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What's happening in the kitchen? The influence of nutritional knowledge, attitudes and, practices (KAP), and kitchen characteristics on women's dietary quality in Ethiopia

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Abstract

Background Low dietary quality significantly contributes to public health risks in low-income countries. This situation is particularly concerning for vulnerable groups, such as women and children, who are at increased risk of malnutrition due to inadequate access to proper nutrition. This study aimed to assess the influence of nutrition-related knowledge, attitudes, and practices, and kitchen characteristics on women's dietary quality in Ethiopia.

Method A population-based cross-sectional survey was conducted from August to September 2022 in five regions and two city administrations in Ethiopia. A multistage stratified cluster sampling method was employed. From ninety-nine enumeration areas, twenty eligible households were selected. A total of 1,980 women aged 15–49 years were included in this survey. The data were collected using a structured questionnaire about socio-demographic characteristics, food frequency, 24-hour dietary recall, and nutrition-related knowledge, attitudes, and practices. The determinants of dietary quality were identified using Poisson, logistic, and ordinary least square regression analyses. Variables with a p-value less than 0.05 were considered to indicate statistical significance.

Results The results showed that the average dietary diversity score for women was 3.4 ± 0.85. Only 21.5% of the participants achieved the minimum dietary diversity for women (MDD-W), and the mean adequacy ratio for nutrients was 61.6%. The participants' average nutrition-related knowledge, attitudes, and practices scores were 63%, 39%, and 23%, respectively. The regression analysis showed knowledge and attitude positively associated with dietary diversity and the mean nutrient adequacy ratio ($P < 0.01$). Cooking time and propensity to prepare new food were also positively associated with dietary diversity and with minimum dietary diversity ($P < 0.01$).

Conclusion Our study showed that good nutrition-related knowledge and a positive attitude toward nutrition positively and significantly influence dietary quality, along with cooking time and the propensity to prepare new foods.

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Keywords Nutritional KAP, Kitchen, Food consumption, Dietary diversity, Nutrient intake, Ethiopia

Background

Across Africa, malnutrition and food insecurity remain significant challenges and are particularly pronounced in Central and Eastern Africa [1]. Ethiopia has significant nutritional problems that pose substantial risks to public health. The 2016 Ethiopian Demographic and Health Survey revealed that malnutrition was highly prevalent among children under the age of five, with 38% being stunted, 24% being underweight, and 10% being wasted; 20% of women of reproductive age were underweight, while 8% were overweight or obese, all of which is indicative of a complex landscape of nutrition-related challenges [2].

A key contributor to nutritional inadequacy in Ethiopia is low dietary quality, especially among vulnerable groups such as women and children. Dietary quality refers to a balanced diet that provides enough energy and essential nutrients [3]. A standard measure of dietary quality is dietary diversity, the number of food groups consumed over a given period of time [4, 5].

Only 7% of Ethiopian women eat the minimum recommended number of food groups [6]. The most commonly consumed food groups are grains (61%), roots and tubers (3.9%), fruits (9.9%), and legumes and nuts (8.4%). The least consumed food groups are eggs (0.3%), dairy products (5%), fleshy foods (1.5%), and oils and fats (1.5%) [7].

The quality of diets in Ethiopia are shaped by various factors that influence people's food choices and intake. Among these, socioeconomic status is a significant determinant, with wealthier households with larger landholdings being better able to afford and access a diverse range of foods [8]. In previous studies, women's empowerment, education level, and occupational status were found to be critical in determining household dietary quality, as women tend to be the primary caregivers and decision-makers regarding household food choices [9].

Dietary quality can be influenced by family size and household food production, which can, in turn, affect the availability and accessibility of food within the household [8, 10]. Even when food is available, however, nutritional knowledge is crucial in determining how effectively these resources are utilized. An individual who understands the nutritional value of various foods is better equipped to make informed dietary choices, optimize the quality of their diet, and support overall health [10–12]. Thus, both the structural factors of food availability and the personal factor of nutritional awareness interact to shape dietary quality.

The scholarly literature has extensively explored the relationships between knowledge, attitudes, and practices (KAP) and nutrition outcomes. Schwartz (1976) developed the cognitive effective behaviour theory, which suggests that increasing nutritional knowledge can significantly affect an individual's attitudes and improve their overall nutritional status [13]. This theory suggests that knowledge serves as a mediator between attitudes and practices. Understanding the role of knowledge in shaping attitudes and practices towards nutrition is thus crucial for addressing malnutrition. Building on this, Kwol et al. (2020) proposed a unified theory that suggests that knowledge plays a fundamental role in shaping an individual's attitude toward nutrition and positively influences dietary behaviour [14]. These authors suggest that knowledge is the key driver of attitudes, thereby influencing dietary outcomes.

Over the past three decades, nutritional status in Ethiopia has steadily improved, albeit at a slow pace. Since 2008, the Ethiopian government has undertaken several nutritional initiatives, including the National Nutrition Strategy and National Nutrition Program parts One and Two, the Seqota Declaration, and the Food and Nutrition Policy [15–19]. Recently, nutrition-specific and nutrition-sensitive programs have been implemented. The malnutrition reduction approach focuses mainly on immediate causes, referred to as nutrition-specific interventions. These address the determinants of foetal and child nutritional development, including vitamin A and zinc supplementation, exclusive breastfeeding, promotion of dietary diversity, and food fortification [20]. Nutrition-sensitive programs address adequate maternal, household, and community caregiving resources, access to health services, and a safe and hygienic environment while incorporating specific nutritional goals and actions [21]. Different sectors, such as agriculture, education, and industry, have been involved in mainstreaming nutrition into their priority activities.

Exploring the dynamics of the food system and its contributions to dietary quality is vital to understanding the complex issues of food and nutritional security. It is also crucial to consider the diverse socioeconomic backgrounds and contexts in which people consume food in order to design effective nutritional interventions. Comprehensive research into various aspects of the food system is necessary, therefore, to uncover the underlying factors influencing dietary quality. Several studies from Ethiopia have explored these factors in general. For instance, Alamirew et al. (2023) examined sociocultural factors in the Amhara region, Anyanwu et al. (2022) focused on household assets in the Oromia region, Abebe (2024) investigated socioeconomic characteristics in the Afar region, and Mekonen et al. (2022) studied women's decision-making in the Amhara region [22–25].

However, limited research has been done on the specific topics of nutrition-related KAP and kitchen characteristics and their impact on dietary quality. Therefore, the aim of this study was to assess the influence of nutrition-related KAP and kitchen characteristics on women's dietary quality.

Methodology

Study setting, design, and sampling procedure

The Federal Democratic Republic of Ethiopia is located in the Horn of Africa, sharing borders with Eritrea and Djibouti to the north, Somaliland to the northeast, Somalia to the east, Kenya to the south, South Sudan to the west, and Sudan to the northwest. The country is divided into nine regional states and two city administrations. Data were collected in five regions and two city administrations: Amhara, Oromia, Somalia, Southern People and Peoples Nationalities, Sidama, Dri Dawa City Administration, and Addis Ababa City Administration. These areas account for 90.4% of the national population [26].

