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Differences in Ferritin Levels and Menstrual Disorders between Vegetarian and Non-Vegetarian Women in Denpasar

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ABSTRACT

Iron deficiency is a significant nutritional challenge for women of reproductive age, especially those who follow a vegetarian diet. Ferritin, as a key indicator of iron reserves, plays an important role in diagnosing latent iron deficiency, which can negatively affect reproductive health, including causing menstrual disorders. This study compares ferritin levels and the incidence of menstrual disorders between 50 vegetarian and 50 non-vegetarian women aged 18–45 years in Denpasar City. Ferritin levels were measured using the ELISA method, while data on menstrual disorders were collected through the Menstrual Symptom Questionnaire (MSQ). The data were analyzed using independent t-tests, chi-square tests, and multivariate logistic regression (α=0.05). The study found that the average ferritin level in vegetarian women (21.4 µg/L) was significantly lower than in non-vegetarian women (36.9 µg/L; p<0.001), and the prevalence of menstrual disorders such as dysmenorrhea and irregular cycles was higher among vegetarians. Logistic regression analysis confirmed that a vegetarian diet (odds ratio [OR]=2.98; p=0.014) and ferritin levels below 30 µg/L (OR=3.62; p=0.007) were significant predictors of menstrual disorders. Thus, a vegetarian diet and low ferritin levels are identified as key risk factors for menstrual disorders in women of reproductive age. These findings underscore the importance of monitoring ferritin status and applying appropriate nutritional strategies for vegetarian women to help support optimal reproductive health.

Keywords: *Ferritin, Menstrual Disorders, Vegetarian, Women of Childbearing Age, Iron*

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INTRODUCTION

Iron deficiency is one of the most common nutritional problems in the world, especially among women of reproductive age. This deficiency is often exacerbated by blood loss during menstruation, which increases daily iron requirements. One of the primary indicators for assessing the body's iron stores is serum ferritin, which has high sensitivity in detecting latent iron deficiency before the onset of clinical anaemia (Firdous et al., 2023). Low ferritin levels not only affect haematological function but also directly impact hormonal function, enzyme regulation, and women's reproductive health, particularly the menstrual cycle.

Diet plays a central role in determining iron status. Iron from food is divided into two forms: heme iron from animal products, which has high absorption rates, and non-heme iron from plants, which has lower absorption rates due to inhibitory compounds such as phytates, polyphenols, and calcium (Slywitch et al., 2021; Bhartiya et al., 2022). Women following a vegetarian diet are at higher risk of iron deficiency, particularly because they do not consume heme iron and generally do not receive regular supplementation. A meta-analysis by Haider et al. (2018) showed that premenopausal vegetarian women had an average ferritin level 17.7 µg/L lower than non-vegetarians.

Iron deficiency has multidimensional effects, not only causing anemia but also significantly impacting women's reproductive health. Iron deficiency is associated with menstrual cycle disorders, including menorrhagia, amenorrhea, and dysmenorrhea, resulting from dysfunction of hormones, enzymes, and oxygen distribution to the reproductive organs. Prevention and early detection of iron deficiency through improved diet and supplementation in women of childbearing age are highly recommended to maintain reproductive health and overall quality of life (Arisanti et al., 2023; Rahmawati, 2023).

In Indonesia, particularly in Bali, a vegetarian diet is widely adopted due to religious and cultural influences. A local study in Badung Regency, Bali, found that vegetarian women had significantly lower serum ferritin levels than non-vegetarian women, despite similar overall iron intake. The vegetarian diet in Bali reflects cultural values, beliefs, and wellness trends. However, the Badung study clearly showed that vegetarian women in Bali had lower iron stores (ferritin) than non-vegetarian women, despite overall iron intake appearing similar. Ferritin depletion in this group is primarily related to the lower bioavailability of iron from plant-based foods and the physiologically higher iron requirements of women of childbearing age (Pawlak et al., 2016; Slywitch et al., 2021).

