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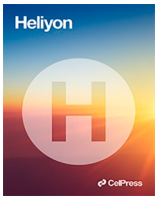

Research article

Maternal dietary diversity increases with women's high decision-making autonomy in Northwest Ethiopia, 2022

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ABSTRACT

Background: Dietary diversification is one of several approaches for improving micronutrient levels in women of reproductive age. Therefore, this study aimed to assess the magnitude of minimum dietary diversity among pregnant women, explore the association between women's decision-making autonomy and dietary diversity, and identify other potential determinants of dietary diversity in Northwest Ethiopia.

Method: A community-based cross-sectional study of 621 pregnant women was conducted from November 2022 to December 2022. A cluster random sampling technique was employed. A binary logistic regression model was used to explore the association between dietary diversity and women's decision-making autonomy. Adjusted odds ratios with 95 % CIs were estimated to identify factors associated with the dietary diversity of pregnant women, and they were considered to be statistically significant at a *P*-value <0.05.

Results: The minimum dietary diversity among pregnant women was 22.4 %. The study revealed a significant association between dietary diversity and women's decision-making autonomy (AOR: 2.82, 95 % CI: 1.73, 4.59; p value: 0.001). Primary education and above (AOR = 4.0, CI: 2.1, 7.67), monthly income 1000–2000 ETB (AOR = 4.46, CI: 2.53, 7.87) and >2000 ETB (AOR = 6.05, CI: 3.16, 11.59), having nutritional information (AOR = 2.15, CI: 1.32, 3.51), being food secure (AOR = 2.63, CI:1.6, 4.34), morbidity status (AOR: 0.278, CI: 0.14, 0.56), ANC visits one time (AOR = 2.08, CI = 1.003, 4.33) and two or three times (AOR = 2.45, CI: 1.15, 5.24) were potential predictors of pregnant women's dietary diversity.

Conclusion: Maternal dietary diversity was significantly associated with women's decision-making autonomy. Thus, the government should strengthen women's empowerment, rights, access to education, and economic opportunities.

1. Background

Poor diet quality is responsible for at least one-fifth of maternal deaths, as well as an increased risk of poor pregnancy outcomes such as preterm birth, low birth weight, and intrauterine growth restriction [1]. More than 170 million children in the world do not have the opportunity to reach their full potential because of inadequate diversified food intake during pregnancy [2]. In countries where food security is poor and resources are limited, diets are based on monotonous staples with inadequate animal products, fresh

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fruits and vegetables; thus, meeting minimum standards of dietary quality is a challenge [3]. As a result, micronutrient malnutrition, such as iron, vitamin A, iodine, and zinc, is highly prevalent among pregnant women. Furthermore, a poor and undiversified diet hurts individuals' health, well-being, and development by reducing physical capacity and resistance to infection, cognitive development, reproduction, and even social capacity [4]. In Ethiopia, the content and quality of the diet consumed by women do not improve when they are becoming pregnant [5]. Even some women deliberately decrease their food intake in the second and third trimesters to have a smaller fetus and easier delivery. The other reasons why some women decrease their food intake are because they experience nausea and an aversion to certain foods [5–7]. In one study conducted in rural Ethiopia, poor diet quality was found to be the cause of maternal anemia in 32.8 % of pregnant women, LBW in 9.1 %, preterm birth in 13.6 %, and stillbirth in 4.5 % of pregnant women [8].

