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Nourishing diversity: exploring the relationship between food variety and anemia status among women workers

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ABSTRACT

Introduction: Anemia in working women is a significant health issue as it can reduce productivity, concentration and well-being. High workload, unbalanced food consumption patterns, and limited access to sources of iron and other micronutrients increase the risk of anemia.

Objective: This study aims to analyze food diversity related to the type and amount of food consumed by anemic and non-anemic women workers.

Method: This study used a cross-sectional design involving 140 women workers in rubber plantations in Seluma Regency, Bengkulu Province, Indonesia. Samples were taken using stratified random sampling technique. Anemia status was determined through biochemical examination and food consumption data was collected through 24-hour food recall method and minimum dietary diversity for women (MDD-W) indicator. The relationship between variables was analyzed using the correlation test.

Results: The prevalence of anemia among women workers was 35%, women workers with primary education had a higher prevalence of anemia (71.4%) compared to those with secondary education (18.1%). In the lowest income quintile the prevalence of anemia reached 42.9%, while in the highest income quintile it was only 20.6%. Women workers without anemia had better food consumption diversity (73.9%) than the anemia group (26.1%).

Conclusion: Education level, income and diverse food consumption had a significant relationship with anemia status. Consumption of tempeh, chicken liver, sardines and green leafy vegetables such as moss, moringa and melinjo leaves support iron sufficiency and play a role in preventing anemia

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KEYWORDS

Iron, micronutrients, nutritional deficiency, women's health.

INTRODUCTION

Anemia is a global health problem that is directly related to the Sustainable Development Goals (SDGs), especially SDG 3 which focuses on health and well-being. Anemia in women of childbearing age is an important indicator that reflects malnutrition and underlying health problems. The main causes of anemia in this group are low nutrient intake, infections, and health conditions that can inhibit iron absorption[1]. Iron is an essential component of heme, the part of hemoglobin that binds oxygen. When iron levels in the body decrease, hemoglobin production also decreases, which in turn leads to a reduced ability of blood to transport oxygen to body tissues. This results in a decline in overall body function, affecting energy, physical endurance and cognitive health[2]. Anemia occurs when hemoglobin levels in the blood are lower than normal (<120 g/L) and is the main indicator for detecting iron deficiency. Iron deficiency anemia occurs when an adequate number of red blood cells cannot be maintained due to iron deficiency[3]. In 2021, it is estimated that about 33.7% of women aged 15-49 years worldwide suffer from anemia[1]. In Indonesia, the prevalence of anemia among women of childbearing age who were pregnant in 2018 reached 48.9%[4]. Despite some changes, the prevalence of anemia among women of childbearing age is still high in some regions. The main factors leading to this are iron deficiency and limited access to nutritious food[5].

Working women, especially those who do physical work such as in plantations, have a higher risk of developing anemia. This is due to working conditions that are often unhealthy and difficult to access[6]. In addition, conditions such as menstruation and pregnancy in women require an increase in adequate iron intake. If these needs are not met, then women become more susceptible to anemia[7]. Anemia also affects productivity, especially in those who perform heavy manual work. The reduction in productivity due to anemia has been recorded at 17%, and women workers are 1.4 to 2.6 times more likely to suffer from anemia than male workers[8].

Inadequate consumption of iron-containing foods is a major pathway to iron deficiency anemia because iron intake cannot meet the needs of hemoglobin and erythrocyte synthesis[9]. Increased dietary diversity has been shown to be associated with adequate micronutrient intake in women[10]. Studies on dietary diversity and iron deficiency anemia in women of childbearing age show that dietary diversity is a major factor influencing iron deficiency anemia[11,12], but these studies have not further examined the types of food consumed and associated with anemia conditions in women workers. Therefore, it is necessary to further study food diversity related to the type and amount of food consumed by anemic and non-anemic women workers to become a guideline in handling iron deficiency anemia in women workers.

