

**THE RELATIONSHIP BETWEEN BODY MASS INDEX, DIETARY
IRON INTAKE, AND DYSMENORRHEA AMONG FEMALE
STUDENTS IN UNIVERSITI SAINS MALAYSIA**

BY

SHALINI VIJAYA KUMAR

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the degree of Bachelor of Health Science (Honours) (Dietetics)**

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LIST OF ABBREVIATIONS

BMI	Body Mass Index
IJT	Index Jisim Tubuh
n	Number of respondents
SD	Standard Deviation
USMKK	Universiti Sains Malaysia Kubang Kerian
VAS	Visual Analogue Scale

HUBUNGAN ANTARA IJT, PENGAMBILAN ZAT BESI DAN DISMENOREA DALAM KALANGAN PELAJAR PEREMPUAN DI UNIVERSITI SAINS MALAYSIA

ABSTRAK

Dismenorea adalah gangguan haid yang biasanya berlaku dalam kalangan wanita pada usia reproduktif. Kajian ini bertujuan untuk menentukan hubungan antara IJT, pengambilan zat besi dan dismenorea dalam kalangan pelajar perempuan di Kampus Kesihatan Universiti Sains Kesihatan (USMKK). Satu kajian rentas telah dijalankan dengan 140 pelajar perempuan. Data mengenai ciri-ciri sosiodemografi, berat, tinggi, dismenorea, keterukan dismenorea dan ingatan diet selama 3 hari telah dikumpulkan menggunakan soal selidik yang diisi oleh peserta. Keterukan dismenorea dinilai menggunakan Skala Analog Visual (VAS) dan pengambilan zat besi dianalisis menggunakan *NutritionistPro*. Data telah dianalisis menggunakan *IBM SPSS Statistical Version 31* menggunakan statistik deskriptif, dan ujian Fisher's Exact. Majoriti peserta terdiri daripada bangsa Melayu (67.9%) dengan purata umur (21.68, SD=1.32) dari Pusat Pengajian Sains Kesihatan (52.1%). Purata ketinggian (157.9 cm, SD=6.866) dan berat badan (55.55 kg, SD=12.58) di mana prevalensi IJT normal (47.9%) adalah tinggi. Penemuan menunjukkan bahawa dismenorea adalah sangat prevalen (95.7%) dengan dismenorea tahap sederhana (45.7%) menjadi tahap yang paling ketara. Pengambilan zat besi yang tidak mencukupi juga tinggi (95.7%). Ujian Fisher Exact menunjukkan tiada hubungan signifikan antara IJT dengan dismenorea ($p=0.448$) atau keterukan dismenorea ($p=0.824$). Begitu juga, ujian Fisher Exact menunjukkan tiada hubungan signifikan antara pengambilan zat besi diet dengan kehadiran ($p=1.000$) atau keterukan ($p=0.848$) dismenorea. Kesimpulannya, penemuan ini mencadangkan bahawa walaupun dismenorea sangat lazim dalam kalangan pelajar perempuan USMKK, IJT dan pengambilan zat besi tidak berkait dengan kehadiran dan keterukan dismenorea.

THE RELATIONSHIP BETWEEN BODY MASS INDEX, DIETARY IRON INTAKE AND DYSMENORRHEA AMONG FEMALE STUDENTS IN UNIVERSITI SAINS MALAYSIA

ABSTRACT

Dysmenorrhea is a common menstrual disorder among women of reproductive age. This study aimed to determine the relationship between BMI, dietary iron intake and dysmenorrhea among female students in Health Campus Universiti Sains Malaysia (USMKK). A cross-sectional study was conducted with 140 female students. Data on sociodemographic characteristics, weight, height, dysmenorrhea presence, dysmenorrhea severity, and dietary iron intake were collected with a self-administered questionnaire and a 3-day diet recall. Dysmenorrhea severity was assessed using the Visual Analogue Scale (VAS), and dietary iron intake was analyzed using *NutritionistPro*. Collected data were analyzed using *IBM SPSS Statistics Version 31* using descriptive statistics and Fisher's Exact tests. The sample was predominantly Malay (67.9%) with a mean age of 21.68 (SD=1.32) from the School of Health Sciences (52.1%), where the majority were from year 3 (35.7%). The mean height (157.9, SD=6.866) and weight (55.55, SD=12.58) where the prevalence of normal BMI (47.9%) was high. The finding shows that dysmenorrhea was highly prevalent (95.7%), with moderate dysmenorrhea (45.7%) being the most common severity level. Inadequate iron intake was also highly prevalent (95.7%). Fisher's exact tests show no significant association observed between BMI and the presence ($p=0.448$) or severity of dysmenorrhea ($p=0.824$). Similarly, Fisher's exact tests show no significant association observed between dietary iron intake and the presence ($p=1.000$) or severity of dysmenorrhea ($p=0.848$). In conclusion, these findings suggest that although dysmenorrhea is highly prevalent among female students of USMKK, BMI and dietary iron intake were not associated with the presence and severity of dysmenorrhea.