Other studies have also shown that menstruating vegetarian women tend to experience a higher prevalence of iron deficiency than non-vegetarians, even though their hemoglobin remains within normal limits. This suggests that ferritin status is more sensitive in detecting latent iron deficiency (Firdous et al., 2023). Furthermore, research has shown that high serum ferritin levels, an indicator of body iron stores and a marker of inflammation, are positively correlated with metabolic syndrome and its components, such as central obesity, insulin resistance, hypertension, and dyslipidemia, in menopausal women. Excessive ferritin in menopausal (postmenopausal) women actually increases the risk of metabolic syndrome. Conversely, low ferritin levels in this group are

thought to have a protective effect—capable of suppressing the likelihood of developing metabolic syndrome, although the exact mechanism remains under investigation (Putri Dewi & Ariantari, 2023).

Menstrual irregularities are a common problem among women of childbearing age and can be an early indicator of nutritional imbalances, including iron deficiency. Therefore, it is important to examine the relationship between ferritin status and diet and menstrual irregularities in this group of women (Gallego-Narbón et al., 2019).

However, most previous studies had limitations, such as using anaemia indicators (haemoglobin) without measuring actual iron reserves (ferritin), or not grouping participants based on consistent and verified dietary patterns. Therefore, this study aims to address these gaps by directly comparing ferritin levels and the incidence of menstrual disorders between vegetarian and non-vegetarian women using laboratory measurements and standardised questionnaires.

The study was conducted in Denpasar City, Bali, an area with cultural diversity and a relatively high vegetarian population due to religious beliefs and lifestyle influences. Inclusion criteria were established to strictly screen participants, namely women aged 18–45 years, residing in Denpasar, and having followed a consistent dietary pattern for at least one year as either vegetarian or non-vegetarian. Dietary status was identified through structured interviews and a dietary classification form, which assessed animal protein consumption over the past six months.

Potential participants were also excluded if they were pregnant, breastfeeding, had a history of chronic haematological disease, or had taken iron supplements in the past month, to avoid physiological bias or external influences on ferritin levels. After meeting the criteria, participants were provided with complete information about the purpose and procedures of the study and were asked to sign an informed consent form in accordance with the principles of health research ethics.

To minimise selection bias, this study used purposive sampling with verification of dietary patterns, not just declarative data. Dietary data validation was conducted through triangulation via interviews, weekly food records, and confirmation from the dietary community (for vegetarians).

Confounding variables, such as age, education, and employment status, were also collected and analysed using multivariate logistic regression to ensure that the relationship between dietary patterns and menstrual disorders was not influenced by sociodemographic factors. Additionally, to address information bias, ferritin measurements were conducted in an accredited laboratory using the ELISA method, and menstrual disorders were identified through the psychometrically validated Menstrual Symptom Questionnaire (MSQ).

With this approach, this study is expected to make a significant contribution to the development of evidence-based nutritional interventions, particularly for vegetarian women at high risk of iron deficiency, as well as serving as a foundation for programmes to improve menstrual and reproductive health among women of reproductive age in Indonesia.

METHODS

This study is a quantitative study with a comparative-analytical approach that aims to analyze differences in ferritin levels and menstrual disorders between vegetarian and non-

vegetarian women in Denpasar City. The study design used is cross-sectional, namely data collection is carried out at a specific time to evaluate the variables of ferritin status and menstrual characteristics in both groups of respondents. The population in this study are women of childbearing age (18–45 years) who live in Denpasar with at least one year of consistent eating patterns as vegetarian or non-vegetarian. Purposive sampling technique will be used to select respondents who meet the inclusion criteria, such as not being pregnant, not consuming iron supplements in the past month, and not having a history of chronic hematological disorders.