Dietary diversity is defined as the number of foods or food groups consumed over a given time period [9]. A diverse diet can meet not only well-established needs but also unknown needs for mothers and fetuses. It is a newly developed proxy measure of the nutrient adequacy of an individual's diet [10]. Dietary diversity is usually computed by adding the number of foods consumed or, more often, by counting the number of food groups consumed over a reference period [11]. Dietary diversity (DD) is one of the benchmarks of the World Health Organization for assessing an individual's feeding habits and forecasting health consequences. Adequate nutrient intake during pregnancy has a critical role in improving maternal nutritional status and healthy fetal growth and development. To ensure adequate nutrient intake, the consumption of a diversified diet is one of several approaches for improving the micronutrient levels of women of reproductive age [12–14]. Studies have indicated that women's dietary diversity is determined by many factors, including residence, marital status, educational status, family size, occupation, wealth index, antenatal care follow-up, land ownership, household food security status, nutrition information, and women's empowerment [15–18]. Of the seventeen sustainable development goals set by the World Health Organization (WHO), gender equity and women's empowerment are the fifth goal to be achieved by 2030 [19]. The success of gender equality and women's empowerment could contribute to the achievement of other goals, such as zero stunting and reducing maternal and child mortality [20]. Many studies have revealed the positive effect of women's empowerment on dietary quality and household livelihood outcomes [21–23]. Although various indicators are used to measure women's empowerment, household decision-making autonomy is a major dimension of women's empowerment because it is strongly linked to dietary diversity and nutritional status [24–26]. When women have control over assets and high decision-making power, they are more likely to invest in health, education, and nutrition, which in turn impacts health outcomes and sustainable development [21,23,27]. Further evidence indicated that women's participation in decision-making regarding household purchases was significantly associated with the achievement of greater dietary diversity [28,29].

A dietary method of nutritional assessment is used for screening individuals who are at risk of developing malnutrition and provides evidence about the necessity of appropriate nutritional interventions. The current study area, the East Belessa rural district, is one of 47 food-insecure and seriously drought-affected mountainous areas in the region [30]. Therefore, we hypothesized that pregnant women residing in this area may are at greater risk of not achieving their minimum dietary diversity and that their diet quality is influenced by women's decision-making autonomy. In addition, no studies have examined the association between women's decision-making autonomy and dietary diversity in the study area of interest. Therefore, this study aimed to assess the magnitude of adequate dietary diversity among pregnant women, explore the association between pregnant women's decision-making autonomy and dietary diversity, and investigate other potential predictors of pregnant women's dietary diversity in Northwest Ethiopia.

2. Methods

2.1. Study setting, design and period

A community-based cross-sectional study was carried out among pregnant women in the rural district of East Bellessa in Northwest Ethiopia from November 2022 to December 2022. The East Belessa rural district borders the south by the Debub Gondar Zone, the west by the Mirab Belessa, the north by Jan Amora, and the east by the Wag-Hemra Zone. It is located 734 km away from Addis Ababa, the capital city of Ethiopia, and 169 km away from Bahir Dar, the capital city of the Amhara regional state. The district is located at elevations ranging from 1496 to 2000 m above sea level. Approximately 90 % of the district is desert (kola), with low annual rainfall resulting in frequent drought and famine [30]. The district comprises nineteen and five rural and urban kebeles (the smallest administrative unit), respectively. According to a woreda health administration report, the district has a total population of 142,529 people, of whom 5804 are pregnant women. People depend on agriculture and cultivate cereals such as teff, sesame, beans, maize, sorghum, barley, and wheat.

2.2. Populations, sample size determination and sampling technique

All pregnant women living in all rural kebeles (the smallest administration unit) of East Belessa district were considered source populations, whereas pregnant women in the selected rural kebeles composed the study population. The sample size was computed using a single population proportion formula by considering the following assumptions: the proportion of minimum dietary diversity among pregnant women (p = 59.6 %) [31], a confidence interval of 95 % (Z1-α/2 = 1.96), a margin of error (d = 5 %), a nonresponse rate of 10 %, and a 1.5 design effect based on the assumption of homogeneity between study subjects in the clusters. The final required sample size was 612.

A random cluster sampling technique was used. Clusters were rural kebeles. A list of kebeles was used as a sampling frame; thus, out of nineteen rural kebeles, six kebeles were selected by a random sampling technique. Although the minimum required sample size for this study was 612, all pregnant women resided under the cluster were candidates to participate in the study since cluster sampling

technique was employed. Then, pregnant women were identified from the pregnant women registration book after being identified as pregnant by health extension workers using a pregnancy confirmation test. As a result, 645 pregnant women who met the eligibility criteria were obtained from the selected clusters.

