Animal-Source food consumption and its contribution to iron adequacy among women reproductive age in Indonesia

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Abstract. Background: Reproductive age is a crucial period which related to the optimal nutritional status of children in the future. However, women of reproductive age (WRA) are prone to anemia, especially iron deficiency anemia. Objective: This study aims to examine the consumption of animal food sources and their contribution to meet the iron's recommended dietary allowances of WRA in Indonesia. Method: The data type used is secondary data from the Individual Food Consumption Survey (IFCS) 2014. The unit of analysis in this study was women of reproductive age (WRA) between 15-49 years old, with a total of 33.367 subjects. Results: Overall, the highest to the lowest average of animal food sources consumed by WRA, consecutively, were fish, other aquatic animals and products, meat and products, eggs and products, milk and products, offal and products. The average iron intake was 3.4±3.6 mg, with a contribution rate of 19.3%. The number of WRA who reached the level of iron adequacy ≥77% was only 2%. Most of the WRA with iron contribution below the average (19.3%) is 64.7%. The contribution of iron from the consumption of animal-source foods is higher in urban areas. Conclusion: Iron intake from animal-sourced food consumption was still far from meeting WRA's iron needs; thus, prioritizing animal foods that have a high iron density is highly recommended.

1 Introduction

The period of a woman's reproductive age is a crucial phase in achieving good nutritional status and health of the child. Therefore, ensuring balanced nutritional intake during the pre-pregnancy and pregnancy periods is essential [1]. Women of reproductive age are a vulnerable group to anaemia and other nutritional deficiencies [2]. The prevalence of anaemia is still notably high, according to Basic Health Research (Riskesdas 2013), the percentage of anaemia among women aged 15-49 was 22.7% [3]. Anemia has adverse effects on fetal growth and development, potentially leading to pregnancy and childbirth complications, and even maternal and neonatal mortality [4]. Iron deficiency anemia is the most commonly

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encountered type of anemia, especially in women of reproductive age, such as adolescents and pregnant women [5].

Preventing and addressing nutritional anaemia in WRA have been implemented through government programs such as iron supplementation tablets; however, it has not been optimally executed. According to data from Basic Health Research 2018, it was found that 98.6% of adolescents and 61.9% of pregnant women had not taken the recommended dosage of iron tablets [6]. Considering the low adherence to iron tablet consumption, one approach to optimizing anemia prevention is by increasing dietary iron intake. Adequate iron intake is recommended to be obtained from animal-based sources because iron from animal-derived food sources (heme iron), such as meat, poultry, eggs, and fish, generally has a higher absorption rate compared to plant-based sources (non-heme iron), such as legumes and vegetables. Therefore, animal-based foods are more effective in maintaining iron status [7]. The results of a study demonstrated that women in the high animal protein (meat) diet group achieved better iron status at the end of the intervention [8]. Even though a recent study analyzed the iron intake of adult women (19-49 years old), the subject's age was not suited to the WRA group, which aged from 15-49 years [9]. Moreover, the iron intake of each type of animal-source food consumption has not been identified. To address this research gap, researchers aimed to examine animal-source food intake and its contribution to iron sufficiency among WRA in Indonesia.

2 Method

2.1 Study design and sampling

This research is a cross-sectional design using secondary data from the Individual Food Consumption Survey (IFCS) conducted in 2014 as part of the Total Diet Study (Studi Diet Total or SDT) 2014 by the Health Research and Development Agency Ministry of Health, Republic of Indonesia. The population of interest comprised all households in Indonesia. The sample units were households that had been visited and registered in the Riskesdas 2013 data. For the analysis, the subjects were members of these households falling within the Women of Reproductive Age (WRA) category. According to the SDT 2014 report, the total number of respondents in the Individual Food Consumption Survey (IFCS) 2014 was 191,524 individuals from 51,127 households. Inclusion criteria for this study were females in their reproductive age, between 15 and 49 years. Exclusion criteria included individuals who were ill, pregnant, lactating mother or had incomplete data. The final sample consisted of 33,367 WRA.

2.2 Data collection method

The data used in this study were secondary data collected by the Health Research and Development Agency. The IFCS 2014 employed face-to-face household interviews to collect data on subject characteristics and economic status. Data on the types and quantities of foods consumed by individuals were obtained through a 1x24-hour recall method using individual consumption questionnaires.