A population-based cross-sectional survey was conducted from August to September 2022. A multistage stratified cluster sampling method was used to choose households for the study. In the first stage, districts were selected from each study region based on a sampling frame developed by the Central Statistical Agency (CSA) for the 2021 Household Income Consumption Expenditure Survey (HICES). Ninety-nine enumeration areas (EA) were chosen from selected districts using the lottery method. A household list was obtained for each of the selected EAs, which were used as a sampling frame for the final stage of household selection. A household had to contain at least one member of the study target group. From the revised listing, twenty eligible households pre-EA were selected randomly.

Sample and sample size determination

The study population was women of reproductive age (15–49 years). Pregnant and lactating women were excluded since their dietary behavior and requirements likely differed from the general population. The subjects were drawn from eligible households in the study areas. The sample size was calculated based on the known prevalence of low dietary diversity [6]. A single population proportion formula was used to estimate the sample size needed regionally based on the prevalence of indicators using a 0.05 desired leave standard error, a 95% confidence level, and a design effect of 1.5. The sample size was adjusted for region-specific average household size, region-specific percentage of the target population, a household response rate of 94.5%, and an individual response rate of 80%.

$$\mathrm{n} = \frac{Z^2_{\alpha\,/2}\, p(1-p)}{d^2} \times DEFE \times \frac{100}{HHRR} \times \frac{100}{IRR} \times \frac{1}{Ave.HH\ size} \times \frac{1}{\%\ of\ Target\ PP}$$

where, n = sample size, $Z_{\alpha/2}$ = standard errors from the mean corresponding to the 95% confidence level = 1.96, P = prevalence, d = allowable error = 0.05, DEFE = design effect = 1.5, Ave. HH size = average household size from each region, %of Target PP = proportion of the target population from each region, HHRR = household response rate (%) = 94.5%, IRR = individual response rate (%) = 80%. After using the formula, we calculated the total sample size to be 1,980.

Data collection and measurement

A structured questionnaire with four modules was designed and administered to gather comprehensive information on respondents' characteristics and various topics related to food systems and dietary outcomes. The questionnaire was created in English but was translated into Amharic and Affan Oromo as spoken in the survey area. The questionnaire was programmed in the CSPro software package using pre-coded responses, and tablet computers were used to collect the data. Several procedures were followed during the survey's design and implementation to ensure data quality. First, data collection training modules and field guidelines were prepared. Qualified and experienced data collectors were recruited and underwent two weeks of intensive data collection training. After the training, a mock test was conducted among the participants. Finally, a pre-test was conducted in the Oromia region (in Bishoftu, near Addis Ababa), and after the necessary adjustment, the survey tool was finalized.

Socio-demographic and time use

The socio-demographic and the women's time-use questionnaire were obtained from Ethiopia Central Statistics Agency (CSA) health and demographic and time-use surveys. These tools underwent testing and validation [2, 27]. The household characteristics module collected data on household members' age, sex, education, residency, assets, wealth, employment, and income. It also examined kitchen characteristics such as the source of drinking water, hand washing facilities, cooking fuel,

cookstove type, available cooking utensils, and propensity to prepare new food. The women's time use module gathered information on how women allocate their time.

Nutrition-related KAP assessment

The nutrition-related KAP module followed the guidelines of the Food and Agriculture Organization (FAO); this tool has been tested and validated in Malawi, Cambodia, and Mexico [28]. In this study, we assessed participants' nutrition-related knowledge by calculating the correct answers to 27 questions across three key areas: infant and young child feeding, micronutrient intake, and malnutrition. Each question was answered with a yes or no response; correct responses were awarded one point, while incorrect responses received a zero score. Good knowledge was where the participant correctly answered more than 50% of the knowledge questions. Attitudes toward nutrition were measured using a three-point Likert scale comprising 1 (agree), 2 (neutral), and 3 (disagree) with a total of 23 questions. These questions were in four areas: benefits of nutrition, barriers to healthy eating, susceptibility to nutritional issues, and severity of dietary complications. The total nutrition-related attitude score was compiled from these subcategories, and the average score was then calculated based on the number of statements agreed upon. A positive attitude was where the participants agreed with more than 50% of the attitude questions. For nutrition-related practices, 18 questions were asked, which included actions such as handwashing, using clean fuel, treating water, attending cooking demonstrations, and food preservation. The results were scored based on recommended health and nutritional practices, earning one point for appropriate practices or zero otherwise. The average score was calculated. Good practices were where the participant reported applying more than 50% of recommended practices.

Dietary quality assessment

The food frequency and dietary diversity module was adapted from the Food and Agriculture Organization (FAO) dietary assessment tools [5, 29]. The food frequency questionnaire was tested and validated in Ethiopia, Tanzania, and Morocco [30–33]. Tailored to fit Ethiopia's list of available food options, it comprises 86 specific lists of food and beverages and offers response categories to indicate the frequency of consumption over seven days. Also, the individual dietary diversity questionnaire (24-hour dietary recall) was tested and validated for several age/sex groups as proxy measures for macro and/or micronutrient adequacy of the diet [3, 5, 34]. Dietary quality was assessed by determining the dietary diversity score (DDS), minimum dietary diversity for women (MDD-W), and mean adequacy ratio (MAR). DDS is the average number of food groups women consume, calculated by summing the ten food groups (Grains, white roots and tubers, and plantains; pulses (beans, peas, and lentils); nuts and seeds; milk and milk products; meat, poultry, and fish; Eggs; Dark green leafy vegetables; other vitamin A-rich fruits and vegetables; and other fruits) consumed during the last 24 h [5]. MDD-W was calculated for women who have consumed at least five of the ten possible food groups during the last 24 h [4]. The MAR was calculated as an overall measure of nutrient adequacy.

$$\text{MAR} = \frac{\sum \text{NAR (Nutrient Adequacy Ratio)}}{\text{Number of Nutrients}} \times 100$$

Nutrient intake was estimated using a seven-day food frequency and calculated using an Ethiopian food composition Tables [30, 35]. Missing values were added from the Kenyan food composition Table [36]. The NAR was calculated as the women's nutrient intake ratio for both macronutrients and micronutrients relative to the recommended allowance in the Ethiopian Food-based dietary guidelines and Dietary Intake Reference [29, 37, 38].

$$\text{NAR} = \frac{\text{Actual Nutrient intake of a nutrient (per day)}}{\text{Recommended daily allowance of the nutrient}}$$

