Mufida, R. (2023). Nutrient intakes of pregnant and lactating women in Indonesia and Malaysia: Systematic review and meta-analysis. Frontiers in Nutrition, 10, 1030343. http://dx.doi.org/10.3389/fnut.2023.1030343

Akunor-Sackey, R. J. (2022). The effect of nutritional knowledge and dietary practices on childbirth weight: The case of adolescents mothers in the Effutu municipality, Winneba Ghana. Int J Home Sci, 8(1), 270–277. Retrieved from https://www.homesciencejournal.com/archives/2022/vol8issue1/PartE/8-1-62-102.pdf

Appiah, P. K., Naa Korklu, A. R., Bonchel, D. A., Fenu, G. A., & Wadga-Mieza Yankey, F. (2021). Nutritional Knowledge and Dietary Intake Habits among Pregnant Adolescents Attending Antenatal Care Clinics in Urban Community in Ghana. Journal of Nutrition and Metabolism, 2021. 1(1), 1–9 https://doi.org/10.1155/2021/8835704

Azene, A., Aragaw, A., Wubetie, H., Wassie, G., Tsegaye, G., Derebe, M., & Mitiku, H. (2021). Dietary diversity among pregnant women and associated factors in Ethiopia: Systematic review and meta-analysis. PLOS ONE, 16(6), e0251906. https://doi.org/10.1371/journal.pone.0251906

Barger, M. K. (2010). Maternal Nutrition and Perinatal Outcomes. Journal of Midwifery & Women's Health, 55(6), 502–511. https://doi.org/10.1016/J.JMWH.2010.02.017

Bikila, H., Ariti, B. T., Fite, M. B., & Sanbata, J. H. (2023). Prevalence and factors associated with adequate dietary diversity among pregnant women in Nekemte town, Western Ethiopia, 2021. Frontiers in Nutrition, 10, 1248974. https://doi.org/10.3389/fnut.2023.1248974

Black, R. E., Victora, C. G., Walker, S. P., Bhutta, Z. A., Christian, P., de Onis, M., Ezzati, M., Grantham-McGregor, S., Katz, J., Martorell, R., & Uauy, R. (2013). Maternal and child undernutrition and overweight in low-income and middle-income countries. Lancet (London, England), 382(9890), 427–451. https://doi.org/10.1016/S0140-6736(13)60937-X

FAO. (2007). Guidelines for measuring household and individual dietary diversity. Food and Agriculture Organization of the United Nations (FAO) the Food and Nutrition Technical Assistance (FANTA) Project, Rome, Italy. Retrieved from https://www.fao.org/4/i1983e/i1983e00.pdf

Fernández-Gómez, E., Luque-Vara, T., Moya-Fernández, P. J., López-Olivares, M., Gallardo-Vigil, M. Á., & Enrique-Mirón, C. (2020). Factors Influencing Dietary Patterns during Pregnancy in a Culturally Diverse Society. Nutrients, 12(11). 1-20 https://doi.org/10.3390/nu12113242

Fikawati, S., Syafiq, A., Purbaningrum, R. P., & Karima, K. (2014). Energy consumption of lactating mothers: current situation and problems. Makara Journal of Health Research, 18(2), 1-8. https://doi.org/10.7454/msk.v18i2.4068

Frankenberger, T. R., & Verduijn, R. (2011). Integrated Food Security Phase Classification (IPC). Rome: The Food and Agriculture Organization of the United Nations. Retrieved from https://www.fao.org/4/i0275e/i0275e.pdf

Gebremichael, M. A. (2023). Prevalence and Predictors of Knowledge and Attitude on Optimal Nutrition and Health Among Pregnant Women in Their First Trimester of Pregnancy. September, 1383–1395. http://dx.doi.org/10.2147/IJWH.S415615

Getacher, L., Egata, G., Alemayehu, T., Bante, A., & Molla, A. (2020). Minimum Dietary Diversity and Associated Factors among Lactating Mothers in Ataye District, North Shoa Zone, Central Ethiopia: A Community-Based Cross-Sectional Study. Journal of Nutrition and Metabolism, 2020 (1), 1–10. https://doi.org/10.1155/2020/1823697