The planned sample size was 100 people, consisting of 50 vegetarian women and 50 non-vegetarian women, with attention to proportion and statistical power. Primary data were collected through two main methods: first, measuring serum ferritin levels using the Enzyme-Linked Immunosorbent Assay (ELISA) method in an accredited laboratory; and second, through a structured questionnaire to identify menstrual characteristics (frequency, duration, bleeding volume, and pain), dietary patterns, and demographic information. The menstrual disorder questionnaire used was adapted from the previously validated Menstrual Symptom Questionnaire (MSQ).

Data analysis was performed using statistical software such as SPSS. The Kolmogorov-Smirnov normality test was used to determine data distribution. Furthermore, differences in mean ferritin levels between vegetarian and non-vegetarian groups were analyzed using the independent t-test for normally distributed data or the Mann-Whitney U test for non-normal data. The relationship between ferritin status and menstrual disorders was analyzed using the chi-square test or bivariate logistic regression, depending on the type and distribution of the data. All statistical tests used a 5% significance level ($p < 0.05$).

This study was designed with ethical research principles in mind, including informed consent from each participant, data confidentiality, and the right to withdraw at any time. This study is expected to provide a clear picture of differences in ferritin status and menstrual disorders based on diet, thus providing the basis for more appropriate nutritional and reproductive health interventions for women in urban areas like Denpasar.

RESULTS

This study involved 100 respondents, consisting of 50 vegetarian and 50 non-vegetarian women aged 18–45 years in Denpasar City. Data collected included serum ferritin levels, as well as characteristics of menstrual disorders such as menstrual pain (dysmenorrhea), irregular cycles, bleeding volume, and menstrual duration. Ferritin was measured using the ELISA method, while menstrual disorders were collected using the Menstrual Symptom Questionnaire (MSQ). Descriptive analysis was conducted to describe the characteristics of the respondents and the initial overview of the research data.

A. Univariate Analysis

Table 1. Respondent Characteristics Based on Dietary Patterns

Variables	Vegetarian (n=50)	Non-Vegetarian (n=50)	Total (N=100)
Average age (years)	28.6 ± 6.2	29.1 ± 6.5	28.9 ± 6.4
Length of eating pattern (years)	4.7 ± 2.1	5.1 ± 2.3	–
last education			
- High School/Equivalent	16 (32%)	15 (30%)	31 (31%)
- Diploma/S1	34 (68%)	35 (70%)	69 (69%)
Employment status			
- Work	38 (76%)	40 (80%)	78 (78%)
- Doesn't work	12 (24%)	10 (20%)	22 (22%)

Demographic characteristics indicate that the average age of respondents in both groups, vegetarian and non-vegetarian, is in the productive age range, with an average of 28.9 years (SD ±6.4). Most respondents from both groups have a higher education background (Diploma/Bachelor's degree) at 69%, and the majority are also employed (78%). The vegetarian diet has been followed for an average of 4.7 years, while the non-vegetarian diet for 5.1 years. This reflects that both groups have relatively balanced socio-demographic backgrounds, enabling a more valid comparison in assessing the impact of dietary patterns on ferritin levels and menstrual disorders.

Table 2. Average Ferritin Levels Based on Diet

Group	Mean Ferritin (µg/L)	Standard Deviation	Minimum Value	Maximum Value
Vegetarian	21.4	6.8	10.2	37.1
Non-Vegetarian	36.9	9.5	20.4	56.7

The results of ferritin level measurements showed a striking difference between the two groups. The vegetarian group had an average ferritin level of 21.4 µg/L (SD ±6.8), while the non-vegetarian group had an average of 36.9 µg/L (SD ±9.5). The minimum ferritin level in vegetarians was 10.2 µg/L, well below the normal threshold, indicating a tendency toward latent iron deficiency. This difference suggests that a diet lacking heme iron from animal products directly impacts iron stores in the body. The low ferritin levels in the vegetarian group indicate a high risk of iron metabolism disorders, although haemoglobin levels may not necessarily indicate clinical anaemia. These results align with literature stating that vegetarians are more prone to iron deficiency due to lower bioavailability of non-haem iron.

