Relationship between variables and anemia status among female workers

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Abstract. One of the micronutrient problems that becomes a worldwide concern, including Indonesia, is iron deficiency anemia. Anemia status in workers can result in reduction of health and work productivity. This study examines anemia status and factors associated with anemia in female workers. The research was conducted among 343 female production workers at a cigarette company in Kudus Regency, Central Java, Indonesia. The variables were hemoglobin levels, age, BMI, MUAC, energy and protein intake, and caffeine consumption. Instruments used include an Easy touch Hb test to check hemoglobin levels, weight scales, and microtoise for body height to calculate BMI, MUAC measuring tapes, Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) in a month for determining energy, protein, and caffeine intake. The results showed that 141 subjects (41.1%) experienced anemia, including 59 mild, 73 moderate, and 9 severe anemia. Factors related to anemia status among female workers include age, energy adequacy, protein adequacy, and caffeine consumption. Meanwhile, BMI and MUAC variables were not related to anemia status. Risk factors for anemia in women under 50 years of age include adequate/excessive energy intake, adequate protein deficit, and caffeine consumption of more than two glasses per day.

1 Introduction

Iron deficiency anemia is a nutritional problem that remains a significant international issue in several countries worldwide. According to the World Health Organization (WHO), the prevalence of iron deficiency anemia ranges from 35 to 75% in developing countries, primarily affecting children and women of childbearing age [1]. In 2018, WHO reported a global anemia prevalence of 29.6%, among women of reproductive age, with the highest prevalence in Southeast Asia at 46.3%. Indonesia ranks in Southeast Asia, with 30.4% of women of childbearing age affected by anemia. This group, which predominantly consists of workers, is particularly vulnerable to iron deficiency anemia [2]. Health and nutritional issues reduce individual well-being, leading to fatigue and decreased work productivity [3].

Anemia is defined as a condition where the hemoglobin (Hb) level falls below the normal range for individuals' gender and age. Women are classified as anemic if their Hb level is less than12 g/L. The red blood cells reduction in the body will affect a person's physiological

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needs, women of childbearing age are more at risk of experiencing anemia. This vulnerability is linked to factors such as their body image, physical activity, and menstrual cycle. Lack of iron in the body results in reduced hemoglobin formation in red blood cells, leading to inadequate oxygen transport to all body tissues. An imbalance in iron consumption with the body's needs causes iron deficiency anemia [4].

In 2021, women constituted 39.52% (51.79 million) of the working population aged 15 years and older in Indonesia. Among female workers, 20.51% were employed as production personnel, transportation equipment operators, and unskilled workers [5]. Research by Sihombing and Riyadina (2009) on workers in the Jakarta industrial area showed that the prevalence of anemia in women was six times greater compared to men [6]. If not addressed properly, anemia in workers can negatively impact health and reduce work productivity. Iron deficiency leads to fatigue and lethargy, diminishing work capacity and productivity. These may result in lower wages, exacerbating economic challenges. Widiastuti's (2011) study of workers in sarong weaving factories found a positive correlation between hemoglobin levels and work productivity, indicating that lower hemoglobin levels are associated with reduced productivity [7].

Several factors that cause anemia in women include age, nutritional status (BMI) [8], mid-upper arm circumference (MUAC) [9], adequacy level of energy and protein [10], and caffeine consumption [11]. A cigarette factory in Kudus Regency, Central Java, Indonesia employs thousands of female workers aged 18–60 years as production personnel. Initial observation results showed that several workers who exhibited thin or overweight body types, appeared pale, and frequently experienced dizziness. Additionally, workers consumed 1-2 glasses of tea daily, provided by the factory. Therefore, to support the health and productivity of workers, it is necessary to assess anemia status and its related factors in female workers in cigarette factories.

2 Materials and methods

This study employed a descriptive-analytical design with a cross-sectional approach. The study was conducted from November toDecember 2023 at a cigarette factory in Kudus Regency, Central Java, Indonesia.

2.1 Subjects

The study subjects were female production workers at a cigarette factory, with a total population of 2,450 individuals who were divided into seven groups. Sampling was conducted using a cluster random sampling technique, resulting in a calculated sample size of 343 participants.