Gezimu, W., Bekele, F., & Habte, G. (2022). Pregnant mothers' knowledge, attitude, practice and its predictors towards nutrition in public hospitals of Southern Ethiopia: A multicenter cross-sectional study. SAGE Open Medicine, 10, 205031212210858. https://doi.org/10.1177/20503121221085843

Gyimah, L. A., Annan, R. A., Apprey, C., Edusei, A., Aduku, L. N. E., Asamoah-Boakye, O., Azanu, W., & Lutterodt, H. (2021). Dietary diversity and its correlates among pregnant adolescent girls in Ghana. PloS One, 16(3), e0247979. https://doi.org/10.1371/journal.pone.0247979

Jouanne, M., Oddoux, S., Noël, A., & Voisin-Chiret, A. S. (2021). Nutrient requirements during pregnancy and lactation. Nutrients, 13(2), 1–17. https://doi.org/10.3390/nu13020692

Kajjura, R. B., Veldman, F. J., & Kassier, S. M. (2019). Effect of Nutrition Education on Knowledge, Complementary Feeding, and Hygiene Practices of Mothers With Moderate Acutely Malnourished Children in Uganda. Food and Nutrition Bulletin, 40(2), 221–230. https://doi.org/10.1177/0379572119840214

KDHS. (2022). 2022-KDHS-2022-Final-Report-Vol.1_1. 2006. Retrieved from https://www.knbs.or.ke/wp-content/uploads/2023/07/Kenya-DHS-2022-Main-Report-Volume-1.pdf

Kennedy, G., Ballard, T., & Dop, M. C. (2011). Guidelines for measuring household and individual dietary diversity. Rome: Food and Agriculture Organization of the United

Nations. Retrieved from https://www.fao.org/4/i1983e/i1983e00.pdf

KNBS. (2019a). Distribution of Population by Administrative Units. In 2019 Kenya Population and Housing Census: Vol. II. Retrieved from https://www.knbs.or.ke/2019-kenya-population-and-housing-census-reports/

KNBS. (2019b). Distribution of population by socio-economic characteristics. In 2019 Kenya population and housing census: Vol. IV (Issue 1). Retrieved from https://www.knbs.or.ke/?page_id=3142

Kominiarek, M. A., & Rajan, P. (2016). Nutrition Recommendations in Pregnancy and Lactation. Medical Clinics of North America, 100(6), 1199–1215. https://doi.org/10.1016/j.mcna.2016.06.004

Lee, S.-O., Park, K.-Y., & Han, M.-J. (2015). Comparing nutrition knowledge, eating habits, and neonatal health status of primipara for pregnant women of advanced maternal age compared to those of younger ages. Korean Journal of Women Health Nursing, 21(4), 253–261. http://dx.doi.org/10.4069/kjwhn.2015.21.4.253

Lokossou, Y. U. A., Tambe, A. B., Azandjèmè, C., & Mbhenyane, X. (2021). Socio-cultural beliefs influence feeding practices of mothers and their children in Grand Popo, Benin. Journal of Health, Population and Nutrition, 40(1), 1–12. https://doi.org/10.1186/s41043-021-00258-7

Marshall, N. E., Abrams, B., Barbour, L. A., Catalano, P., Christian, P., Friedman, J. E., Hay, W. W. J., Hernandez, T. L., Krebs, N. F., Oken, E., Purnell, J. Q., Roberts, J. M., Soltani, H., Wallace, J., & Thornburg, K. L. (2022). The importance of nutrition in pregnancy and lactation: lifelong consequences. American Journal of Obstetrics and Gynecology, 226(5), 607–632. https://doi.org/10.1016/j.ajog.2021.12.035

Marvin-Dowle, K., Burley, V. J., & Soltani, H. (2016). Nutrient intakes and nutritional biomarkers in pregnant adolescents: a systematic review of studies in developed countries. BMC Pregnancy and Childbirth, 16, 1–24. http://dx.doi.org/10.1186/s12884-016-1059-9