2.3 Data processing and analysis

Data processing for IFCS included several key steps, such as editing, data entry, data merging, cleaning, and imputation. After the initial processing by the Health Research and Development Agency, researchers conducted additional data cleaning. Data that met the

exclusion criteria were excluded. Subsequently, a check for consistency between food item details and food item codes was performed. Data processing and analysis were conducted using Microsoft Excel 2019 and IBM Statistical Program for Social Sciences (SPSS) version 26. Descriptive statistical analysis in Excel was performed on categorized data to obtain an overview of subject characteristics.

The average consumption of animal-based foods was calculated by summing the raw weight (in grams) of all animal-based foods consumed by each subject and then dividing this total by the number of subjects (33,367 individuals). This calculation yielded the average consumption of animal-based foods. In the meantime, the contribution of iron intake from animal-based foods to the iron sufficiency level was determined through a multi-step process. This involved calculating the iron content of the food consumption and the percentage contribution. Data on food consumption, expressed as the amount of food consumed in raw grams, was processed by the researchers to determine the total daily iron intake from individual consumption of animal-based foods. The iron content of food items was referenced from the Indonesian Food Composition Table (IFCT). If a food item was not found in the IFCT, alternative sources were used, such as food composition tables from countries such as Singapore, Thailand, ASEAN, and the United States Department of Agriculture (USDA).

Once the total intake of iron from animal-based foods per person per day is known, the percentage contribution of iron from animal-based foods to the iron sufficiency level can be calculated using the following formula:

$$Iron\ contribution\ (\%) = \frac{(\text{Total Iron Intake from Animal Based Foods})}{(\text{Iron Adequacy Level})}\ x\ 100\% \quad (1)$$

The Iron Adequacy Level is based on the Ministry of Health Regulation No. 28 of 2019 regarding Recommended Nutritional Adequacy Levels for the Indonesian Population. The recommended iron adequacy level for women aged 15-18 years is 15 mg/day, while for those aged 19-49 years is 18 mg/day. To analyze the differences in iron intake and its contribution from the consumption of animal-based foods between urban and rural areas, an independent t-test (unpaired data) is performed with a two-way hypothesis (two-tailed, p-value<0.05).

3 Results and discussion

3.1 Subject characteristics

The study subjects consisted of women in the reproductive age range of 15-49 years, totaling 33,367 individuals. The characteristics of the subjects analyzed in this study included age, level of education, employment status, marital status, regional classification, and economic status. Subject characteristics are presented in Table 1. The study results indicate that more than half of the Women of Reproductive Age (WRA) fall within the age range of 19-49 years (86.2%), with an average age of 32 years. The majority of WRA (28.3%) have completed their education up to senior high school. This is partly due to 14.4% of the subjects being in the 15-18 age group, which means they are still pursuing their high school education. Education level can influence food choices, as individuals with higher levels of education tend to select higher quality and quantity of food items compared to those with lower levels of education [10].

Most Women of Reproductive Age (WRA), accounting for 59.2%, are not engaged in any employment. Out of the WRA who are unemployed, 24.5% are still students. The predominant occupation for those WRA who are employed is farmer (27.3%). More than half of them (51.2%) reside in rural areas, where agriculture plays a central role in family economies. Based on the research findings, a substantial portion of WRA is already married (66.4%), reflecting that the majority of the sample is married. The unmarried WRA have an

average age of 20 years. The majority of WRA are in the highest economic quintile, which is quintile 5 (24.1%). Behavior related to consuming a product, including animal protein sources, can be influenced by various factors, one of which is household income.

Table 1. The distribution of women of reproductive age based on characteristics

Characteristics	n	%
Age		
15-18	4610	13.8
19-49	28757	86.2
Total	33367	100.0
Education level		
Not literate	1061	3.2
Did not finish elementary school	2614	7.8
Elementary school	9138	27.4
Middle school	8172	24.5
High school	9452	28.3
Vocational school	1163	3.5
College or university	1767	5.3
Total	33367	100.0
Employment status		
Unemployed	19760	59.2
Employed :		
Civil servant	1464	10.8
Private sector employee	1947	14.3
Entrepreneur	3220	23.7
Farmer	3719	27.3
Fisherman	40	0.3
Labor	1580	11.6
Unspecified	1637	12.0
Subtotal	13607	40.8
Total	33367	100.0
Marital status		
Single	8497	25.5
Married	23611	70.8
Divorced	541	1.6
Widowed	718	2.2
Total	33367	100.0
Family economic status		
Quintile 1 (Lowest)	4698	14.1
Quintile 2 (Low-middle)	5904	17.7
Quintile 3 (Middle)	6874	20.6
Quintile 4 (Upper-middle)	7856	23.5
Quintile 5 (Highest)	8035	24.1
Total	33367	100.0
Region classification		
Urban	16283	48.8
Rural	17084	51.2
Total	33367	100.0

The proportion of WRA living in rural areas is not significantly different from urban areas, with 51.2% in rural areas and 48.8% in urban areas. According to the 2014 data from the Central Bureau of Statistics, there are more villages than cities, so it is reasonable to find a higher number of WRA in rural areas compared to urban areas. The location and region of

residence will impact purchasing power and food choices. The place of residence for WRA (rural or urban) is significantly related to the level of animal protein consumption.