Econometrics approach

An econometric approach was employed to analyze three distinct dietary outcomes for women: DDS, MDD-W, and MAR, which served as the dependent variables. The analysis aimed to establish the relationships between these dietary outcomes and various factors, including nutrition-related KAP, and kitchen characteristics, which were considered the independent variables that facilitate or hinder outcome variables. To analyse the first dependent variable, the DDS, we had to consider that it can only take nonnegative integral values. Therefore, a count data modelling approach was necessary, and the Poisson model was a suitable choice as it accommodates the discrete nature of the dependent variable. In contrast, the MDD-W is a binary value, so the logistic model was appropriate. The MNA is continuous, and for this result, the ordinary least square method (OLS) method was suitable for modelling. We modelled women's dietary outcomes (DD, MDD, and MNAR) as a function of nutrition-related KAP, kitchen characteristics, and selected sociodemographic characteristics using the following regression model:

Table 1 Socio-demographic characteristics of women of reproductive age (15–49 years) in Ethiopia, 2022 ($n = 1910$)

Characteristics	Total
Age (%)	
15–19	5.20
20–29	37.81
30–39	37
40–49	19.90
Marital status (%)	
Never married	13.13
Married or living together	77.52
Divorced or separated	5.60
Widowed	3.84
Education (%)	
No education	37.30
Read and write	0.51
Primary	30.40
Secondary	19.80
More than secondary	12
Average household size (Mean ± SD)	4.60 ± 1.10
Employment (%)	
Engage in any job	68.47
Employed in agriculture	48.02
Wholesale and retail	7.20
Education	4.08
Community and social service	4.52
Manufacturing	1.49

$$
\begin{aligned}
DDs_i = {} & \beta_0 + \beta_1 KAP_i + \beta_2 KC_i \\
& + \beta_3 SD_i + \epsilon_i \, MDDWs_i \; \beta_0 \\
& + \beta_1 KAP_i + \beta_2 KC_i \\
& + \beta_3 SD_i + \epsilon_i \, MARs_i \; \beta_0 \\
& + \beta_1 KAP_i + \beta_2 KC_i + \beta_3 SD_i + \epsilon_i
\end{aligned}
$$

Where; DDs_i is dietary diversity score, $MDDs_i$ is minimum dietary diversity score, MAR_i is the mean adequacy ratio of nutrients, KAP_i is a vector of variables capturing nutrition-related knowledge, attitude, and practice, KC_i is a vector of variables capturing kitchen characteristics, SD_i is a vector of variables capturing socio-demographics, and ϵ_i is a random error term.

Data analysis

We used a combination of quantitative methods to gain insights into the factors affecting women's dietary quality. SPSS version 16 statistical software was used to analyze descriptive statistics such as the mean, median, standard deviation, and percentages of the collected data. To assess the normality, we used the Shapiro-Wilk test. To further examine and understand the influencing factors, we deployed multinomial regression, which allowed us to determine the extent to which various factors contributed to the quality of women's diets. Following regression analysis, we conducted post-estimation tests to verify the accuracy and validate the assumptions. To check for homoscedasticity, we used Cameron and Trivedi's decomposition test and the Breusch-Pagan/ Cook-Weisberg test for heteroscedasticity, while for multicollinearity, we employed the Variance Inflation Factor (VIF) test. Missing data have been imputed. Variables with a p-value less than 0.05 were considered to indicate statistical significance.

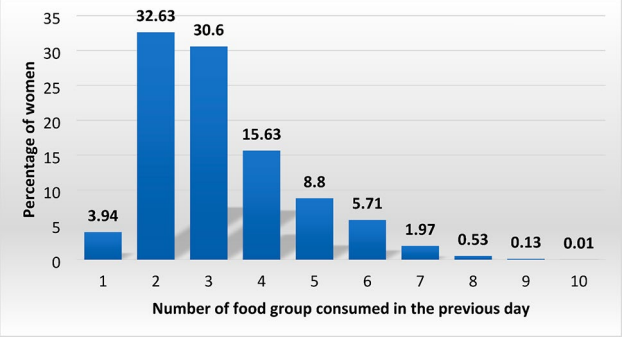

Fig. 1 The percentage of women of reproductive age (15–49 years) and the dietary diversity score across ten food groups in the previous 24 h in Ethiopia, 2022

Results

Socio-demographic factors

Table 1 presents the key socio-demographic characteristics of the study participants. These show that most participants were in their twenties or thirties, with the majority (77%) being married. Approximately 37% of the individuals had never attended school, while more than 60% had completed primary education or beyond. The average household size was 4.6 ± 1.1 people. 68% (68.47%) of the participants were employed (including self-employed individuals), with agriculture being the leading employment sector (48.02%). Wholesale and retail (7.20%), education (4.08%), community and social service (4.52%) followed, while manufacturing industries (1.94%) had the lowest level of participation.

Dietary quality outcomes

Figure 1 shows the distribution of the dietary diversity indicators for women in the survey sample. Most respondents consumed two (32.63%) or three (30.60%) food groups, while less than 10% consumed five food groups or more. Consumption of eight or more food groups was below 1%. Nearly all women consume staple crops (grains, roots, and tubers) and legumes or nuts. The consumption of animal-source foods, however, was minimal. The average dietary diversity score of the group was 3.41 ± 0.85, and only a minority (21.57%) of the respondents met the FAO MDD-W criteria (i.e. have consumed at least five of the ten possible food groups over a 24-hour period).

The median nutrient intake and nutrient adequacy ratio (NAR%), which compares the actual intake to the recommended amount of macro and micronutrients, is provided in Table 2. These computations showed that participants consumed an average of 1,361.82 ± 539.66 Kcal or 68% of the recommended daily energy intake. Consumption of lipids was 23.10 ± 15.60 g (29.7% of the recommendation). The intake of minerals was also calculated, and it was found that the participants consumed 351.4 ± 195.21 mg of calcium (27% of the recommendation), 44.54 ± 16.70 mg of iron (above the recommendation), and 8 ± 3.32 mg of zinc (89% of the recommendation); however, the bioavailability of these minerals is lower in plant-based foods due to phytic acid, which inhibits absorption. Additionally, an average of 241.63 ± 323.62 mg of vitamin A retinol equivalent (34.5% of the recommendation) was consumed. The MAR for the participants was 55.84%.

Table 2 Average energy, macro, and micronutrient intake in 24 h among women of reproductive age (15–49 years) in Ethiopia, 2022 ($n = 1910$)

Nutrients	Median	SD	NAR%
Energy (kcal)	1361.82	539.66	68
Protein (g)	37.30	22.45	83
Fat (g)	23.10	15.60	29.77
Calcium (mg)	351.41	195.21	27
Iron (mg)	44.54	16.70	100
Zinc (mg)	8	3.32	89
Vitamin A RAE (mg)	241.63	323.62	34.50
Thiamine (mg)	0.41	0.21	44.46
Riboflavin (mg)	0.70	0.43	64.54
Niacin (mg)	2.57	1.51	18.33
MAR	-	-	**55.84**

SD Standard Deviation, NAR Nutrient Adequacy Ratio, MAR Mean Adequacy Ratio

Nutrition-related KAP

Table 3 summarizes the results on nutrition-related knowledge, attitudes, and practices. A score of 50% indicates a good level of knowledge of these subjects. The average score for nutrition-related knowledge was 63.94%, while that for infant and young child feeding was 67.43%. The highest knowledge score, 75.30%, was observed for malnutrition, and the lowest was for micronutrient deficiency (45.61%).