Matsumoto, M., Hatamoto, Y., Masumoto, A., Sakamoto, A., & Ikemoto, S. (2020). Mothers' nutrition knowledge is unlikely to be related to adolescents' habitual nutrient intake inadequacy in Japan: A cross-sectional study of Japanese junior high school students. Nutrients, 12(9), 1–12. https://doi.org/10.3390/nu12092801

Moura, M., Marçal, G. D. M., Di, M., Mafra, G., Maria, T., Toledo, D. M., Bueno, N. B., Paula, A., & Clemente, G. (2020). Association between iron deficiency anaemia and complementary feeding in children under 2 years assisted by a Conditional Cash Transfer programme. Public Health Nutrition, 24(13), 4080-4090. https://doi.org/10.1017/S1368980020002542

Mutea, L., Were, V., Ontiri, S., Michielsen, K., & Gichangi, P. (2022). Trends and determinants of adolescent pregnancy: Results from Kenya demographic health surveys 2003-2014. BMC Women's Health, 22(1), 416. https://doi.org/10.1186/s12905-022-01986-6

Odiwuor, F., Kimiywe, J., & Waudo, J. (2020). Influence of Nutrition Knowledge on Dietary Practices and Attitudes of Pregnant Women in Migori, Kenya. Global Research Journal of Public Health and Epidemiology, 8(3), 5–12. Retrieved from https://ir-library.ku.ac.ke/bitstreams/1e950421-eb48-4ad4-8d90-c67523b23ef2/download

Olatona, F. A., Ogide, P. I., Abikoye, E. T., Ilesanmi, O. T., & Nnoaham, K. E. (2023). Dietary diversity and nutritional status of adolescents in Lagos, Nigeria. Journal of Family Medicine and Primary Care, 12(8), 1547–1554. https://doi.org/10.4103/jfmpc.jfmpc_1783_22

Olimba, L. A. (2018). A dietary analysis of pastoral and agro zones in turkana county. (Doctoral dissertation, Ghent University). https://libstore.ugent.be/fulltxt/RUG01/002/509/522/RUG01-002509522_2018_0001_AC.pdf

Rah, J. H., Chalasani, S., Oddo, V. M., & Sethi, V. (2017). Adolescent Health and Nutrition. Nutrition and Health in a Developing World, 559–577. https://doi.org/10.1007/978-3-319-43739-2_25

Rahmiwati, A. (2015). Contributions Knowledge of Nutrition and Dietary Restriction to Nutritional Status of Pregnant Women in. International Journal of Sciences: Basic and Applied Research (IJSBAR) International Journal of Sciences: Basic and Applied Research, 24(1), 342–349. retrieved from http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

Ravula, P., & Kasala, K. (2022). 7 Assessment of nutrition related knowledge, attitudes and practices of pregnant and lactating mothers in the tribal areas of Telangana, India. BMJ Nutrition, Prevention &Amp; Health, 5(Suppl 1), A7 LP-A7. https://doi.org/10.1136/bmjnph-2022-nnedprosummit.14

Robert-McComb, J. J., González, Á. G., & Carraway, L. (2014). Nutritional Guidelines and Energy Needs During Pregnancy and Lactation BT - The Active Female: Health Issues Throughout the Lifespan In: J. J. Robert-McComb, R. L. Norman, & M. Zumwalt (eds.); pp. 517–533). Springer New York. https://doi.org/10.1007/978-1-4614-8884-2_31

Sedgwick, P. (2015). Multistage sampling. BMJ (Online), 351(July), 1–2. https://doi.org/10.1136/bmj.h4155

Seid, A., Dugassa Fufa, D., Weldeyohannes, M., Tadesse, Z., Fenta, S. L., Bitew, Z. W., & Dessie, G. (2023). Inadequate dietary diversity during pregnancy increases the risk of maternal anemia and low birth weight in Africa: A systematic review and meta-analysis. Food Science & Nutrition, 11(7), 3706–3717. https://doi.org/10.1002/fsn3.3388

Serbesa, M. L., Iffa, M. T., & Geleto, M. (2019). Factors associated with malnutrition among pregnant women and lactating mothers in Miesso Health Center, Ethiopia. European Journal of Midwifery, 3(13). 1–5. https://doi.org/10.18332/ejm/110131