2.3. Data collection procedure and tools

A structured face-to-face interviewer-administered questionnaire adapted from the EDHS 2016 was used to collect demographic, economic and health-related data [32]. The data were collected by four well-trained nutrition professionals with previous experience in data collection. Pregnant women's food security status was measured using nine questions adapted from the Food and Agriculture Nutrition Technical Assistance III (FANTA III) household food insecurity access scale (HFIAS) that are applicable to individuals [33]. Each of the questions under the HFIAS was asked with a recall period of four weeks (30 days) prior to the data collection period. The respondent was asked whether the condition in the question happened at all in the past four weeks (yes or no). All "Yes" responses were coded "1", "No" responses were coded "0", and the scores were summed. Pregnant women who had a food insecurity index of 2 or above were considered food insecure; otherwise, they were considered food secure. To measure the internal consistency of the data collection tool, a Cronbach's alpha test was conducted, and it was found a high internal consistency (Cronbach's alpha = 0.81).

Women's decision-making autonomy, the main explanatory variable, was assessed using three questions. The women were asked if they participated in decisions regarding their healthcare-seeking behavior, major household purchases, and visiting their families or relatives. A score of "1" was given if the woman participated in the decision-making either alone or jointly with her husband/partner, while a score of "0" was assigned if the decision was made by her husband or partner. Accordingly, women's participation in the decision-making process is considered "high" if they are involved in all three activities mentioned above, either alone or jointly with their husbands/parents; otherwise, their participation is considered "low" [32].

The assessment of pregnant women's dietary diversity, the outcome variable of the study, was made based on the Food and Agriculture Organization (FAO) guidelines for measuring women's dietary diversity, which are composed of ten food groups: (1) cereals, grains and tubers, (2). Legumes, (3). Nuts and seeds, (4). Vitamin A-rich fruits and vegetables. (5). Other fruits, (6). Other vegetables, (7). Dark green leafy vegetables, (8). Eggs, (9). Meat, poultry, and fish, (10). Milk and milk products [34]. A 24-h dietary recall method was used to assess pregnant women's dietary diversity. Answers were coded for each food group as "1" if the respondent consumed any food item from that specific food group in the previous 24-h period; otherwise, they were coded as "0". Furthermore, to assess the presence of any morbidity, we asked the participants to recall and tell us whether they had been encountered any sickness in the previous two weeks, and recorded "yes" if they had felt illness; otherwise, recorded "no".

To ensure the quality of the data, the questionnaire was initially prepared in English and then translated into Amharic and returned to English to check consistency. One week prior to the main fieldwork, a pretest was conducted on 5 % of pregnant women from other kebeles who were not enrolled in the study, and amendments were made depending on the results of the pretest.

2.4. Operational definitions

Adequate dietary diversity: Consumption of five or more food groups out of the ten food groups recommended by the Food and Agriculture Organization (FAO); otherwise, it is considered inadequate dietary diversity [34].

Women's high decision-making autonomy: If women were able to decide or participate in all three major activities, such as a decision on her healthcare-seeking behavior, major household purchases, and visiting her family or relatives either alone or jointly with her husband or partners, they considered high decision-making autonomy [32].

Nutritional information, defined as pregnant women's exposure to the importance of consuming a diversified diet to maintain the health of both mothers and the fetus, may come from health extension workers, media, and/or parents.

Pregnant women were defined as women who were registered in the pregnant women registration book after being identified as pregnant by health extension workers using a pregnancy confirmation test. Whereas, trimester was determined by asking the woman to count how many days or weeks had passed since the first day of her last menstrual period.

Access to home gardening: defined as the cultivation of fruits, vegetables, and other crops in or around their homestead, which allows easy access to a variety of foods that may not be available on the market [35].

Land ownership: For our purpose, land ownership is defined as a valuable asset that owners can use to access credit or sell for cash when they face an economic crisis and are used to harvest cereals and pulses, which leads to diverse crop production. Livestock ownership refers to the rearing of any type of animal, which plays a role in achieving food security and dietary diversity [35,36].

2.5. Data analysis and statistics

The data were entered into Epidata version 3.1 and exported to the Statistical Package for the Social Sciences (SPSS) software version 23.0 for analysis. To explore the association between dietary diversity and maternal household decision-making autonomy, a binary logistic regression model was used. Then, variables that showed an association in the unadjusted model at a *P*-value of <0.2 were considered for further analyses. Multicollinearity was checked by considering the variance inflation factor (VIF) and standard error, and none of the variables had a VIF greater than 10.0 or a standard error greater than 2.0. Adjusted odds ratios with 95 % CIs were estimated to identify factors associated with the dietary diversity of pregnant women, and they were considered to be statistically significant at a *P*-value ≤ 0.05. The Hosmer–Lemeshow goodness of fit test model coefficient was found to be insignificant, with a large *P*-value (0.96), which indicates the fitness of the model.