2.2 Data collection

The study variables included hemoglobin levels, age, BMI, MUAC, energy intake, protein intake, and caffeine consumption. The instruments used include an Easy touch Hb test to check hemoglobin levels, weight scales, and microtoise for determining body weight and height to calculate BMI, MUAC measuring tapes, and a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) in a month period to assess energy, protein, and caffeine intake. Adequacy levels were calculated by comparing intake against the 2019 RDA. Data were dichotomized into categories: hemoglobin levels as anemia (<12 g/dL) or normal (≥12 g/dL); age as premenopausal (<50 years) or menopausal (≥50 years); BMI as underweight (<18.5) or normal/overweight (≥18.5); MUAC as CED risk (<23.5 cm) or normal (≥23.5 cm); and

energy and protein adequacy as deficit (<90%) or adequate/excessive (≥90%) [12]. Caffeine consumption was categorized based on the 75th percentile. To determine the correlation between independent variables and anemia status, a multivariate logistic regression analysis [13] was carried out using SPSS.

3 Results and discussion

The study included 343 female workers aged 18-60 years. Data collection showed that the majority of participants (65.3%) were under 50 years old, placing them in childbearing age group. Regarding BMI, 7.9% was categorized as underweight, while the majority (92.1%) were overweight and obese. MUAC measurement aims to determine whether or not women are at risk of chronic energy deficiency (CED). Results showed that 27.1% of subjects were at risk of CED (MUAC <23.5 cm), while 72.9% fell within the normal range (MUAC ≥23.5 cm). The level of energy adequacy was categorized as deficit (46.9%) and adequate/excessive (53.1%). Protein adequacy levels were classified as deficit (50.2%) and adequate/excessive (49.8%). Among the subjects, 48.1% consumed ≥2 glasses of caffeine daily, while 51.9% consumed <2 glasses daily. Hemoglobin examinations revealed that 141 subjects (41.1%) had anemia, with 59 classified as mild, 73 as moderate, and 9 as severe.