RESEARCH METHOD

This study used a cross-sectional design and was conducted from February to April 2024 in a rubber plantation located in Seluma Regency, Bengkulu Province, Indonesia. This location was chosen because it has more than 200 women rubber tappers, as well as the willingness of the company to collaborate in the implementation of the study. The sample in this study consisted of women workers aged between 19 and 36 years who met the criteria for participation, namely not being pregnant and willing to become respondents by signing an informed consent letter. The sample size was determined based on the one-proportion estimation formula with an absolute level of precision[13]. Based on the calculation results, a sample size of 140 women workers was obtained. This study was approved by the Faculty of Public Health, Universitas Airlangga with permit number 41/EA/KEPK/2024. Prior to participation, each women worker who agreed to take part in this study received a full explanation of the purpose and procedures of the study, and they then gave written consent to participate. Measurement of hemoglobin level, which serves as an indicator of anemia status, was performed using a hematology analyzer type Mindray BC-10 [14]. In determining the severity of anemia, a person is considered not anemic if the blood hemoglobin level reaches or exceeds 120 g/L. Mild anemia is defined by hemoglobin levels in the range of 110-119 g/L, while moderate anemia is characterized by hemoglobin levels between 80-109 g/L. Severe anemia occurs when the hemoglobin level is below 80 g/L [3].

Data on respondent characteristics including age, education level and income were collected through a structured questionnaire. To determine the type and amount of food consumed, a food consumption survey was conducted using the 24-hour food recall method with a multiple-pass approach. This method is carried out by recording all foods and beverages consumed by respondents within the previous 24 hours, starting from the first food or drink consumed in the morning to the last food or drink in that period[15]. The types of food consumed were categorized by food group to assess the diversity of food consumption according to the Minimum Dietary Diversity for Women (MDD-W) indicator. Food types mentioned by respondents during the food consumption survey were classified according to food groups at the end of the interview. Micronutrient adequacy was considered achieved if a woman consumed at least five of the ten predefined food groups within 24 hours with a minimum consumption requirement of 15 grams per food type to be counted in the score. The scoring of this indicator is dichotomous, meaning that it yields a "yes" or "no" answer regarding the achievement of minimum food consumption diversity. If a woman consumes at least five of the ten recommended food groups in a 24-hour period, then the scoring result is "yes", indicating that the level of food consumption diversity has been achieved. Conversely, if the number of food groups consumed is less than five, the assessment is "no"[16]. For the amount of food consumed, it is calculated based on the median value of the consumption portion of each type of food within 24 hours.

Data processing and analysis were performed using the Statistical Program for Social Sciences (SPSS) software version 26 and Microsoft Excel Windows version 2019. A Mann Whitney U-test was conducted to determine the difference between two independent samples, the relationship between variables was analyzed using the Spearman rank correlation test that considers the level of significance, where a p-value <0.05 indicates a statistically significant relationship between the variables tested[17].

RESULT

Anemia status of women workers is obtained through examination of blood hemoglobin (Hb) levels, the average hemoglobin level of women workers was 126.2 g/L, with the lowest level being 101 g/L and the highest reaching 153 g/L. Based on severity, 35% of women workers were found to be anemic, of which 33.6% were in the mild anemia category and 1.4% in the moderate anemia category, with no women workers with severe anemia. Based on this percentage of anemia coverage, anemia among women workers is classified as a moderate public health problem[18].