2.6. Ethical consideration

This study involved human subjects, and all research methods and procedures were performed in accordance with the Declaration of Helsinki, and it was approved by Bahir Dar Institute of Technology, Faculty of Chemical and Food Engineering Institutional Research Ethics Review Committee (IRERC), which was registered under ethical approval number BiT/FCFE/5082/2014. Further permission was obtained from the East Belessa Woreda Administration. The purpose of the study was explained to the respondents, and informed consent was obtained from all subjects. The confidentiality of the information was maintained, and the collected data were kept in the form of a file in a secure place where no one could access it except for the investigators. The authors had no access to information that could identify individual participants during or after data collection.

3. Results

3.1. Sociodemographic and economic characteristics of the respondents

Of the 645 pregnant women, 621 with an age range of 15–38 years were included, with a response rate of 96.28 %. More than half of the study participants (57.5 %) were aged between 25 and 34 years. The majority of participants (95.65 %) were orthodox, and 94.8 % of them were married. Concerning educational status, 68.7 % of the participants were unable to read and write. With respect to respondents' occupation, 95.2 % were housewives. Of the total, 53.3 % of the husbands were unable to read and write. Concerning the decision-making autonomy measurement items, 42.20 % of pregnant women were involved in major household purchases, 62.64 % of them participated in their decision to own health care, and 34.78 % of them were involved in deciding whether to visit their families or parents. Overall, 58.1 % of pregnant women had high decision-making autonomy. Out of the total pregnant women, 44.6 % of them earned a monthly income less than 1000 ETB, 40.7 % earned 1000–2000 ETB, and 14.7 % earned more than 2000 ETB. From the total

Table 1
Sociodemographic and economic characteristics of pregnant women in Northwest Ethiopia, 2022 (n = 621).

Variable	Categories	Frequency	Percent (%)
Age (in years)	15–24	218	35.10
	25–34	35 7	57.50
	35–49	46	7.40
Religion	Orthodox	599	96.46
	Muslim	22	3.54
Marital status	Married	589	94.80
	Divorced	19	3.10
	Widowed	13	2.10
Respondent educational status	Unable to read and write	445	71.70
	Able to read and write	105	16.90
	Primary education	63	10.10
	Secondary education and above	8	1.30
Occupation of respondents	Housewife	591	95.20
	Government employed	5	0.80
	Laborer	25	4.00
Husband educational status	Unable to read and write	331	53.30
	Able to read and write	190	30.60
	Primary education	85	13.70
	Secondary education and above	15	2.40
Family size	≤3	184	29.60
	4–5	258	41.50
	>5	179	28.80
Family monthly income	<1000 ETB	277	44.60
	1000–2000 ETB	253	40.70
	>2000 ETB	91	14.70
Farm land ownership	No	177	28.50
	Yes	444	71.50
Access to home gardening	No	556	89.50
	Yes	65	10.50
Ownership of live stocks	No	92	14.80
	Yes	529	85.20
Participation in decision of own health care	Alone or jointly with her husband/parents	389	62.64
	Husband/parents only	232	37.36
Participation in decision of major household purchase	Alone or jointly with her husband/parents	262	42.20
	Husband/parents only	359	57.81
Participation in decision of visiting families and relatives	Alone or jointly with her husband/parents	216	34.78
	Husband/parents only	405	65.21
Women's decision-making autonomy	Low	260	41.90
	High	361	58.10
Food insecurity	Yes	267	43.00
	No	354	47.00

pregnant women, 71.5 % of them had farmland, while only 10.5 % of pregnant women had their own home gardens. Of the respondents, 85.2 % were owners of livestock (Table 1).

4. Reproductive and health characteristics of the respondents

Of the total, 39.6 % of the participants had more than three pregnancies. With respect to gestation, 50.1 % were in the second trimester. Regarding antenatal care practices, 19.5 % of pregnant women did not receive ANC follow-up. Similarly, 52.3 % of the respondents received nutritional information, 94.8 % from health institutions and 5.2 % from mothers and relatives. Among the participants enrolled in the study, 22.4 % reported suffering from different morbidities. Regarding supplementation, nearly half (49.9 %) of the participants received iron/folate supplementation. A few participants (13.2 %) had a habit of food prohibition, such as fruits and vegetables (43.9 %), fat and oils (15.9 %), brassica seeds (25.6 %) and fast food/kolo and fruits (14.6 %). The main reason for food prohibition was food taboo (61.0 %) (Table 2).