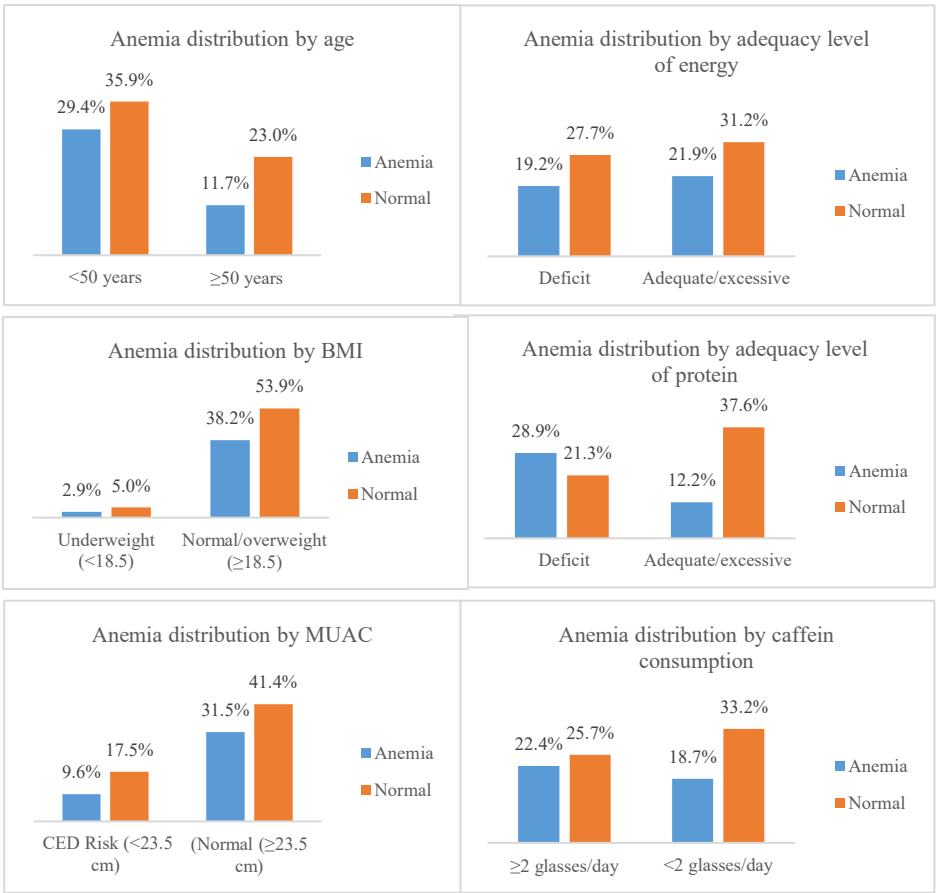

Fig. 1. Distribution of anemia status among workers based on selected variables

The eating patterns of female cigarette factory workers are irregular, with insufficient food intake, typically consisting only breakfast and dinner, often with poor quality menu composition, small portions, and lacking protein sources. Every day, workers receive 1-2 glasses of sweet tea and heavy snacks from the factory as lunch. Most subjects did not purchase lunch outside the factory during break times, as they preferred to continue working for higher productivity. Only 28% of subjects brought a complete lunch from home. In addition, subjects consumed caffeine-containing beverages such as tea, coffee, and chocolate both at home and outside the factory. The distribution of anemic subjects based on the variables such as age, BMI, MUAC, level of energy and protein adequacy, and caffeine consumption is shown in Figure 1.

Table 1. Relationship between variables and anemia status in female workers

Variables	Anemia		Non anemia		Mean±SD	p-value	OR (95%CI)
	n	%	n	%			
Age							
(0) <50 years	101	29.4	123	35.9	42.0±10.6	0.006*	2.053 (1.224-3.444)
(1) ≥50 years	40	11.7	79	23.0			
Body mass index							
(0) Underweight (<18.5)	10	2.9	17	5.0	24.9±4.8	0.658	1.261 (0.452-3.514)
(1) Normal/overweight (≥18.5)	131	38.2	185	53.9			
Mid-upper arm circumference							
(0) CED Risk (<23.5 cm)	33	9.6	60	17.5	25.5±4.4	0.324	0.728 (0.388-1.367)
(1) Normal (≥23.5 cm)	108	31.5	142	41.4			
Adequacy level of energy							
(0) Deficit (<90%)	66	19.2	95	27.7	89.9±56.6	0.012*	0.505 (0.296-0.860)
(1) Adequate/excessive (≥90%)	75	21.9	107	31.2			
Adequacy level of protein							
(0) Deficit (<90%)	99	28.9	73	21.3	91.1±41.1	0.000*	5.773 (3.275-10.177)
(1) Adequate/excessive (≥90%)	42	12.2	129	37.6			
Caffeine consumtion							
(0) ≥2 glasses/day	77	22.4	88	25.7	2	0.049*	1.616 (1.003-2.603)
(1) <2 glasses/day	64	18.7	114	33.2			

*) significant at $p<0.05$, analysed using multivariate logistic regression and odd ratio

The results of multivariate logistic regression analysis showed that age, adequacy level of protein, caffeine consumption were positively related to anemia status, while adequacy level of energy was negatively associated. Most subjects (65.3%) were under 50 years old, representing women of childbearing age, who were 2.053 times more likely to experience anemia than women aged ≥50 years. Regular menstruation among women of childbearing age contributes to the higher incidence of anemia. Energy adequacy was negatively related to anemia status, with subjects having sufficient energy intake (deficit) being at lower risk of anemia (OR 0.505). This may be attributed to the food menu consumed by the subject contains more carbohydrate and fat portions, with protein intake falling short of daily requirement. A protein deficiency increases the risk of anemia by 5.773 times compared to adequate/excessive intake. Protein needs must be met daily, as it is essential for iron transport and red blood cell production. Protein facilitates the delivery of iron to the spine for the production of red blood cells. Furthermore, animal protein sources provide heme iron [10].

Drinking more than two glasses of caffeine-containing sources significantly increases the risk of anemia 1.6 times compared to consuming fewer than two glasses per day. Caffeine in coffee, tea, and chocolate can inhibit iron absorption, resulting in anemia [11]. The variables BMI and MUAC were not significantly related to anemia status, likely because these values are influenced by the body's energy reserves in the form of muscle or fat. The subject's energy intake mostly came from carbohydrates and fats, with a protein deficit. Hemoglobin levels are more directly influenced by protein intake.

4 Conclusion

Female workers of childbearing age (<50 years) are more susceptible to anemia. Therefore, attention should be given to the quality of their diet, especially ensuring that the protein requirements are met. Consumption of caffeinated beverages (such as tea or coffee) should be limited to no more than two glasses per day, as excessive intake can inhibit iron absorption. Increasing consumption of non-caffeinated beverages, such as water or fruit juice, is recommended, as these can enhance iron absorption.

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