Table 1 illustrates the characteristics of women workers in relation to anemia status. In the age variable, the proportion of anemia in different age groups does not show significant differences. For example, in the 19-25 age group, 25% of women workers are anemic, while in the 31-36 age group, the prevalence of anemia is slightly higher at 34.3%. In con-

Table 1. Characteristics of women workers

Variables	Anemia status		Total n (%)	*p* value
	Anemia n (%)	Non-anemic n (%)		
Age (year)				
19-25	2 (25.0)	6 (75.0)	8 (100)	0.979[1]
26-30	23 (37.1)	39 (62.9)	62 (100)	
31-36	24 (34.3)	46 (65.7)	70 (100)	
Education				
Primary education (6 years)	15 (71.4)	6 (28.6)	21 (100)	0.000[1]
Lower secondary education (9 years)	21 (44.7)	26 (55.3)	47 (100)	
Upper secondary education (12 years)	13 (18.1)	59 (81.9)	72 (100)	
Income				
Quintile 1	15 (42.9)	20 (57.1)	35 (100)	0.069[2]
Quintile 2	11 (31.4)	24 (68.6)	35 (100)	
Quintile 3	16 (44.4)	20 (55.6)	35 (100)	
Quintile 4	7 (20.6)	27 (79.4)	35 (100)	

1Mann Whitney U test.

trast, education level showed significant differences. Women workers with primary education (6 years) had a high prevalence of anemia, at 71.4%, compared to those with upper secondary education (12 years) who were only 18.1% anemic. The majority of women workers with upper secondary education, 81.9%, were not anemic. In the income variable, although the difference in anemia status between groups was not significant, an interesting trend was observed. In the lowest income quintile (quintile 1), 42.9% of women workers were anemic, while in the highest income quintile (quintile 4), only 20.6% were anemic. In contrast, the majority of women workers in the highest quintile, 79.4%, were not anemic.

More than half of the women workers did not meet the minimum dietary diversity. Non-anemic women workers had better food consumption diversity (73.9%) than anemic women workers (26.1%) and the difference was statistically significant (table 2). Variations in food consumption in terms of both types and amounts of food among anemic and non-anemic women workers are presented in table 3.

Table 2. Diversity of food consumption

Variable	Anemia status		Total n (%)	*p* value*
	Anemia n (%)	Non-anemic n (%)		
Diversity of food consumption				
Meet minimum food consumption diversity (≥5 food groups)	6 (26.1)	17 (73.9)	23 (100)	0.001
Does not meet minimum food consumption diversity (<5 food groups)	43 (36.8)	74 (63.2)	117 (100)	

*Mann Whitney U test.