3.2 Profile of animal-based food consumption by WRA in Indonesia

Animal-based foods are categorized into five groups based on the Food and Agriculture Organization (FAO), namely, meat, offal/non-meat, fish, eggs, and milk. All Women of Reproductive Age (WRA), whether they consume animal-based foods or not, are involved in the calculation of consumption analysis. An overview of animal-based food consumption by WRA in Indonesia is presented in Table 2.

Table 2. Animal-based food consumption by animal-based food groups

Animal source food groups	Consumption (gram/capita/day)	
	Mean	SD
Meat and processed products	43.6	92.4
Offal, non-meat and processed products	2.0	16.1
Fish, seafood and processed products	116.3	139.9
Eggs and processed products	18.9	33.5
Milk and processed products	3.8	24.1
Animal source foods	184.6	145.1

Table 2 shows that the average total consumption of animal-based foods by Women of Reproductive Age (WRA) in Indonesia is approximately 184.6±145.1 grams per capita per day. This figure can be considered to meet the ideal consumption of animal-based foods according to the Indonesian Dietary Guidelines, which recommend 2-4 servings equivalent to 70-140 grams (2-4 pieces) of medium-sized beef; or 80-160 grams (2-4 pieces) of medium-sized chicken; or 80-160 grams (2-4 pieces) of medium-sized fish per day. The findings of this study differ slightly from the research conducted by Perdana et al. (2014) with adult women subjects (19-55 years) obtained from secondary data from the National Basic Health Research (Riskesdas) in 2010. In that study, the average consumption of animal-based foods was 107.8±102.5 grams per capita per day [11]. The unalike result might be due to the different age ranges used for the subject and data source.

The most commonly consumed animal-based food commodities by Women of Reproductive Age (WRA) in Indonesia are fish, seafood, and processed products. This consumption figure already aligns with the ideal fish consumption as per the balanced nutrition guidelines, which recommend 2-4 servings equivalent to 80-160 grams per capita per day. Indonesia's strategic geographical location and abundant resources make it a dominant player in the maritime sector. Moreover, fish has a relatively short production process, and domestic fish consumption can be met by local producers. This is evidenced by the high fish production in the market.

Meat and processed products are the second-highest consumed commodities nationwide (43.6±92.4 g). Meat is divided into ruminants like cattle, goats, buffaloes and non-ruminants such as poultry (chicken, duck, goose, birds), pork, rabbits, and others. The research indicates that consumption of non-ruminant meats such as chicken dominates compared to ruminant meats. This is due to the availability and accessibility of these food items. Domestic supplies of chicken meat can meet the domestic consumption needs [12]. In this study, the subjects are predominantly in the highest economic quintile (24.1%), resulting in the highest participation rate in meat and processed product consumption, particularly in quintile 5 (44.8%).

3.3 Distribution of iron intake and contribution from animal-based foods by animal-based food group

Daily iron intake is considered sufficient or ideal if it meets at least ≥77% of the iron adequacy [13]. Therefore, the minimum iron intake required for individuals is 11.6 mg for those aged 15-18 and 13.9 mg for those aged 19-49. On average, WRA's iron adequacy is 12.7 mg. Iron intake is obtained not only from animal-based foods but also from plant-based foods. However, this research focuses on iron intake from animal-based foods, assuming that iron adequacy can be optimally fulfilled when 100% of iron intake comes from animal-based foods, considering that animal-based foods have a higher heme content. The distribution of iron intake and its contribution by animal-based food groups is presented in Table 3.

Tabel 3. Iron intake and the level of animal-based food contribution by animal-based food group

Animal food groups	Iron intake (mg)		Contribution (%)	
	Mean	SD	Mean	SD
Meat and processed products	0.6	1.5	3.3	8.4
Offal, non-meat and processed products	0.1	1.3	0.6	7.4
Fish, seafood and processed products	2.1	3.3	12.2	18.7
Eggs and processed products	0.5	1.0	3.0	5.5
Milk and processed products	0.0	0.2	0.2	1.4
Animal source foods	3.4	3.6	19.3	20.3

Based on Table 3, it is evident that the overall average iron intake for WRA is 3.4±3.6 mg, with a contribution of 19.3±20.3%. This figure is still far from reaching the ideal iron adequacy for WRA, which is 12.7 mg. The average daily iron intake for Indonesian WRA aged 19-49, based on subjects from the same data source, is 14.6±9.7 mg [9]. It can be interpreted that iron intake from animal-based food contributes to 23.6% of the total daily iron intake. This indicates that iron intake is primarily derived from the consumption of plant-based foods, such as cereals, vegetables, and legumes.