Shaukat, B., Javed, S. A., & Imran, W. (2020). Wealth index as substitute to income and consumption: assessment of household poverty determinants using demographic and health survey data. Journal of Poverty, 24(1), 24–44. http://dx.doi.org/10.1080/10875549.2019.1678550

Shumayla, S., Irfan, E. M., Kathuria, N., Rathi, S. K., Srivastava, S., & Mehra, S. (2022). Minimum dietary diversity and associated factors among lactating mothers in Haryana, India: a community based cross-sectional study. BMC Pediatrics, 22(1), 525. http://dx.doi.org/10.1186/s12887-022-03588-5

Singh, A., Trumpff, C., Genkinger, J., Davis, A., Spann, M., Werner, E., & Monk, C. (2017). Micronutrient dietary intake in Latina pregnant adolescents and its association with level of depression, stress, and social support. Nutrients, 9(11), 1212. http://dx.doi.org/10.3390/nu9111212

Stewart, C. P., Katz, J., Khatry, S. K., Leclerq, S. C., Shrestha, S. R., West, K. P., & Christian, P. (2007). Preterm delivery but not intrauterine growth retardation is associated with young maternal age among primiparae in rural Nepal. Maternal and Child Nutrition, 3(3), 174–185. https://doi.org/10.1111/j.1740-8709.2007.00097.x

Tareq, M., Abdel-Razzaq, A. I., Rahman, M. A., & Choudhury, T. (2021). Comparison of weighted and unweighted methods of wealth indices for assessing Socio-Economic status. Heliyon, 7(2). 1– 10. https://doi.org/10.1016/j.heliyon.2021.e06163

Tesfaye, A., Adissu, Y., Tamiru, D., & Belachew, T. (2024). Nutritional knowledge, nutritional status and associated factors among pregnant adolescents in the West Arsi Zone, central Ethiopia. Scientific Reports, 14(1), 6879. https://doi.org/10.1038/s41598-024-57428-w

Tesfaye, A., Gerbaba, M., Tamiru, D., & Belachew, T. (2024). Inadequate dietary diversity practices and associated factors among pregnant adolescents in the West Arsi Zone, Central Ethiopia: a community-based cross-sectional study. Scientific Reports, 14(1), 2871. https://doi.org/10.1038/s41598-024-53467-5

Umallawala, T. M., Shah, P., Puwar, T., Saha, S., Pandya, A., Wanjari, M. B., & Saxena, D. (2022). Food consumption pattern and dietary diversity among pregnant and lactating women, children, and adolescent girls in Devbhumi Dwarka District, Gujarat: A Cross-Sectional Study. Cureus, 14(8), 1–8. https://doi.org/10.7759/cureus.28168

UNICEF. (2014). Ending child marriage: Progress and prospects. Unicef. https://data.unicef.org/wp-content/uploads/2015/12/Child-Marriage-Brochure-HR_164.pdf

USDA. (2020). Dietary guidelines for Americans. The American Journal of Clinical Nutrition, 34(1), 121–123. https://doi.org/10.1093/ajcn/34.1.121

Villacís Calderón, G. D. (2012). Nutritional intake of adolescent and adult breastfeeding mothers at the Isidro Ayora Gynecological and Obstetric Hospital. (Bachelor's thesis, San Francisco University of Quito, College of Health Sciences). http://repositorio.usfq.edu.ec/handle/23000/1429

Weerasekara, P. C., Withanachchi, C. R., Ginigaddara, G. A. S., & Ploeger, A. (2020). Food and nutrition-related knowledge, attitudes, and practices among reproductive-age women in marginalized areas in Sri Lanka. International Journal of Environmental Research and Public Health, 17(11), 1–24. https://doi.org/10.3390/ijerph17113985

Welch, C., Wong, C. K., Lelijveld, N., Kera c, M., & Wrottesley, S. V. (2024). Adolescent pregnancy is associated with child undernutrition: Systematic review and meta-analysis. Maternal & Child Nutrition, 20(1), e13569. http://dx.doi.org/10.1111/mcn.13569