Table 3. Food consumption pattern

Food group, food item	Food consumption						Iron per 100g EPW (mg)	*p* value[2]
	Anemia (n = 49)			Non-anemic (n = 91)				
	Yes n (%)	No n (%)	Portion[1] (g)	Yes n (%)	No n (%)	Portion[1] (g)		
Grain, white rout and tubers, plantains	49 (100)	0 (0.0)		91 (100)	0 (0.0)			1.000
Glotinous rice	0 (0.0)	49 (100)	0	1 (1.1)	90 (98.9)	50	3.4	
Vermicelli, dried	1 (2.0)	48 (98.0)	50	1 (1.1)	90 (98.9)	10	1.8	
Ketupat	0 (0.0)	49 (100)	0	1 (1.1)	90 (98.9)	60	0.2	
Yellow noodles	1 (2.0)	48 (98.0)	120	6 (6.6)	85 (93.4)	130	1.3	
Rice	49 (100)	0 (0.0)	200	91 (100)	0 (0.0)	250	0.4	
Rice flour	0 (0.0)	49 (100)	0	4 (4.4)	87 (95.6)	40	0.8	
Wheat flour	9 (18.4)	40 (81.6)	20	21 (23.1)	70 (76.9)	15	1.3	
Noodles, dried	4 (8.2)	45 (91.8)	75	9 (9.9)	82 (90.1)	75	3.9	
Potato	3 (6.1)	46 (93.9)	60	6 (6.6)	85 (93.4)	52	0.7	
Sago palm	3 (6.1)	46 (93.9)	60	4 (4.4)	87 (95.6)	60	0.1	
Cassava	4 (8.2)	45 (91.8)	200	9 (9.9)	82 (90.1)	180	1.1	
Plantain	2 (4.1)	47 (95.9)	125	7 (7.7)	84 (92.3)	150	0.8	
Beans, peas and lentil	17 (34.7)	32 (65.3)		69 (75.8)	22 (24.2)			0.000
Mungbeans	1 (2.0)	48 (98.0)	10	2 (2.2)	89 (97.8)	30	7.5	
Tempeh	14 (28.6)	35 (71.4)	50	43 (47.3)	48 (52.7)	80	4.0	
Tofu	4 (8.2)	45 (91.8)	50	24 (26.4)	67 (73.6)	100	2.2	
Nuts and seeds	1 (2.0)	48 (98.0)		12 (13.2)	79 (86.8)			0.031
Peanut	1 (2.0)	48 (98.0)	10	12 (13.2)	79 (86.8)	17	4.1	
Dairy	0 (0.0)	49 (100)		0 (0.0)	91 (100)			1.000
Meat, poultry and fish	43 (87.7)	6 (12.3)		67 (73.6)	24 (26.4)			0.053
Beef	0 (0.0)	49 (100)	0	2 (2.2)	89 (97.8)	30	2.8	
Beef sausage	0 (0.0)	49 (100)	0	1 (1.1)	90 (98.9)	40	1.1	
Chicken	5 (10.2)	44 (8.,8)	60	14 (15.4)	77 (84.6)	60	1.5	
Chicken liver	0 (0.0)	49 (100)	0	3 (3.3)	88 (96.7)	30	15.8	
Chicken gut	0 (0.0)	49 (100)	0	1 (1.1)	90 (98.9)	30	8.4	
Fried anchovy	5 (10.2)	44 (89.8)	30	5 (5.5)	86 (94.5)	30	1.7	
Mullet fish	1 (2.0)	48 (98.0)	73	0 (0.0)	91 (100)	0	0.4	
Salt fish, dried	11 (22.4)	38 (77.6)	35	20 (21.9)	71 (78.1)	40	0.0	
Skipjack fish	2 (4.1)	47 (95.9)	67	4 (4.4)	87 (95.6)	80	2.9	
Cork fish	0 (0.0)	49 (100)	0	1 (1.1)	90 (98.9)	75	2.0	
Cutlassfish	0 (0.0)	49 (100)	0	6 (6.6)	85 (93.4)	60	2.2	
Carp fish	2 (4.1)	47 (95.9)	67	0 (0.0)	91 (100)	0	2.0	
Tilapia	2 (4.1)	47 (95.9)	72	3 (3.3)	88 (96.7)	80	1.0	
Long jawed mackarel fish	1 (2.0)	48 (98.0)	80	0 (0.0)	91 (100)	0	0.8	

Abbreviations: EPW, edible portion weight; g, gram; mg, milligram. [1] Using the 5th percentile. [2] Mann Whitney U test.