In contrast to the study by Perdana et al. (2014), which found that the average daily iron intake for Indonesian women aged 19-49 based on Riskesdas (2010) data was 4.8 mg, Sahana & Sumarmi (2015) reported an average daily iron intake for women of reproductive age (WRA) of 7.62±3.30 mg [2]. The difference in iron intake might due to the difference in sample size and region, that study involved 71 subjects in Proboliggo region. Based on the findings of these two studies, it can be inferred that iron intake from animal-based foods contributes to approximately 44-70% of the total daily iron intake.

3.4 Distribution of iron intake and contribution from animal-based foods by region

Animal-based food consumption is influenced by residential location. Urban communities are generally associated with higher income and education levels compared to rural populations, which in turn affects their access to and preferences for animal-based foods. Table 4 presents the average iron intake from animal-based foods by regional classification.

The distribution of WRA in rural and urban areas is almost evenly split, with 48.8% residing in villages and 51.2% in urban areas. Overall, iron intake among WRA in urban areas (3.4±3.4 mg) is higher than in rural areas (3.3±3.7 mg), with greater variability in rural regions. Statistical analysis reveals that iron intake and its contribution to meeting iron sufficiency significantly differ between rural and urban areas ($p<0.05$).

Iron intake and the percentage contribution are higher in almost all animal-based food groups in urban areas, except for fish, seafood, and processed products, which are higher in rural areas. This discrepancy is due to higher consumption of fish, seafood, and their

processed products in regions like Maluku, Sulawesi, Aceh, which are geographically closer to aquatic resources. A significant portion of WRA in these regions resides in rural areas (Percentage of WRA in rural areas: North Maluku 61%, Maluku 57%, North Sulawesi 60%, Aceh 60%, Southeast Sulawesi 61%). These findings align with the research conducted by Ermanda et al. (2019), where the average household meat consumption in urban areas (79.13 g/capita/week) was higher than in rural areas (45.89 g/capita/week) [14]. According to the Indonesian Statistical Report 2015 on food and non-food consumption and expenditure, in 2014, expenditures on meat, milk, and eggs were higher in urban areas, while spending on fish was higher in rural areas.

Table 4. Differences in Iron Intake and Contribution Levels from Animal-Based Foods by Regional Classification

Animal source food groups	Regional classification		*p-value*
	Urban	Rural	
	mean±SD	mean±SD	
Meat and processed products			
Consumption (g)	55.8±99.5	31.9±83.5	
Iron intake (mg)	0.8±1.6	0.4±1.3	0.251
Contribution level (%)	4.3±9.1	2.4±7.4	0.311
Offal, non-meat and processed products			
Consumption (g)	2.8±18.7	1.3±13.1	
Iron intake (mg)	0.2±1.4	0.1±1.1	0.627
Contribution level (%)	0.8±8.2	0.4±6.3	0.553
Fish, seafood, and processed products			
Consumption (g)	107.1±137.4	125.0±141.7	
Iron intake (mg)	1.9±3.0	2.4±3.5	<0.001*
Contribution level (%)	10.7±17.3	13.6±19.9	<0.001*
Eggs and processed products			
Consumption (g)	22.3±34.8	15.7±31.8	
Iron intake (mg)	0.6±1.0	0.4±0.9	0.017*
Contribution level (%)	3.5±5.6	2.5±5.3	0.025*
Milk and processed products			
Consumption (g)	6.0±31.8	1.8±12.8	
Iron intake (mg)	0.1±0.3	0.0±0.1	<0.001*
Contribution level (%)	0.3±1.8	0.1±0.7	<0.001*
Animal source foods			
Consumption (g)	193.9±146.0	175.8±143.6	
Iron intake (mg)	3.4±3.4	3.3±3.7	0.016*
Contribution level (%)	19.6±19.6	19.0±20.8	0.008*

Note : Independent sample comparasion t-test , *Significantly different (p<0,05)

Ermanda et al. (2019) and Utama (2018) argue that consumption patterns, especially for animal-based foods, are influenced by the area of residence, where urban dwellers are believed to have higher incomes and education levels compared to rural residents. The percentage of animal protein sufficiency in women living in urban areas is higher than in those residing in rural areas [14, 15]. In this study, 35% of WRA in urban areas belong to the highest economic quintile (Quintile 5), while WRA in rural areas are predominantly in quintile 2 (25%). An increase in income enhances the purchasing power for obtaining food.