4.1. Magnitude of pregnant women's dietary diversity

According to the data for foods consumed by pregnant women obtained using a 24-h recall, the median dietary diversity score was three. The mean dietary diversity score with a standard deviation was 3.41 ± 1.19 SD, the number of food groups consumed ranged from two to seven, and no one consumed all ten food groups. Overall, only 22.4 % of pregnant women achieved adequate dietary diversity scores, which is recommended by the FAO 2016 (≥five food groups) [34]. The most commonly consumed food group was cereals (100 %), followed by pulses (80.8 %) and other vegetables (72.6 %) (Fig. 1).

4.2. Association between pregnant women's dietary diversity and decision-making autonomy

Bivariate analysis showed that the achievement of adequate dietary diversity among pregnant women was positively associated with women's high decision-making autonomy. Further analysis revealed that women's decision-making autonomy was still an independent predictor of women's dietary diversity in the adjusted model. Pregnant women who had high household decision-making autonomy were 2.82 times more likely to achieve minimum dietary diversity than those who had low decision-making autonomy (AOR = 2.82, 95 % CI: 1.73, 4.59). In the bivariate analysis, variables with a p value < 0.2 were considered for multivariate analysis to rule out the effect of confounders. Variables such as maternal educational status, family income, ANC visits, nutritional information, and food security status were positively and significantly associated with pregnant women's dietary diversity (p value < 0.05). On the other hand, experiencing morbidity in the last two weeks had a significant negative association with pregnant women's dietary diversity. In this study, we found that pregnant women who had completed primary education and above were almost 4.10 times more likely to attain minimum dietary diversity than those who were unable to read and write (AOR = 4.10, 95 % CI: 2.10, 7.67). With

Table 2
Reproductive and health characteristics of pregnant women in Northwest Ethiopia, 2022 (n = 621).

Variable	Categories	Frequency	Percent (%)
Parity	First time	179	28.80
	One-three times	196	31.60
	More than three times	246	39.60
Gestational age	First trimester	124	19.96
	Second trimester	311	50.10
	Third trimester	186	29.95
ANC visit	None	121	19.50
	One visit	267	43.00
	Two-three visits	158	25.40
	Four and more	75	12.10
Nutritional information	Yes	325	52.30
	No	296	47.70
Sources of nutrition information	Health institution	308	94.80
	Mother and relatives	17	5.20
Morbidity in the past two weeks	Yes	139	22.40
	No	482	77.60
Iron/folate supplementation	Yes	310	49.9
	No	311	50.10
Food prohibition	Yes	82	13.20
	No	539	86.8
Food items prohibited	Fruits and vegetables	36	43.90
	Fat and oils	13	15.90
	Brassica seed	21	25.60
	Fast foods/kolo	12	14.60
Main reason of food prohibition	Food taboo	50	61.00
	Food aversion	12	14.60
	Did not know its importance	20	24.40

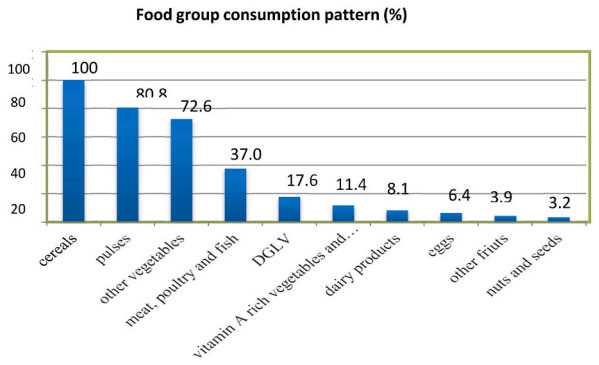

Fig. 1. Patterns of pregnant women's food group consumption patterns based on past 24-h recall in Northwest Ethiopia, 2022.

regard to family monthly income, those who had an estimated monthly income of 1000–2000 ETB had a 4.46-fold increase in the chance of achieving minimum dietary diversity compared to those who had an estimated monthly income of less than 1000 ETB (AOR = 4.46, 95 % CI: 2.53, 7.87), and those who had an estimated monthly income greater than 2000 ETB had an increased likelihood of attaining minimum dietary diversity by 6.05-fold compared to those who had an estimated monthly income of less than 1000 ETB (AOR = 6.05, 95 % CI: 3.15, 11.6).