Table 3 continuation. Food consumption pattern

Food group, food item	Food consumption						Iron per 100g EPW (mg)	p value[2]
	Anemia (n = 49)			Non-anemic (n = 91)				
	Yes n (%)	No n (%)	Portion[1] (g)	Yes n (%)	No n (%)	Portion[1] (g)		
Scad fish	3 (6.1)	46 (93.9)	40	6 (6.6)	85 (93.4)	60	0.5	
Catfish	0 (0.0)	49 (100)	0	1 (1.1)	90 (98.9)	80	1.6	
Fresh sardines	3 (6.1)	46 (93.9)	58	8 (8.8)	83 (91.2)	80	2.9	
Sepat fish	1 (2.0)	48 (98.0)	60	0 (0.0)	91 (100)	0	0.4	
Mackarel tuna fish	11 (22.4)	38 (77.6)	75	6 (6.6)	85 (93.4)	85	1.7	
Fresh anchovy	0 (0.0)	49 (100)	0	1 (1.1)	90 (98.9)	65	3.9	
Shrimp	0 (0.0)	49 (100)	0	1 (1.1)	90 (98.9)	25	8.0	
Eggs	12 (24.5)	37 (75.5)		28 (30.8)	63 (69.2)			0.434
Broiler eggs	12 (24.5)	37 (75.5)	40	28 (30.8)	63 (69.2)	65	3.0	
Quail eggs	0 (0.0)	49 (100)	0	1 (1.1)	90 (98.9)	45	3.1	
Dark green leafy vegetables	30 (61.2)	19 (38.8)		66 (72.5)	25 (27.5)			0.171
Spinach	5 (10.2)	44 (89.8)	77	13 (14.3)	78 (85.7)	80	0.5	
Leunca leaves	1 (2.0)	48 (98.0)	40	4 (4.4)	87 (95.6)	50	6.1	
Moringa leaves	2 (4.1)	47 (95.9)	55	1 (1.1)	90 (98.9)	65	6.0	
Pumpkin leaves	3 (6.1)	46 (93.9)	60	0 (0.0)	91 (100)	0	2.5	
Melinjo leaves	0 (0.0)	49 (100)	0	1 (1.1)	90 (98.9)	25	4.2	
Fiddlehead ferns leaves	2 (4.1)	47 (95.9)	80	8 (8.8)	83 (91.2)	80	2.3	
Papaya leaves	0 (0.0)	49 (100)	0	5 (5.5)	86 (94.5)	50	0.8	
Cassava leaves	10 (20.4)	39 (79.6)	72	27 (29.7)	64 (70.3)	75	1.3	
Genjer leaves	0 (0.0)	49 (100)	0	4 (4.4)	87 (95.6)	65	2.1	
Chinese convolvulus leaves	5 (10.2)	44 (89.8)	80	11 (12.1)	80 (87.9)	80	2.3	
Sauropus leaves	2 (4.1)	47 (95.9)	55	3 (3.3)	88 (96.7)	55	3.5	
Chives fresh	0 (0.0)	49 (100)	0	1 (1.1)	90 (98.9)	50	1.1	
Other vitamin A–rich fruit and vegetables	5 (10.2)	44 (89.8)		16 (17.6)	75 (82.4)			0.245
Mangos	0 (0.0)	49 (100)	0	2 (2.2)	89 (97.8)	120	1.0	
Papaya	0 (0.0)	49 (100)	0	4 (4.4)	87 (95.6)	150	1.7	
Tomatoes	5 (10.2)	44 (89.8)	25	13 (14.3)	78 (85.7)	25	0.6	
Carrot	4 (8.2)	45 (91.8)	21	11 (12.1)	80 (87.9)	55	1.0	
Sweet potato yellow	0 (0.0)	49 (100)	0	5 (5.5)	86 (94.5)	120	0.4	
Other vegetables	36 (73.5)	13 (26.5)		76 (83.5)	15 (16.5)			0.158
Beansprouts	3 (6.1)	46 (93.9)	30	2 (2.2)	89 (97.8)	50	1.3	
Fresh bean	4 (8.2)	45 (91.8)	32	8 (8.8)	83 (91.2)	60	0.5	
Papaya flower	2 (4.1)	47 (95.9)	27	1 (1.1)	90 (98.9)	35	4.2	
Sweet corn	2 (4.1)	47 (95.9)	55	6 (6.6)	85 (93.4)	55	0.5	
Oyster mushrooms	0 (0.0)	49 (100)	0	2 (2.2)	89 (97.8)	75	0.7	

Abbreviations: EPW, edible portion weight; g, gram; mg, milligram. [1] Using the 5th percentile. [2] Mann Whitney U test.