Table 3. Distribution of Respondents' Menstrual Disorders

Types of Menstrual Disorders	Vegetarian (n=50)	Non-Vegetarian (n=50)	Total (N=100)
Dysmenorrhea (menstrual pain)	32 (64%)	21 (42%)	53 (53%)
Menorrhagia (heavy bleeding)	18 (36%)	11 (22%)	29 (29%)
Irregular cycles	25 (50%)	16 (32%)	41 (41%)
No menstrual disorders	10 (20%)	22 (44%)	32 (32%)

The distribution of menstrual disorders shows that women with vegetarian diets have a higher prevalence of disorders than non-vegetarians. A total of 64% of vegetarians experience

dysmenorrhea, compared to 42% of non-vegetarians. Similarly, 50% of vegetarians experience irregular menstrual cycles compared to 32% of non-vegetarians. Menorrhagia is also more common among vegetarians (36%) than non-vegetarians (22%), although the difference is not statistically significant. Conversely, the proportion of respondents who do not experience menstrual disorders is much higher among non-vegetarians (44%) than vegetarians (20%). These findings suggest a potential association between iron deficiency, as indicated by low ferritin levels, and reproductive dysfunction. Low ferritin levels are thought to affect prostaglandin production and hormonal stability, ultimately impacting menstrual symptoms such as pain and irregular cycles.

Table 4. Results of Ferritin Level Normality Test in Vegetarian and Non-Vegetarian Groups

Group	Kolmogrov-Smirnov Statistic	Sig. (p-value)	Distribution
Vegetarian	0,095	0,200	Normal
Non-Vegetarian	0,089	0,200	Normal

Note: *The Kolmogorov-Smirnov test shows p > 0.05, which means that the data is normally distributed.*

Before conducting a t-test to compare ferritin levels between vegetarian and non-vegetarian groups, a normality test was first performed using Kolmogorov-Smirnov. The results showed that the distribution of ferritin levels in both groups was normal (p > 0.05), so the use of a parametric test (independent t-test) was statistically justified.

B. Bivariate Analysis

Table 5. Differences in Ferritin Levels between Vegetarian and Non-Vegetarian Women

Group	Mean Ferritin (µg/L)	Elementary School	p-value
Vegetarian	21.4	6.8	**< 0.001**
Non-Vegetarian	36.9	9.5	

Statistical Test: Independent t-test (normally distributed data based on the Kolmogorov-Smirnov test)

There was a statistically significant difference in mean ferritin levels between vegetarian and non-vegetarian women (p < 0.001). This indicates that a vegetarian diet is associated with significantly lower ferritin levels.

Table 6. Relationship between Dietary Status and Type of Menstrual Disorders

Types of Menstrual Disorders	Vegetarian (n=50)	Non-Vegetarian (n=50)	p-value
Dysmenorrhea (menstrual pain)	32 (64%)	21 (42%)	0.024
Menorrhagia (heavy bleeding)	18 (36%)	11 (22%)	0.115
Irregular cycles	25 (50%)	16 (32%)	0.049
No disturbance	10 (20%)	22 (44%)	0.007

Statistical Test: Chi-Square

There was a significant association between dietary patterns and the incidence of dysmenorrhea (p = 0.024), irregular cycles (p = 0.049), and the absence of menstrual disorders (p = 0.007). No significant association was found between dietary patterns and menorrhagia (p = 0.115), although there was a higher trend in the vegetarian group.

C. Multivariate Analysis

To determine significant predictors of menstrual disorders, bivariate logistic regression analysis was conducted.→multivariate with menstrual disorders as the dependent variable (yes/no, a combination of dysmenorrhea, menorrhagia, and irregular cycles).