High education in the study is defined as WRA who have completed at least high school, while low education means completing junior high school or below.

The study results show that the majority of WRA in rural areas have low educational levels. Among WRA aged 19-49 years in rural areas, 74% have completed education up to junior high school or lower. Furthermore, access to animal-based foods may not necessarily reach rural areas comprehensively. Therefore, consumption relies on the food resources available in the region. The most consumed type of animal source foods by WRA in urban areas and which in aggregate provide a high contribution of iron are chicken eggs, tuna, anchovies, chicken and beef. Food commodities are easily distributed to urban areas, and people have easy access to food-selling places (supermarkets, mobile traders, and markets). Housewives with higher education (77.34 grams/RT/week) have much greater meat consumption than housewives with low education levels (46.04 g/household/week) [14].

4 Conclusion

This research was dominated by WRA aged 19-49 years with a high school education level, unemployed, farmer as their primary occupation, married status, high-class economic status, and residing in a rural area. Nationally, the highest animal source food consumed by WRA was marine fish, seafood and processed products (116.3 g/cap/day). Iron intake from animal-sourced food consumption was still far from meeting WRA's iron needs. Mean iron intake reached 3.4 mg/cap/day with a contribution level of 19.3% to the iron adequacy rate. Most of WRA (64.7%) have iron contribution levels below the average. Iron intake was higher in the urban areas. Therefore, prioritizing animal foods that have a high iron density, such as chicken liver, beef, skipjack tuna, and fish cob, is highly recommended.

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References

1. K.G. Dewey, K. Begum, Long-term consequences of stunting in early life. Matern. Child Nutr. **7**, 5–18 (2011). https://doi.org/10.1111/j.1740-8709.2011.00349.x
2. O.N. Sahana, S. Sumarmi, The relationship between micronutrient intake and hemoglobin levels in women of reproductive age (WRA). Media Gizi Indonesia. **10**, 184–191 (2015). https://doi.org/10.20473/mgi.v10i2.184-191
3. Ministry of Health, Basic Health Research Results 2013. Minist. Health Indones. (2013), Jakarta.
4. Ministry of Health, Guidelines for Prevention and Management of Anemia in Adolescent Girls and Women of Reproductive Age (WRA). (2016), Jakarta
5. N.N. Al Hassan, The prevalence of iron deficiency anemia in a Saudi University female students. J. Microsc. Ultrastruct. **3**, 25–28 (2015). https://doi.org/10.1016/j.jmau.2014.11.003
6. Ministry of Health, Basic Health Research Results 2018. Minist. Health Indones (2018), Jakarta.
7. I.M. Bakta, Clinical Hematology. EGC (2006), Jakarta.

8. H.L. Cheng, H.J. Griffin, C.E. Bryant, K.B. Rooney, K.S. Steinbeck, H.T. O'Connor, Impact of diet and weight loss on iron and zinc status in overweight and obese young women. Asia Pac. J. Clin. Nutr. **22**, 574–582 (2013). https://doi.org/10.6133/apjcn.2013.22.4.08
9. T.J. Prasetyo, I.N. Khoiriani, Food consumption and nutritional density of adult women aged 19-49 years in Indonesia. J. Dunia Gizi **3**, 105–113 (2020). https://doi.org/10.33085/jdg.v3i2.4746
10. K. Ashima, I. Barry, Family income and education were related with 30-year time trends in dietary and meal behaviors of American children and adolescents. J. Nutr. **143**, 690–700 (2013). https://doi.org/10.3945/jn.113.176024
11. S.M. Perdana, Hardinsyah, E. Damayanthi, Alternative balanced nutrition index for assessing the nutritional quality of food consumption of Indonesian adult women. J. Gizi Pangan **9**, 43–50 (2014).
12. Central Bureau of Statistics, Livestock in Figures 2020. Central Bureau of Statistics (2020), Jakarta.
13. R.S. Gibson, Principles of Nutritional Assessment. Oxford University Press (2005), New York.
14. A.P. Ermanda, Jafrinur, J. Hellyward, Pola konsumsi pangan hewani pada rumah tangga di Propinsi Sumatera Barat (penerapan model almost ideal demand system). J. Peternak. Indones. **21**, 220–229 (2019).
15. L.J. Utama, Analysis of risk factors for animal food consumption in adult women in Indonesia. CHMK Health J. **2**, 38–43 (2018).