The analysis of nutrition-related attitudes (Table 3) revealed that the average score was 39.78%, which indicates that the respondents did not have a positive attitude toward nutrition. Looking at the individual components in this area, almost two-thirds (65.51%) of the participants believed that following good nutritional practices would be beneficial, while slightly more (68.25%) expressed concerns about barriers to engaging in such practices. In contrast, only a small minority (13.40%) of the respondents believed in the severity of poor nutrition and perceived their susceptibility to nutrition-related health problems (11.95%).

The average score regarding household nutrition-related practices (Table 3), which captures the adoption or attendance of various practices in the households, was only 23.03%. Among the individual components, the application of preservation techniques had the highest score, (53.71%), while the lowest score recorded was for participation in community-based cooking demonstrations (2.52%). The scores for clean fuel use and water treatment practices were in between these extremes, at (13.08% and 14.97%, respectively).

Table 3 Nutrition-related KAP score summary statistics for women of reproductive age (15–49 years) in Ethiopia, 2022 ($n = 1910$)

Knowledge score	Mean (%)	Std. Err.	[95% Conf.	Interval]
Infant Young child feeding	67.43	0.58	64.14	69.43
Micronutrient deficiency	45.61	0.86	43.91	47.31
Malnutrition	75.30	0.55	74.21	76.39
Total	63.94	0.50	62.95	64.94
Attitude score				
Perceived benefits	65.51	0.68	64.16	66.86
Perceived susceptibility	11.95	0.44	11.07	12.83
Perceived barrier	68.25	0.7	66.89	69.64
Perceived severity	13.40	0.77	11.87	14.93
Total	39.78	0.4	38.99	40.57
Practice score				
Clean fuel use	13.08	0.96	11.19	14.98
Treated water	14.97	1.04	12.92	17.02
Cooking demonstration participation	2.52	0.36	1.8	3.2
Preservation techniques	53.71	1.1	51.55	55.87
Proper hand washing	34.39	1.09	32.24	36.54
Total	23.03	0.51	21.02	25.05

Factors related to kitchen characteristics

The data in Table 4 revealed that, on average, women spent a quarter of the day on home care activities, with two hours spent on cooking and one-and-a-half hours (1.5 ± 0.1) dedicated to fetching water and collecting firewood. The primary energy source used in the home was solid biomass fuel, which accounted for four-fifths (80%) of households. For cooking, the majority of households used tripod stone open fires (40.50%) or a variety of traditional stoves (37%), with only a small minority (2.80%) using improved stoves. Less than a quarter (23%) of households were connected to the electricity grid, but this was not commonly used for cooking. The great majority of the respondents (86%) had access to basic drinking water services, while the remainder (14%) were below the basic services level. The average

Table 4 Factors associated with Kitchen characteristics of women of reproductive age (15–49 years) in Ethiopia, 2021 ($n=1910$)

Variables	Total
Time used for home care (mean ± SD)	2.21 ± 2.70
Time used for cooking (mean ± SD)	2.16 ± 1.15
Tiem used for water fetching and firewood collection (mean ± ± SD)	1.53 ± 0.10
Solid biomass fuel user (%)	80
Tripod stone open fire (%)	40.50
Improved stove user (%)	2.80
Limited kitchen utensils (%)	52.46
Basic kitchen utensils (%)	47.54
Electric grid-connected (%)	23
Basic water service user (%)	86
Propensity to prepare new food (mean ± SD)	5.52 ± 3.21

propensity score for preparing new foods was five and a half (5.52 ± 3.21) out of a possible score of ten.

Table 5 displays the regression analysis results with the Poisson coefficient for the dietary diversity score (column one), the OLS for the mean adequacy ratio (column two), and the logistic coefficient for minimum dietary diversity for women (column three).

The regression analysis (Table 5) showed that having completed secondary level education or higher had a significant and positive impact on the diversity of a person's diet, with improvements of 0.13 and 0.16, respectively, for each education level. However, there was no significant association between higher levels of education and nutrient mean adequacy ratio. Individuals with primary education were 75.60% more likely to achieve minimum dietary diversity than those who could only read and write ($P<0.05$). The analysis also shows that married women had better dietary habits than unmarried women across the three components of dietary diversity score, nutrient mean adequacy ratio, and minimum dietary diversity ($P<0.01$). Being married improved the dietary diversity score by 0.19 and the nutrient mean adequacy ratio by 0.10, while the minimum dietary diversity for women was 3 times higher than for unmarried women ($P<0.01$).

According to the analysis, women with good nutrition knowledge tend to have a better diet. A positive and significant association with dietary diversity scores, nutrient mean adequacy ratio, and minimum dietary diversity showed this. For every one-point increase in nutrition-related knowledge, the dietary diversity score improved by 0.45, and the mean nutrient adequacy ratio improved by 0.18. In contrast, individuals with better nutrition knowledge were 11.53 times more likely to achieve minimum dietary diversity ($P<0.01$).

This regression analysis showed (Table 5) that having a negative attitude toward nutrition was linked to a lower dietary diversity score ($P<0.01$). Specifically, for each point decrease in nutrition-related attitudes, there was a decrease of 0.42 in the dietary diversity score. A negative attitude towards nutrition was associated with 89.2% lower odds of achieving minimum dietary diversity ($P<0.01$). Nutrition-related practices were positively associated with all dietary quality outcomes but were not statistically significant. According to our study (Table 5), there was a positive association between cooking time and dietary diversity for women. Cooking time was significantly related to dietary diversity and minimum dietary diversity ($P<0.05$) and mean adequacy ratio

Table 5 Results of regression analysis on dietary quality outcomes and associated factors in women of reproductive age (15–49 years) in Ethiopia, 2022 ($n=1910$)