With respect to morbidity, pregnant women who reported having morbidity had a 72.2 % lower likelihood of achieving minimum dietary diversity (AOR = 0.28, 95 % CI: 0.14, 0.56) than those who had not been sick. In addition, pregnant women who had one ANC visit (AOR = 2.08, 95 % CI: 1.003, 4.33) and two to three ANC visits (AOR = 2.45, 95 % CI: 1.15, 5.24) had greater odds of adequate dietary diversity than those who had not attended ANC. This study also showed that pregnant women who had nutritional information had a 2.15-fold greater chance of adequate dietary diversity than those who did not have nutritional information (AOR = 2.15, 95 % CI: 1.32, 3.51). Furthermore, pregnant women from food-secure households were almost 2.63-fold more likely to have minimum dietary diversity than pregnant women from food-insecure households (AOR = 2.63, 95 % CI: 1.60, 4.33) (Table 3).

5. Discussion

This study revealed that only 22.4 % of pregnant women achieved adequate dietary diversity (≥5 food groups). This finding was much lower than the findings of studies conducted in Pakistan (89 %) [37], Kenya (61 %) [38], Bangladesh (37 %) [39], Northern

Table 3
Binary logistic regression analysis of factors associated with adequate dietary diversity among pregnant women in Northwest Ethiopia, 2022 (n = 621).

Variable	Categories	Adequate dietary diversity		COR (95 % CI)	AOR (95 % CI)
		Yes	No		
Respondent education	Unable to read and write	71	374	1	1
	Able to read and write	33	72	2.41 (1.49, 3.92)	1.71 (0.98, 2.99)
	Primary education and above	35	36	5.12 (3.015, 8.7)	4.0 (2.10, 7.67)*
Husband education	Unable to read and write	61	270	1	1
	Able to read and write	41	149	1.22(0.78, 1.9)	1.07(0.63, 1.79)
	Primary education	28	57	2.17(1.28, 3.7)	0.92 (0.48, 1.74)
	Secondary education and above	9	6	6.64(2.28,19.35)	2.26 (0.63, 8.10)
Family monthly Income	<1000 ETB	24	253	1	1
	1000-2000 ETB	77	176	1.61(2.81, 7.58)	4.46 (2.53, 7.87)*
	>2000 ETB	38	53	2.56(4.19,13.64)	6.05(3.16, 11.6)*
Number of ANC visit	No	15	106	1	1
	One times	63	204	2.18(1.16, 4.02)	2.1(1.003, 4.33)*
	Two-three times	40	118	2.39(1.25, 4.58)	2.45 (1.15, 5.24)*
	Four and above times	21	54	2.75(1.31, 5.75)	1.94 (0.79, 4.75)*
Morbidity in the past two weeks	No	127	355	1	1
	Yes	12	127	0.26 (0.14,0.49)	0.28 (0.14, 0.56)*
Nutritional information	No	48	248	1	1
	Yes	91	234	2.01(1.36, 2.97)	2.15 (1.32, 3.51)*
Women decision making autonomy	Low	36	224	1	1
	High	103	258	2.48 (1.63, 3.78)	2.82(1.73, 4.59)*
Food insecurity	Yes	35	232	1	1
	No	104	250	2.76 (1.81, 4.21)	2.63 (1.6, 4.34)*

The superscript * indicates a statistically significant association.
AOR: Adjusted odds ratio, CI: Confidence interval, COR: Crude odds ratio; Maximum standard error = 0.65, Hosmer–Lemeshow test of goodness of model fit statistics (p = 0.96).

Ghana (46.1 %) [40], two provinces of Burkina Faso (Sanduie (40 %) and Sourou (30 %) [41], Tanzania (46 %) [42] and Togo (45 %) [43]. The possible reason for this discrepancy may be differences with respect to sociodemographic, economic (repeated occurrence of drought in the study area), and health characteristics of the population and sample size. On the other hand, the finding of our study was consistent with studies performed in rural Mali (27 %) [44] and Shashemene district, Oromia, Ethiopia (25.4 %) [45].