Table 3 continuation. Food consumption pattern

Food group, food item	Food consumption						Iron per 100g EPW (mg)	*p* value[2]
	Anemia (n = 49)			Non-anemic (n = 91)				
	Yes n (%)	No n (%)	Portion[1] (g)	Yes n (%)	No n (%)	Portion[1] (g)		
Banana flower	1 (2.0)	48 (98.0)	113	1 (1.1)	90 (98.9)	120	0.1	
Broadbeans	0 (0.0)	49 (100)	0	2 (2.2)	89 (97.8)	80	0.7	
Yardlong beans	10 (20.4)	39 (79.6)	71	22 (24.2)	69 (75.8)	75	0.6	
Cauliflower	1 (2.0)	48 (98.0)	30	0 (0.0)	91 (100)	0	1.1	
Cucumber	1 (2.0)	48 (98.0)	83	3 (3.3)	88 (96.7)	75	0.8	
Cabbage	5 (10.2)	44 (89.8)	40	11 (12.1)	80 (87.9)	50	0.5	
Kundur	0 (0.0)	49 (100)	0	1 (1.1)	90 (98.9)	125	0.5	
Chayote	3 (6.1)	46 (93.9)	85	2 (2.2)	89 (97.8)	70	2.5	
Turnip	1 (2.0)	48 (98.0)	60	0 (0.0)	91 (100)	0	0.6	
Leunca fresh	0 (0.0)	0 (0.0)	0	1 (1.1)	90 (98.9)	50	1.0	
Melinjo fresh	1 (2.0)	48 (98.0)	30	1 (1.1)	90 (98.9)	15	2.8	
Squash	2 (4.1)	47 (95.9)	72	1 (1.1)	90 (98.9)	85	0.9	
White paria	2 (4.1)	47 (95.9)	45	1 (1.1)	90 (98.9)	60	0.9	
Papaya unripe	0 (0.0)	49 (100)	0	2 (2.2)	89 (97.8)	100	0.4	
Jackfruit raw	0 (0.0)	49 (100)	0	3 (3.3)	88 (96.7)	100	0.5	
Stinky bean	2 (4.1)	47 (95.9)	50	6 (6.6)	85 (93.4)	65	1.6	
Bamboo shoots	6 (12.2)	43 (87.8)	120	8 (8.8)	83 (91.2)	130	0.5	
Rimbang fresh	1 (2.0)	48 (98.0)	35	3 (3.3)	88 (96.7)	45	0.6	
Chinese cabbage	1 (2.0)	48 (98.0)	52	7 (7.7)	84 (92.3)	80	1.1	
Eggplant	5 (10.2)	44 (89.8)	80	16 (17.6)	75 (82.4)	85	0.4	
Other fruit	19 (38.8)	30 (61.2)		30 (32.9)	61 (67.1)			0.493
Dragon fruit	1 (2.0)	48 (98.0)	120	2 (2.2)	89 (97.8)	150	0.9	
Sweet oranges	1 (2.0)	48 (98.0)	60	2 (2.2)	89 (97.8)	100	0.4	
Avocado	1 (2.0)	48 (98.0)	50	1 (1.1)	90 (98.9)	150	0.9	
Duku	2 (4.1)	47 (95.9)	125	4 (4.4)	87 (95.6)	110	0.9	
Durian fresh	1 (2.0)	48 (98.0)	150	0 (0.0)	91 (100)	0	0.4	
Coconut flesh	0 (0.0)	49 (100)	0	1 (1.1)	90 (98.9)	120	1.4	
Langsat	0 (0.0)	49 (100)	0	2 (2.2)	89 (97.8)	125	1.1	
Longan	0 (0.0)	49 (100)	0	1 (1.1)	90 (98.9)	100	0.5	
Mangosteen	0 (0.0)	49 (100)	0	1 (1.1)	90 (98.9)	100	0.8	
Jackfruit ripe	0 (0.0)	49 (100)	0	1 (1.1)	90 (98.9)	150	0.9	
Banana ambon	1 (2.0)	48 (98.0)	160	1 (1.1)	90 (98.9)	120	0.2	
Banana kepok	2 (4.1)	47 (95.9)	150	4 (4.4)	87 (95.6)	150	0.5	
Banana uli	1 (2.0)	48 (98.0)	120	0 (0.0)	91 (100)	0	0.9	
Ramboosteen	11 (22.4)	38 (77.6)	150	13 (14.3)	78 (85.7)	200	0.5	
Sapodilla	0 (0.0)	49 (100)	0	1 (1.1)	90 (98.9)	100	1.0	

Abbreviations: EPW, edible portion weight; g, gram; mg, milligram. [1] Using the 5th percentile. [2] Mann Whitney U test.