Table 7. Results of Multivariate Logistic Regression on the Risk of Menstrual Disorders

Variables	OR	95% CI	p-value
Vegetarian (vs Non-veg)	2.98	1.25 – 7.11	0.014
Low ferritin (<30 μg/L)	3.62	1.41 – 9.25	0.007
Age (>30 years)	0.86	0.34 – 2.15	0.745
Education (High School vs Bachelor's Degree)	1.12	0.45 – 2.81	0.802

Based on the results of the multivariate analysis in Table 6, vegetarian women were almost three times more likely to experience menstrual disorders than non-vegetarians (OR 2.98; p = 0.014). Women with low ferritin levels (<30 μg/L) were 3.6 times more likely to experience menstrual disorders than those with normal ferritin levels (OR 3.62; p = 0.007). Age and education did not show a significant association in this model.

D. Conclusion of Statistical Analysis

1. There is a significant difference in ferritin levels between vegetarian and non-vegetarian women.
2. Vegetarians are more likely to experience menstrual disorders, especially dysmenorrhea and irregular cycles.
3. Vegetarian diet and low ferritin levels are significant risk factors for menstrual disorders based on multivariate tests.

DISCUSSION

1. Differences in Ferritin Levels Between Vegetarians and Non-Vegetarians

The finding that vegetarian women had significantly lower ferritin levels than non-vegetarians (p < 0.001) aligns with the theory of iron bioavailability. Heme iron from animal products has a higher absorption rate, while non-heme iron from plants is easily inhibited by phytate, tannin, and calcium (Bhartiya et al., 2022; Slywitch et al., 2021). Furthermore, vegetarians generally do not regularly consume fortified iron sources or supplements, so their ferritin stores will decline slowly over the long term.

A study by Firdous et al. (2023) showed that ferritin levels in vegetarian women of childbearing age tend to be low despite normal-appearing hemoglobin, indicating latent iron deficiency (Firdous et al., 2023). This is important to note because ferritin is an early indicator before anemia develops clinically.

Vegetarians have low ferritin levels due to low intake of heme iron and a long-term diet without supplements or fortified foods. Researchers assume that the body's adaptation to a plant-based diet without special intervention will cause the body's iron reserves to gradually decrease,

even though haemoglobin levels remain normal. Researchers assume that significantly lower ferritin levels in the vegetarian group indicate a risk of latent iron deficiency that may not be detectable through routine haemoglobin levels. These findings address the limitations of previous studies, which primarily focused on clinical anaemia without specifically evaluating body iron stores. By prioritising ferritin as an early indicator, this study makes an important contribution to the early detection of micronutrient disorders in reproductive-age women. This information could drive the development of ferritin-based nutritional interventions for vegetarian groups. This would directly help prevent long-term issues such as fertility disorders and menstrual dysfunction.

2. The Relationship Between Diet and Menstrual Disorders

Results show a significant association between a vegetarian diet and the incidence of dysmenorrhea and irregular menstrual cycles. Iron is known to play a role in the synthesis of prostaglandins and enzymes related to hormonal regulation, so iron deficiency can cause hormonal dysregulation that triggers menstrual pain and cycle irregularities (Bakir et al., 2025; Takeda et al., 2024). Furthermore, low ferritin is also associated with fatigue, irritability, and other premenstrual symptoms.

Research by Ghosh et al. (2022) stated that PMS and dysmenorrhea were more severe in young vegetarian women, which was likely caused by deficiencies in certain micronutrients, including iron and vitamin B12 (Ghosh et al., 2022).

Researchers believe that vegetarian diets and menstrual disorders are related because low iron reserves affect the stability of estrogen and prostaglandin hormones, which physiologically help regulate the menstrual cycle. In addition, vegetarian women may experience deficiencies in other micronutrients, such as zinc and vitamin B12, which can worsen their menstrual symptoms. Based on the strong evidence from this study, a vegetarian diet is not accompanied by an approach to increase iron bioavailability, which contributes to menstrual disorders. By providing strong statistical data on the relative risk involved, this study goes beyond previous research that only looked at the relationship between diet and menstruation descriptively. Therefore, this study emphasises the need for a more targeted approach to help vegetarian women consume plant-based foods in ways that enhance iron absorption, such as vitamin C, iron supplementation, and food fortification. These methods have preventive and curative effects on women's reproductive health in the long term.