Independent variables	DDS	MAR	MDD-W
	Poisson	OLS	Logistic
	β, CI	β, CI	OR, CI
Educational level			
Can read and write	0.061 (-0.659–0.537)	0.104 (-0.193–0.401)	1
Primary	0.071 (-0.013 – 0.156)	0.055 * (0.009–0.101)	1.756 * (1.139–2.709)
Secondary	0.134 *(0.024 – 0.245)	0.022 (-0.041-0.-0.084)	1.691 (0.956–2.992)
More than secondary	0.161 * (0.03–0.292)	0.008 (-0.07–0.086)	1.564 (0.805–3.041)
Marital status			
Married	0.195 ** (0.051–0.34)	0.107 ** (0.032–0.182)	3.376 ** (1.369–8.325)
Divorced/Separated/ widow	0.172 (-0.004–0.348)	0.069 (-0.025–0.162)	2.729 (0.944–7.888)
Knowledge, Attitude, and Practice			
Nutrition-related Knowledge	0.457 ** (0.268 – 0.647)	0.18 ** (0.074–0.287)	11.534 ** (4.33–30.66)
Nutrition-related Attitude	0.42 **(0.638 – 0.209)	0.005 (-0.116 -0.126)	0.108 ** (0.035–0.331)
Nutrition-related Practice	0.161 (-0.24–0.346)	0.076 (-0.029–0.18)	2.125 (0.831–5.431)
Kitchen characteristics			
Cooking time use	0.036 * (0.08 – 0.065)	0.028 ** (0.011–0.044)	1.178 * (1.101–1.365)
Women Time use	-0.001 (-0.001 – 0.009)	-0.005 (-0.01–0.001)	0.994 (0.943–1.048)
Basic kitchen utensils	0.033 (-0.04–0.106)	0.001 (-0.04 – 0.04)	0.961 (0.656–1.409)
Propensity to prepare new food	0.02 ** (0.009 – 0.031)	0.01 ** (0.004 – 0.016)	1.127 ** (1.062–1.197)
Don't eat food I like/aspire	-0.196 ** (-0.277–0.11)	-0.139 ** (-0.185 - -0.093)	-0.284 ** (-0.192 - -0.421)
Constant	0.735 ** (0.49–0.97)	0.641 ** (511–0.771)	0.018 ** (0.004–0.07)

DDS Dietary Diversity Score, MAR Mean Adequacy Ratio, MDD-W Minimum Dietary Diversity for women, OR Odd Ratio, OLS Ordinary Least Square, CI Confidence interval at 95%

** statistically significant at $p<0.01$, * statistically significant at $p<0.05$

($P < 0.01$). With every hour increase in cooking time, the dietary diversity score increased by 0.03, the nutrient mean adequacy ratio by 0.02, and the odd ratio of minimum dietary diversity for women by 17.8%.

The study showed that the propensity to prepare new foods was positively associated with all the indicators($P < 0.01$). Every additional level of risk-taking propensity increased the dietary diversity score by 0.02 and the nutrient mean adequacy ratio by 0.01 and meant that respondents were 12.7% more likely to achieve the minimum diet diversity for women. Being unable to eat the desired food reduced the dietary diversity score by 0.19, the nutrient mean adequacy ratio by 0.13, and meant that respondents were 71.6% less likely to achieve the minimum dietary diversity for women ($P < 0.01$).

Discussion

Nutritional knowledge is important in promoting dietary quality [22, 23], but knowledge of nutrition may not translate into the desired outcomes. It is crucial to supplement knowledge with a positive attitude towards healthy eating and adopt appropriate dietary practices for sustainable dietary quality [24, 25]. This means that individuals must understand the importance of good nutrition and the benefits of healthy eating habits in order to achieve optimal health outcomes. This understanding can, in turn, help in the design of effective interventions to improve women's dietary quality and reduce the burden of diet-related health risks.

Nutrition-related knowledge

It is recommended that infants be fed within an hour of birth, with exclusive breastfeeding for the first six months of life. After six months, complementary foods that are safe and nutritionally adequate should be given while continuing to breastfeed for up to two years of age or more [39]. According to this study, the knowledge score for infant and young child feeding was 67.43%, which is lower than those of other studies conducted in Ethiopia, such as those in the Somali region (Shebel zone 96.1%) and Benishangul Gumez region (Assosa woreda 93.8%) [40, 41]. This may be due to differing cultural practices and traditional knowledge in the perspective regions. They could also benefit from targeted interventions and support from non-governmental organizations, or being close to central hubs may enhance access to health education and services. Studies in central India and Maharashtra also, had higher than this study (83.7% and 90.1%, respectively) [42, 43]. This might be due to educational attainment and socioeconomic status, the specific focus of the study, or community engagement. Our score is higher than the score obtained from a study conducted in the South Omo zone, which reported a score of 54.3% [44]. The South Omo zone may face challenges such as limited healthcare access, fewer trained health professionals, and logistical difficulties in reaching remote areas.

Micronutrients, comprising essential vitamins and minerals, are required in trace amounts, which are crucial in maintaining our overall health and well-being. Even if minor, deficiencies can have profound health consequences, including weakened immunity, developmental delays, and increased susceptibility to chronic diseases. This study revealed that the knowledge score for micronutrients was 45.61%, underscoring participants' moderate level of awareness. Such knowledge is critical for preventing the adverse health outcomes of micronutrient deficiencies. These findings are consistent with the findings of previous studies in Ethiopia [45, 46]. However, the score is higher than those of comparable studies conducted in Iran and Sri Lanka [47, 48].

Malnutrition arises when the body does not receive adequate essential nutrients required for proper growth and functioning. This can occur due to either undernutrition, which results from insufficient nutrients, or overnutrition, which results from consuming more nutrients than the body requires. This study found a knowledge score for malnutrition of 75.30%, which is higher than that reported in a previous study (57.2%) conducted in Kombolcha city, Amhara region of Ethiopia [45]. This may be due to differences in awareness, less effective interventions, and cultural practices in an area not prioritizing nutrition-focused health education. Scores of 19.5% and 52.2% were reported in comparable studies conducted in Sri Lanka and Iran, respectively [47, 48]. The overall score for nutrition-related knowledge was 63.9%, which is in line with other studies conducted in Ethiopia [46, 47].

Nutrition-related attitudes

The principles of nutrition focus on nutrient function, human nutritional requirements, and food sources. In this study, participants were asked about their perception of the importance of these principles, and the majority (65.51%) were found to perceive the benefits of nutrition principles. These findings are consistent with those of other studies conducted in Iran (79.6%) and greater than those conducted in Sri Lanka (46%) [47, 48].

This study analysed women's perceptions of the barriers to nutritional principles and practices and found the majority of the participants (68.25%) perceived barriers to nutritional principles and practices. These findings align with international research, which highlights a variety of socioeconomic, cultural, and educational factors that hinder adherence to recommended dietary guidelines, particularly among women in low and middle-income countries [49, 50].

The study also explored perceptions of susceptibility to nutritional problems and the severity of dietary complications. It found that only a small minority of participants (11.95%) perceived themselves as susceptible to nutritional problems, while slightly more (13.40%) perceived the severity of nutritional problems. This low perception of susceptibility and severity reflects findings in similar studies that suggest a general underestimation of health risks related to poor nutrition [43, 51]. This low attitude may be due to limited nutrition literacy, socioeconomic constraints, gender inequality, dependency on food aid, and low perception of the risks associated with malnutrition consequences. This implies that a negative attitude toward nutrition is linked to poor dietary quality and suggests the need for interventions that address attitudes toward better nutrition and health outcomes.