Table 4. Correlation of education, income and food consumption with anemia status (Hb level)

Variables	Median (IQR)	Anemia status*	
		r	*p*
Education	1.600.000,00 (600.000,00)	0.347	0.000
Income	3.000.000,00 (1.500.000,00)	0.248	0.003
Diversity of food consumption	5 (1)	0.212	0.012
Consume beans, peas and lentil	1 (1)	0.342	0.000
Consume nuts and seeds	0 (0)	0.087	0.308

* Spearman rank correlation test.

All women workers consumed grain white rout and tubers, such as rice, with a higher portion in the non-anemic group (250 grams) than in the anemic group (200 grams). The food groups of bean peas and lentil as well as nuts and seeds showed significant differences. Women workers without anemia consumed more foods such as tempeh and tofu with a portion of 80 grams of tempeh containing 3.2 mg of iron, compared to the anemic group who only consumed 50 grams (2.0 mg of iron). Mungbeans, although little consumed, contributed the highest iron (7.5 mg for 100 grams), mainly consumed by the non-anemic group. Likewise, peanuts were consumed more by the non-anemic group with an iron contribution of 4.1 mg in 100 grams. In the animal food group, the consumption pattern shows the dominance of food consumption that contributes to iron intake in non-anemic women workers. Consumption of chicken liver as one of the highest sources of iron (15.8 mg for 100 grams) was only found in the non-anemic group. Fresh sardines were also consumed more by the non-anemic group, with a portion of 80 grams contributing 2.3 mg of iron, compared to the anemic group who only consumed 58 grams. Other types of fish, such as skipjack, fresh anchovies, and shrimp, were also consumed more frequently by non-anemic women workers.

Dark green leafy vegetables also showed a higher consumption pattern in the non-anemic group. Iron-rich leunca leaves (6.1 mg for 100 grams) were consumed more frequently by the non-anemic group than the anemic group. Other dark green leafy vegetables such as moringa leaves, melinjo leaves and katuk which contribute to iron intake are also consumed by women workers although in small amounts. Vitamin A-rich fruits and vegetables such as papaya, red tomatoes and carrots were consumed more frequently by the non-anemic group although with a small additional iron contribution. Meanwhile, other vegetable groups that contribute to iron intake such as chayote, melinjo fruit and papaya flower were found in the consumption pattern of women workers.

Table 4 presents the relationship between education level, income, and various aspects of food consumption with anemia status as measured by hemoglobin (Hb) levels. Correlation analysis showed a significant positive relationship between education level and anemia status, indicated by a correlation value (r) of 0.347 and $p < 0.001$. The analysis showed a significant positive relationship between income and anemia status, with a correlation value of 0.248 and a p value of 0.003. This indicates that higher income is associated with improved anemia status among female workers. Diverse food consumption was also analyzed, the correlation between diverse food consumption and anemia status showed a significant positive relationship, with a correlation value of 0.212 and a p value of 0.012. This indicates that more diverse food consumption tends to contribute positively to the improvement of anemia status. Meanwhile, the analysis showed a highly significant positive relationship between the consumption of this type of food and anemia status, with a correlation value of 0.342 and a p value of <0.001. This finding indicates that consumption of lentils and legumes plays an important role in improving anemia status. No significant association was found between consumption of these food types and anemia status.