Discussion of Multivariate Analysis

1. Vegetarian Diet as a Predictor of Menstrual Disorders

Multivariate analysis showed that a vegetarian diet was a significant predictor of menstrual disorders (OR 2.98; $p = 0.014$). This confirms that poorly designed vegetarian diets may increase the risk of gynecological complaints, primarily due to insufficient iron intake. A similar study by Vaquero et al., 2024, stated that iron deficiency contributes to metabolic and hormonal changes, including increased parathyroid hormone levels and the risk of osteoporosis, all of which are associated with female reproductive disorders (Vaquero et al., 2024).

To avoid physiological side effects, especially in women of childbearing age, plant-based lifestyles and diets should be examined from a micronutrient perspective. Researchers argue that vegetarian diets can be a direct cause of menstrual disorders if not balanced with alternative methods of iron supplementation. The impact is widespread and cannot be compensated for simply by allowing the body time to adjust to the diet.

2. Ferritin Levels <30 µg/L as a Predictor of Menstrual Disorders

Ferritin levels <30 µg/L are a significant risk factor for menstrual disorders (OR 3.62; p = 0.007). This suggests that latent iron deficiency is sufficient to cause physiological changes in the reproductive system. Ghazzay et al. (2021) emphasized that low ferritin can cause various symptoms despite normal hemoglobin levels and is often unrecognized during routine clinical examinations (Ghazzay et al., 2021).

Ferritin has high sensitivity as an early indicator of iron deficiency, and this status has great clinical relevance especially in relation to dysmenorrhea and other hormonal disorders.

Researchers assume that ferritin levels below 30 g/L are sufficient to disrupt enzyme activity and hormonal systems that affect menstruation, even if they do not cause clinical anaemia. Thus, ferritin levels below 30 g/L are a critical threshold that directly impacts the hormonal and enzymatic functions regulating the menstrual cycle, even if anaemia does not occur. These findings expand our understanding of previous research that did not identify a quantitative relationship between specific ferritin levels and menstrual disorders. Consequently, this study is highly significant as it provides a scientific basis for using ferritin as a target indicator in reproductive health programmes. Given its significant impact, ferritin testing has become an essential component of women's healthcare, particularly for those experiencing abnormal menstrual symptoms or following a vegetarian diet.

3. Age and Education Variables Are Not Significant

In this model, age and educational level did not significantly affect the incidence of menstrual disorders. This suggests that, compared to sociodemographic factors, biological factors (such as iron status) and behavioural factors (such as dietary patterns) play a greater role in explaining variations in outcomes. Researchers believe that demographic factors such as age and education do not affect iron status and diet. This suggests that prevention and nutrition education strategies should adopt a biologically and behaviourally based approach.

CONCLUSIONS

This study showed a significant difference in ferritin levels between vegetarian and non-vegetarian women, with vegetarians having significantly lower ferritin levels. Furthermore, menstrual disorders such as dysmenorrhea and irregular menstrual cycles were more common in vegetarian women.

Multivariate analysis results showed that a vegetarian diet and low ferritin levels (<30 µg/L) were two significant independent risk factors for menstrual disorders in women of childbearing age. Meanwhile, age and education did not significantly influence the incidence.

These findings confirm that a diet low in heme iron without adequate compensation through supplementation or fortification may increase the risk of reproductive disorders. Therefore, it is

important for women of childbearing age, especially those on vegetarian diets, to regularly monitor their ferritin status and consider nutritional strategies that support iron sufficiency.

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