Nutrition-related practices

This study revealed that approximately one-third of participants (34.39%) practiced proper hand washing, which is consistent with the findings of a similar survey conducted in Ethiopia by Gizaw et al. [52]. Hand washing is a cornerstone of good hygiene and is closely linked to reduced incidences of diarrheal diseases and other infections that compromise nutrient absorption and overall health. A review by Curtis and Cairncross (2003) showed that poor hygiene can exacerbate undernutrition, particularly in resource-constrained settings [53]. Treatment of water before consumption was 14.97%, which was higher than the reported value of 6.5% in the 2016 EDHS report [2]. Safe drinking water is essential for preventing waterborne diseases such as diarrhoea, which depletes essential nutrients and contributes to malnutrition. A study by Fink et al. (2011) in sub-Saharan Africa found that households treating their water had significantly lower rates of child stunting and wasting, emphasizing the importance of safe water for dietary outcomes [54]. We found that 13.08% of the survey participants used so-called clean fuel for cooking, which is higher than the reported value of 7.7% in the Mini EDHS 2019 report [55]. Indoor air pollution has been linked to compromised immune function and increased vulnerability to infections, which in turn can affect dietary quality by reducing the body's ability to utilize nutrients effectively. We observed that the participation of women in cooking demonstrations, however, was very low, at only (2.52%). Studies have shown that women participating in cooking demonstrations are more likely to adopt improved cooking methods, leading to better dietary diversity and quality [56–58].

Kitchen characteristics

This study showed that, on average, women spent approximately six hours daily on home care and cooking. These findings are consistent with those of other studies conducted in Ethiopia [27]. Time constraints adversely affect women's dietary quality through reduced meal preparation time, skipping meals or poor eating patterns, limited participation in cooking demonstrations, and workload and energy requirements. A study by Komatsu et al. (2018) showed that women who have more cooking time have better dietary diversity [59]. Another study by Vemireddy and Pingali (2021) showed that women's time trade-offs are negatively associated with the intake of macro and micronutrients [60]. This finding highlights the critical role of time constraints in shaping women's dietary behaviour and nutritional outcomes. With many women balancing multiple responsibilities, the lack of time for meal preparation and healthy cooking practices may lead to poor dietary quality.

Solid biomass fuel and open tripod stone fires present significant health risks, particularly for women and children, as they are exposed to harmful pollutants that negatively impact nutrition outcomes. Several studies have highlighted the detrimental effect of open pollution on health, with findings consistently linking to poorer nutritional outcomes for women and children [61–66]. In this research, the great majority of participants still rely on solid biomass fuels for cooking, and the use of improved cook stoves remains alarmingly low. These findings echo similar results from previous studies conducted in Ethiopia [2]. This implies that the harmful pollutants emitted by traditional cooking methods are known to exacerbate respiratory problems, reduce overall health, and impair nutritional outcomes.

This study highlights the importance of considering behavioural and household factors as part of efforts to improve the quality of diets in low-income countries such as Ethiopia. It emphasizes the need for nutrition education, greater awareness, the allocation of more time to cooking, and the introduction of new foods to the common diet. These factors can all contribute to improving dietary quality and, in turn, the overall health and well-being of the population. To improve the dietary quality of women, it is imperative that the government of Ethiopia, development partners, and other stakeholders prioritize nutrition mainstreaming in their activities and provide opportunities to increase awareness and knowledge of what constitutes a healthy diet. This can be achieved by implementing various formal and informal educational programs specifically targeting women, thus equipping them with the necessary skills and knowledge to implement healthier practices to enhance the overall quality of diets and promote improved health outcomes for families. Promoting healthy cooking methods, introducing new food crops, and providing access to safe drinking water is also crucial. This comprehensive approach is expected to foster a greater understanding and appreciation of nutrition, encourage a positive mindset, and

ultimately lead to healthier lifestyles for individuals and communities.

Conclusion

The quality of diet is a significant nutritional concern for Ethiopia. Despite the government's efforts to address this through various interventions, more progress needs to be made to meet the required standard. The findings of this study revealed that the average dietary diversity for women across the study area was relatively low, and only one out of five women reached the minimum dietary diversity. The nutrient mean adequacy ratio was far from the required level. This study also explored the factors that influenced dietary quality and revealed that it was positively and significantly influenced by improved nutrition-related knowledge, a positive attitude toward nutrition, additional cooking time, and a propensity to prepare new foods.

Strengths and limitations of the study

A key strength of this study is its comprehensive approach to assessing the influence of KAP on dietary quality. To our knowledge, this is the first national-level study of its kind. However, it is important to note that the research was limited to five of Ethiopia's nine regions due to ongoing conflicts and war, which may restrict the generalizability of the findings. Additionally, the study may not have explored all relevant external and internal factors that contribute to dietary quality. Furthermore, the cross-sectional nature of this study presents notable limitations, as data were collected over a short period, potentially failing to account for seasonal variations in dietary practices and food availability. Additionally, using a single day to observe dietary diversity may not accurately reflect habitual dietary patterns. The reliance on a food frequency questionnaire to estimate average daily energy and nutrient intake may introduce potential biases on over or under-estimation.

Abbreviations

CSA	Central Statistics Agency
DDS	Dietary Diversity Score
EA	Enumeration area
FAO	Food and Agriculture Organization
HICES	Household Income Consumption and Expenditure Survey
KAP	Knowledge, attitudes, and practices
MAR	Mean adequacy ratio
MDD-W	Minimum Dietary Diversity for Women
NAR	Nutrient adequacy ratio

Supplementary Information

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Supplementary Material 1

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Author contributions

TA, conceptualization, design, acquisition, data analysis, interpretation, and writing. MT, conceptualization, design, and acquisition EL, conceptualization, design, data analysis, interpretation, and review All authors review the manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethical approval and consent to participate

The study received approval from the Ethiopian Public Health Institute Institutional Review Board (EPHI-IRB) under reference number EPHI 6–13/140. It involved conducting surveys with women of reproductive age to gather information about their socioeconomic status, food consumption, and knowledge, attitudes, and practices towards nutrition. The participation of all research subjects was voluntary. Informed consent was obtained from all participants and the legal guardian of the participant under 18 years of age, and all procedures were conducted in accordance with relevant guidelines.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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References

1. FAO ECA and AOU. Regional Overview of Food Security and Nutrition Statistics and Trends. FAO. Accra; 2021. https://www.fao.org/3/ca2127en/CA2127EN.pdf
2. CSA and ICF. Ethiopia Demographic and Health Survey 2016. EDHS. Addis Ababa, Ethiopia, and Rockville. Maryland, USA: CSA and ICF.; 2016.
3. Ruel MT. Operationalizing Dietary Diversity: A Review of Measurement Issues and Research Priorities. J Nutr [Internet]. 2003;133(11 SUPPL. 2):3911S-3926S. https://doi.org/10.1093/jn/133.11.3911S
4. FAO. Minimum Dietary Diversity for Women. 2021. 1–176 p. https://doi.org/10.4060/cb3434en
5. FAO. Guidelines for measuring household and individual dietary diversity. Fao. 2010. 1–60 p.
6. Ethiopian Public Health Institute (EPHI). National Food and Nutrition Strategy Baseline Survey. 2022.
7. EPHI. Ethiopia National Food Consumption Survey 2013 Ethiopian Public Health Institute. 2013.
8. Kuche D, Moss C, Eshetu S, Ayana G, Salasibew M, Dangour AD, et al. Factors associated with dietary diversity and length-for-age z-score in rural Ethiopian children aged 6–23 months: a novel approach to the analysis of baseline data from the sustainable undernutrition reduction in Ethiopia evaluation. Matern Child Nutr. 2020;16(1):1–11.