The current study revealed that women's decision-making autonomy was an independent predictor of pregnant women's dietary diversity in the adjusted model. Achievement of adequate dietary diversity was significantly higher among women with high decision-making autonomy. This finding is similar to those of other studies conducted in Bangladesh [46], Ghana [47], and Ethiopia [48,49]. Autonomy is the ability to obtain information and make decisions about one's own concerns [50,51]. It facilitates access to material resources such as food, land, income, and social resources such as knowledge and prestige that are important for improving dietary quality. In particular, women's autonomy in healthcare and major purchasing decision making is highly important for better maternal and child health outcomes [52–54]. Women with high decision-making autonomy tend to consume a more diverse range of foods and provide their families with a more varied diet, as they have greater access to household resources. Previous studies have shown that programs that target women are more effective since women are more likely to spend their resources on education, health, and nutrition [22,49]. However, their decision-making power regarding food choices is often limited by cultural norms, gender inequalities, educational status and lack of access to resources [55–57]. This may have negative consequences for dietary diversity and health and nutritional outcomes. Thus, government and development partners can support women's decision-making autonomy and empower them by investing in programs that promote gender equality and women's rights. For instance, a community-based intervention conducted in Bangladesh involves empowering women through the provision of nutrition education, behavioral change communication, and awareness creation strategies on the benefits of consumption of diversified diets, sustainable agriculture, and natural resource management in rural areas. This contributed to enhancing women's economic access to nutritious foods, improving nutrition knowledge, stimulating nutrition-sensitive spending, and allocating other household resources [58]. Another interventional study carried out in Bangladesh revealed effective women's empowerment through the delivery of training on agriculture, aquaculture, and market development, as well as challenging gender barriers to agriculture, health, and nutrition practices by incorporating husbands and other household members into the program [59]. There is also promising evidence regarding women's empowerment interventions from low and middle-income countries that focus on the social empowerment of women and girls (including life skills, safe spaces, and mentoring), which significantly reduces women's and girls' experiences of violence and increases women's self-confidence [60].

An interventional study undertaken in South Africa also indicated significant positive effects of multi-sectoral approaches (social, health, education, and economic) on women's primary school completion, sexual and reproductive health knowledge, social safety nets, financial literacy, savings behavior, and household economic status [61]. In addition, providing literacy and legal rights training and credit can improve women's decision-making power on household matters and enable them to take individual or collective action with local authorities, which helps them to spend more household resources for family well-being, including food, clothing, education, and health care [62]. Furthermore, the women's association was another successful women's empowerment strategy that helped them gain experience in decision-making and managing local development activities, participate in new political structures, reduce social tensions, and promote unity [63].

Pregnant women with primary education and above were more likely to achieve adequate dietary diversity than pregnant women who were unable to read and write. This is in line with the findings of studies in Kenya [38], Shashemene, Oromia [45], and Northeast Ethiopia [64]. The reason is that educated pregnant women have good food choices due to knowledge about the importance of food and can easily understand educational messages transferred through different media outlets. Additionally, pregnant women who have received formal education may have greater awareness about how to utilize available resources to improve their diet quality. However, this finding was different from the results of studies conducted in Nekemet town, Ethiopia [65], Gindeberet district, Oromia, Ethiopia [66], and the Afar region of Ethiopia [67], since they reported an insignificant association between educational status and pregnant women's dietary diversity. Family monthly income was significantly associated with dietary diversity in pregnant women. The odds of adequate dietary diversity was higher among those who had a family monthly income of 1000 ETB and above compared to those who had a monthly income of less than 1000 ETB. Similar observations were revealed in studies conducted in Northeast Ethiopia [64] and Nigeria [68]. The logic behind this is that women with higher incomes may have the power to purchase food from the market even if it is not available at home. Controversially, a study carried out in Southwest Ethiopia revealed a nonsignificant association between monthly income and pregnant women's dietary diversity [64]. The variation might be due to the standards used to categorize monthly income levels.