DISCUSSION

Anemia, especially in the mild category, often goes undetected and can affect an individual's quality of life. Anemia can result in a variety of health problems, including fatigue, decreased endurance, and impaired concentration. Education and income levels are factors that influence anemia status. Women with low education have less access or opportunity to obtain information about proper nutrition and how to maintain a balanced food consumption pattern. This lack of knowledge can lead to suboptimal food consumption decisions such as low consumption of iron-rich foods[19]. Likewise, income can influence food consumption decisions. Studies on food consumption diversity in low- and middle-income countries conclude that there is inadequate consumption of diverse foods and micronutrient intake in most women[20]. Individuals with low incomes prioritize food quantity over nutritional quality, choosing cheaper and less varied foods when their income is limited[21,22]. Conversely, individuals with good disposable income have higher dietary diversity[23].

Iron in food consists of two types: heme iron found in animal foods such as red meat, fish and poultry, and non-heme iron found in plant foods such as beans, legumes and green leafy vegetables. Heme iron is absorbed more efficiently (15-35%) than non-heme iron (2-10%)[24]. Vitamin C and amino acids in the diet can increase the absorption of non-heme iron[25]. The mechanism occurs through increasing the solubility of non-heme iron and reducing its form to ferrous iron which is more easily absorbed by the body. Once absorbed through the gut, iron enters the intestinal mucosal cells and is bound by the protein ferritin as a form of temporary storage. Iron is then released into the bloodstream and transported by transferrin to the bone marrow, where red blood cell formation occurs. Iron is used in the production of hemoglobin, a protein in red blood cells responsible for carrying oxygen from the lungs to the rest of the body. Iron deficiency inhibits hemoglobin production leading to anemia and decreased oxygen-carrying capacity[26]. In addition to the need for iron, several other micronutrients also play a role in the prevention and treatment of anemia. Vitamin A, for example, helps mobilize iron from reserves in the body and vitamin B12 and folic acid are important for the formation of healthy red blood cells[27].

Anemia status is closely related to the diversity of food consumption. A less diverse diet has the potential to cause deficiencies in several important micronutrients such as iron and vitamin A which are associated with the risk of anemia[28]. There is a significant correlation between inadequate food consumption and low iron status, low consumption of iron-containing foods ultimately increases the risk of anemia[29]. The higher the food diversity, the more likely it is that women can meet their micronutrient needs[30]. The results showed that non-anemic women workers had better food consumption diversity than anemic women workers, with statistically significant differences. All respondents consumed grain white roots and tubers, but there was variation in other food types. The non-anemic group consumed more beans peas and lentils such as tempeh and tofu, with a larger portion of tempeh than the anemic group. Mung bean consumption, although limited, made a significant iron contribution and was more dominant in the non-anemic group. In the nuts and seeds group, peanuts were more frequently consumed by non-anemic women workers. Animal food consumption also showed a dominant pattern in the non-anemic group, especially chicken liver which was only consumed by this group. Fresh sardines, skipjack, fresh anchovies, and shrimp were also consumed more frequently with larger portions than the anemia group. Dark green leafy vegetables such as leunca, moringa, melinjo, and sauropus leaves were consumed more frequently by the non-anemic group, making an important contribution to iron intake. In addition, vitamin A-rich fruit and vegetables such as papaya, tomatoes, and carrots were consumed more by the non-anemic group, although their contribution to iron intake was relatively small. Some other vegetables such as chayote, melinjo fresh, and papaya flower are also part of the consumption pattern of women workers. Overall, the non-anemic group showed a more diverse and iron-rich food consumption pattern, especially from animal food sources, beans, peas, and dark green leafy vegetables.

CONCLUSION

Education level, income, consumption of diversified foods, and consumption of beans peas and lentils food groups had a significant association with anemia status. This shows the importance of education, economy and specific food consumption patterns in influencing anemia status in women workers. Women workers without anemia have more varied consumption patterns with larger portions, especially in iron-rich foods such as tempeh, chicken liver, fresh sardines and dark green leafy vegetables such as leunca, moringa and melinjo leaves. These food consumption patterns support iron sufficiency and play a role in preventing anemia.

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