9. Bikila H, Ariti BT, Fite MB, Sanbata JH. Prevalence and factors associated with adequate dietary diversity among pregnant women in Nekemte town. Western Ethiopia. 2023;10(December):1–12.
10. Endalifer ML, Andargie G, Mohammed B, Endalifer BL. Factors associated with dietary diversity among adolescents in Woldia, Northeast Ethiopia. BMC Nutr. 2021;7(1):1–8.
11. Molla W, Mengistu N, Madoro D, Assefa DG, Zeleke ED, Tilahun R, et al. Dietary diversity and associated factors among lactating women in Ethiopia: Cross sectional study. Int J Afr Nurs Sci. 2022;17(June):100450. https://doi.org/10.1016/j.ijans.2022.100450.
12. Abebe T, Mezgebu GS, Feleke FW, Tamrat M. Dietary diversity and associated factors among adolescent girls in Nifas Silk Laphto sub city, Addis Ababa, Ethiopia, 2021. BMC Nutr. 2023;9(1):1–10. https://doi.org/10.1186/s40795-023-00693-1.
13. Schwartz NE. Nutritional knowledge, attitudes, and practices of high school graduates. J Am Diet Assoc. 1975;66(1):28–31. http://europepmc.org/abstract/MED/1110296.
14. Kwol VS, Eluwole KK, Avci T, Lasisi TT. Another look into the knowledge attitude practice (KAP) model for food control: an investigation of the mediating role of food handlers' attitudes. Food Control. 2020;110:107025. https://doi.org/10.1016/j.foodcont.2019.107025.
15. FMOH. National-Nutrition-Strategy.pdf. 2008. pp. 1–17.
16. FMOH. National Nutrition Programme 2013–2015. 2013;(June).
17. FMOH. Food and Nutrition Policy. 2018.
18. FMOH. Government of Ethiopia National Nutrition Program. 2016–20. 2016;(July 2016):1–83.
19. FMOH. Seqota Declaration. Seqota Declar. January 2018:1–15.
20. International Food Policy Research Institute. 2016. Global Nutrition Report 2016: From promise to impact: ending malnutrition by 2030. Washington, DC
21. Ruel MT, Alderman H. Nutrition-sensitive interventions and programmes: how can they help to accelerate progress in improving maternal and child nutrition? Lancet. 2013;382(9891):536–51. https://doi.org/10.1016/S0140-6736(13)60843-0.
22. Alamirew SK, Lemke S, Stadlmayr B, Freyer B. Dietary Behaviour and Sociocultural determinants of Dietary Diversity among Rural women of Reproductive Age: a case of Amhara Region, Ethiopia. Nutrients. 2023;15(15).
23. Mekonen H, Endalifer ML, Assaye BT. Maternal dietary diversity increases with women's high decision-making autonomy in Northwest Ethiopia, 2022. Heliyon. 2024;10(11):e31735. https://doi.org/10.1016/j.heliyon.2024.e31735.
24. Abebe A. Prevalence of Dietary Diversity Practice and Associated Factors among women of Reproductive Age in Asaita districts, Ethiopia. 2024;7(3):1–14.
25. Anyanwu O, Ghosh S, Kershaw M, Abuye C, Kennedy E. The role of Household assets in improving women's Dietary Diversity in Ethiopia. Curr Dev Nutr. 2022;6(4):nzab131. https://doi.org/10.1093/cdn/nzab131.
26. CSA. The 2007 Population and Housing Census of Ethiopia: Federal Democratic Republic of Ethiopia Population Census Commission. 2007;1–125.
27. CSA. Ethiopia Time Use Survey. Central Statistics agency. 2013;1–92.
28. FAO. Guidelines for assessing nutrition-related knowledge, attitudes and practices manual. Control 2014. 1–188 p.
29. FAO. Dietary Assessment: A resource guide to method selection and application in low resource settings. Rome; 2018.
30. Regassa IF, Endris BS, Habtemariam E, Hassen HY, Ghebreyesus SH. Development and validation of food frequency questionnaire for food and nutrient intakes of adults in Butajira, Southern Ethiopia. J Nutr Sci. 2021;10:1–13.
31. Zack RM, Irema K, Kazonda P, Leyna GH, Liu E, Gilbert S, et al. Validity of an FFQ to measure nutrient and food intakes in Tanzania. New Testam Stud. 2018;21(12):2211–20.
32. El Kinany K, Garcia-Larsen V, Khalis M, Deoula MMS, Benslimane A, Ibrahim A, et al. Adaptation and validation of a food frequency questionnaire (FFQ) to assess dietary intake in Moroccan adults. Nutr J. 2018;17(1):1–12.
33. Khamis AG, Mwanri AW, Ntwenya JE, Senkoro M, Kreppel K, Bonfoh B, et al. Design and validation of a food frequency questionnaire to assess the dietary intake for adults in pastoral settings in Northern Tanzania. BMC Res Notes. 2021;14(1):1–7. https://doi.org/10.1186/s13104-021-05692-8.
34. Kennedy G, Razes M, Ballard T, Dop MC. Measurement of Dietary Diversity for monitoring the impact of food-based approaches. Int Symp Food Nutr Secur Food-based approaches Improv diets Rais levels Nutr; 2010.
35. Agren G, Gibson R. Food composition table for use in Ethiopia.:(31pp.).
36. FAO/GOK. Kenya Food Composition [Internet]. 2018. 254 p. Available from: www.kilimo.go.ke/wp-content/../KENYA-FOOD-COMPOSITION-TABLES-2018.pdf
37. Institute of Medicine. Dietary Reference Intakes. 1997.
38. Federal Government of Ethiopia, Ministry of Health EPHI. (2022). Ethiopia: Food-Based Dietary Guidelines–2022. Fed Gov Ethiop Minist Heal Ethiop Public Heal Inst. 2022;108.
39. Fallis A. Infant Young Child Feeding. J Chem Inf Model. 2013;53(9):1689–99.
40. Assefa DG, Woldesenbet TT, Molla W, Zeleke ED, Simie TG. Assessment of knowledge, attitude and practice of mothers/caregivers on infant and young child feeding in Assosa Woreda, Assosa Zone, Benshangul Gumuz Region, Western Ethiopia: a cross-sectional study. Arch Public Heal. 2021;79(1):1–10.
41. Guled RA, Mazlan N, Mamat B, Azdie W, Abu M, Assefa N, et al. Knowledge, attitude and practice of Mothers/caregivers on infant and young child feeding in Shabelle Zone, Somali Region, Eastern Ethiopia: A Cross Sectional Study. Revel Sci. 2016;6(2):42–54.
42. Jain S, Thapar RK, Gupta RK. Complete coverage and covering completely: breast feeding and complementary feeding: knowledge, attitude, and practices of mothers. Med J Armed Forces India. 2018;74(1):28–32. https://doi.org/10.1016/j.mjafi.2017.03.003.
43. Deshpande M, Gokhale D. Knowledge, attitude and practices regarding infant and young child feeding among lactating mothers from rural areas of Nanded, Maharashtra. Biomed Pharmacol J. 2020;13(2):833–41.
44. Tadesse A. Predictors of infant and young feeding practices among children 6–23 months old in Bennatsemayworeda, Ethiopia. J Nutr Heal Food Eng. 2018;8(6).
45. Tessema DG, Girma E, Mekonnen TC, Mebratu W. The extent of maternal nutritional knowledge and practice during lactation in Kombolcha Town, South Wollo Zone, Ethiopia: a mixed study design. Int J Womens Health. 2020;12:79–87.
46. Ambikapathi R, Passarelli S, Madzorera I, Canavan CR, Noor RA, Abdelmenan S, et al. Men's nutrition knowledge is important for women's and children's nutrition in Ethiopia. Matern Child Nutr. 2021;17(1):1–13.
47. Ahadi Z, Heshmat R, Sanaei M, Shafiee G, Ghaderpanahi M, Homami MR, et al. Knowledge, attitude and practice of urban and rural households towards principles of nutrition in Iran: results of NUTRIKAP survey. J Diabetes Metab Disord. 2014;13(1):1–7.
48. Weerasekara PC, Withanachchi CR, Ginigaddara GAS, Ploeger A. Food and nutrition-related knowledge, attitudes, and practices among reproductive-age women in marginalized areas in Sri Lanka. Int J Environ Res Public Health. 2020;17(11):1–24.
49. WHO. Global nutrition policy review: 2013.
50. Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, De Onis M, et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. Lancet. 2013;382(9890):427–51.
51. Kigaru DMD, Loechl C, Moleah T, Macharia-Mutie CW, Ndungu ZW. Nutrition knowledge, attitude and practices among urban primary school children in Nairobi City, Kenya: a KAP study. BMC Nutr. 2015;1(1):1–8. https://doi.org/10.1186/s40795-015-0040-8.
52. Gizaw Z, Demissie NG, Gebrehiwot M, Destaw B, Nigusie A. Hand hygiene practice and associated factors among rural communities in northwest Ethiopia. Sci Rep. 2023;13(1):1–8. https://doi.org/10.1038/s41598-023-30925-0.
53. Curtis V, Cairncross S. Effect of washing hands with soap on diarrhoea risk in the community: a systematic review. Lancet Infect Dis. 2003;3(5):275–81.
54. Fink G, Günther I, Hill K. The effect of water and sanitation on child health: evidence from the demographic and health surveys 1986–2007. Int J Epidemiol. 2011;40(5):1196–204.
55. Ethiopian Public Health Institute (EPHI), ICF. Ethiopia Mini Demographic and Health Survey 2019: Final Report. 2021. 1–207 p. https://dhsprogram.com/pubs/pdf/FR363/FR363.pdf
56. Mizehoun-Adissoda C, Morou K, Edjrokinto H, Padonou GSR, Mahounou JR, Flénon A, et al. Participatory cooking demonstrations for mothers improve feeding practices of young children in southern Benin. North Afr J Food Nutr Res. 2023;8(17):149–58.
57. Pienaah CKA, Saaka SA, Yengnone HZ, Molle MN, Luginaah I. Does government food demonstration intervention influence household dietary diversity in the Upper West Region of Ghana? PLoS ONE. 2024;19(5 May):1–18. https://doi.org/10.1371/journal.pone.0302869.
58. Sato Y, Khamphithoun S, Saiyachak K, Ando H, Ishizuka T, Saeki S, et al. Enhancing child dietary diversity through cooking demonstration and nutritional education in rural Lao PDR. Trop Med Health. 2024;52(1). https://doi.org/10.1186/s41182-023-00571-3.
59. Komatsu H, Malapit HJL, Theis S. Does women's time in domestic work and agriculture affect women's and children's dietary diversity? Evidence