The presence of nutritional information was another independent variable that was positively associated with adequate dietary diversity among pregnant women. Women who had nutrition information via different outlets had a greater chance of achieving adequate dietary diversity than those with no nutrition information. Studies conducted in other parts of Ethiopia have reported similar findings to our study [64,69,70]. Having nutrition information helps pregnant women to have better knowledge and understanding about the importance of consuming diversified diets in maintaining good health and pregnancy outcomes. Similarly, pregnant women who attended ANC one or two or three times had an increased likelihood of adequate dietary diversity compared to non-attenders. A possible reason might be that pregnant women attending ANC receive nutritional counseling regarding the benefit of diversifying their diet and healthy eating behaviors. In addition, during ANC visits, women may get information on locally available food sources.

Another non-surprising finding of the current study was a positive significant association between adequate dietary diversity and being food secure. Pregnant women from food-secure households were 2.63 times more likely to have adequate dietary diversity than pregnant women that were from food-insecure households. This finding is in line with studies carried out in rural Mali [71], rural Bangladesh [39], and Angena, southern Ethiopia [72]. Another factor that was negatively associated with pregnant women's dietary

diversity was morbidity. This finding is in line with a study done in Kenya (16). For women exposed to some morbidities, the odds of adequate dietary diversity decreased by 72.2 % compared to their counterparts. This might be because of poor appetite, poor food preferences and choices, and inability to enjoy work, which leads to limited food access even for daily consumption. In contrast, studies performed in Shashemene town [45] and Gindeberet district, Oromia, Ethiopia [66], revealed no association between morbidity in the previous week and the dietary diversity of pregnant women.

5.1. Strengths and limitations of the study

The strength of the study was its attempt to include many pregnant women, who were from rural areas, the most vulnerable group due to a lack of access to information, while many studies were conducted in urban areas. This may provide insight for the design of nutrition-sensitive interventions for the study area. In addition, as the study used an open-ended questionnaire, participants were able to report any foods and beverages they had consumed without restriction, which helped provide a precise estimate of the dietary diversity score. However, since a 24-h our dietary recall was used, it does not indicate pregnant women's habitual diet and its respective amounts. As the study design was cross-sectional, it does not show the causal effect relationship between the explanatory variables and the outcome variables of the study.

6. Conclusion

Although diverse diets best ensure nutrient adequacy and benefit optimal pregnancy outcomes, the magnitude of adequate dietary diversity among pregnant women in the rural East Belessa district, Northwest Ethiopia, was low (22.4 %). Dairy products, eggs, other fruits, nuts, and seeds were minimally consumed. We found that women's decision-making autonomy was a significant predictor of their dietary diversity. The study also revealed that women's educational status, family income, ANC practices, nutritional information, morbidity status, and food security status were significantly associated with the dietary diversity of pregnant women. Thus, the government should strengthen women's empowerment, rights, access to education, and economic opportunities.

In addition, health extension workers should provide regular advice to women about the nutritional benefits of consuming different food groups, especially animal sources of food, fruits and vegetables. Moreover, healthcare providers should pay attention to the importance of early detection and timely treatment of diseases.

Consent for publication

Not applicable.

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Funding was not obtained for this study.

Ethics statement

This study involved human subjects, and all research methods and procedures were performed in accordance with the Declaration of Helsinki, and it was reviewed and approved by Bahir Dar Institute of Technology, Faculty of Chemical and Food Engineering Institutional Research Ethics Review Committee (IRERC) [approval number: BiT/FCFE/5082/2014]. All participants provided informed consent to participate in the study.

Data availability statement

The data associated with this study will be made available upon reasonable request.

CRediT authorship contribution statement

Habitamu Mekonen: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Melese Linger Endalifer:** Writing – review & editing, Validation, Methodology, Investigation, Formal analysis, Data curation. **Bayou Tilahun Assaye:** Writing – review & editing, Writing – original draft, Validation, Formal analysis, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2024.e31735.

Abbreviations

AOR	adjusted odds ratio
ANC	antenatal care
CI	confidence interval
COD	crude odds ratio
DD	dietary diversity
DDS	dietary diversity score
EDHS	Ethiopian demographic health survey
ETB	Ethiopian Birr
FAO	Food and Agriculture Organization
NGO	Non-Governmental Organization
SPSS	Social Package for Social Science
UNICEF	United Nations Children's Fund
WHO	World Health Organization

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