from Bangladesh, Nepal, Cambodia, Ghana, and Mozambique. Food Policy. 2018;79(July 2017):256–70. https://doi.org/10.1016/j.foodpol.2018.07.002.
60. Vemireddy V, Pingali PL. Seasonal time trade-offs and nutrition outcomes for women in agriculture: evidence from rural India. Food Policy. 2021;101(March):102074. https://doi.org/10.1016/j.foodpol.2021.102074.
61. Gizachew B, Tolera M. Adoption and kitchen performance test of improved cook stove in the Bale Eco-region of Ethiopia. Energy Sustain Dev. 2018;45:186–9. https://doi.org/10.1016/j.esd.2018.07.002.
62. Gebreegziabher Z, Beyene AD, Bluffstone R, Martinsson P, Mekonnen A, Toman MA. Fuel savings, cooking time and user satisfaction with improved biomass cookstoves: evidence from controlled cooking tests in Ethiopia. Resour Energy Econ. 2018;52:173–85. https://doi.org/10.1016/j.reseneeco.2018.01.006.
63. Hooper LG, Dieye Y, Ndiaye A, Diallo A, Sack CS, Fan VS, et al. Traditional cooking practices and preferences for stove features among women in rural Senegal: informing improved cookstove design and interventions. PLoS ONE. 2018;13(11):1–15.
64. Anderman TL, DeFries RS, Wood SA, Remans R, Ahuja R, Ulla SE. Biogas Cook stoves for healthy and sustainable diets? A case study in Southern India. Front Nutr. 2015;2.
65. Vigolo V, Sallaku R, Testa F. Drivers and barriers to clean cooking: a systematic literature review from a consumer behavior perspective. Sustain. 2018;10(11).
66. Waswa F, Mcharo M, Mworia M. Declining wood fuel and implications for household cooking and diets in tigania sub-county Kenya. Sci Afr. 2020;8:e00417. https://doi.org/10.1016/j.sciaf.2020.e00417.

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