CHAPTER 1: INTRODUCTION

1.1 Background of Study

Dysmenorrhea is known as periodic painful menstruation that can be characterized from mild to intense for some women (Aktaş et al., 2023). There are 2 types of dysmenorrhea: primary and secondary. Primary dysmenorrhea is the cramping pain that comes before or during the menstrual cycle. It is caused by the natural chemical substance prostaglandin, which is produced in the lining of the endometrium. Prostaglandin is at its highest on the first day of menstruation, and the pain is at its peak. The pain tends to reduce after a few days of the cycle. Secondary dysmenorrhea is associated with disease of the reproductive organs, which tends to cause extreme pain that is typically more than that of a normal menstrual cycle. Underlying health conditions that may cause secondary dysmenorrhea include endometriosis, fibrosis, and adenomyosis (ACOG, 2020).

Based on a systematic review and meta-analysis, women with a Body Mass Index (BMI) less than 18.5kg/m² or underweight individuals had a significantly higher risk of experiencing primary dysmenorrhea compared to individuals with a normal BMI (Wu et al., 2022). This indicates that being underweight may increase the risk and severity of dysmenorrhea. In addition, a study conducted by Takata et al (2023) shows that the general female population with significantly higher BMI means have reported experiencing severe menstrual pain. This suggests that a higher BMI is associated with an increased risk of painful menstruation. These findings highlight that both low and high BMI may influence menstrual pain.

Globally, 65 to 73% of females with dysmenorrhea also have low iron intake. A study investigating menstrual and nutritional status among females showed that 65.9% of females with dysmenorrhea had low iron intake (Söderman et al., 2025). Therefore, inadequate iron intake should also be recognized as a potential risk factor for dysmenorrhea. This is because low iron status may heighten central and peripheral pain sensitivity, which leads to more severe menstrual cramps (Dimas-Bendicto et al., 2023).

1.2 Problem Statement

Dysmenorrhea remains a highly prevalent and disruptive health issue among young women, particularly university students. This impacts their daily functioning, academic performance, and quality of life. For instance, a cross-sectional study conducted among Chinese female university students reports that the prevalence of primary dysmenorrhea is 41.7% (Hu et al., 2020). Meanwhile, in Malaysia, the prevalence rate of dysmenorrhea is 62.3% among women (Mohammad Bakro et al., 2023).

One of the risk factors that has been frequently associated with dysmenorrhea is BMI. Women with low BMI were found to have low body fat, malnutrition, overproduction of prostaglandins, and less estrogen production (Wu et al., 2022). On the other hand, women who had a BMI categorized as obese also had a high risk of developing dysmenorrhea due to activation of the prostaglandin-related pathway and a lower level of pain threshold (Takata et al., 2023).

In addition, studies have shown that dietary iron intake also influences dysmenorrhea. A study conducted by Syafila et al. (2024) found that female adolescents with inadequate iron intake were significantly associated with an increased incidence of dysmenorrhea. Inadequate iron intake may lead to lower hemoglobin

levels, reduced oxygen delivery, fatigue, and possibly heavier menstrual blood loss. Thus, this underlying mechanism could exacerbate menstrual pain and should be further explored.

There is a lack of studies conducted to explore how BMI and dietary iron intake influence dysmenorrhea. A cross-sectional study concluded that dysmenorrhea is linked to insufficient iron intake and unusual BMI, which is shorthand for BMI values outside the normal weight range, including underweight and obese (Talahatu et al.,2025). Yet, there is still a lack of research to determine the association of dysmenorrhea with BMI and dietary iron intake among university students in Malaysia.

Therefore, this study aims to investigate the relationship between BMI, dietary iron intake, and dysmenorrhea among female students in Universiti Sains Malaysia (USM), Kubang Kerian.

1.3 Relevance of Study

Dysmenorrhea is a major gynecological problem faced by women of reproductive age, in which they experience various physical and psychological complaints during their menstrual cycle. Severe dysmenorrhea among female students may affect the quality of life, academic performance, and daily activities. It is consistently reported that BMI and dietary iron are significantly associated with dysmenorrhea. However, studies investigating the prevalence and severity of dysmenorrhea and its correlation with both BMI and iron intake are limited primarily to university students. Hence, understanding the relationship between BMI and dietary iron intake in dysmenorrhea may contribute to the development of initiatives to alleviate menstrual pain and enhance both well-being and academic performance, primarily among female university students.

1.4 Research Question

1. What is the prevalence and severity of dysmenorrhea among female students in Universiti Sains Malaysia, Kubang Kerian?
2. What is the BMI status of the female students in Universiti Sains Malaysia?
3. What is the dietary iron intake of female students in Universiti Sains Malaysia?
4. Is there a relationship between BMI status and the presence and severity of dysmenorrhea among female students of Universiti Sains Malaysia, Kubang Kerian?
5. Is there a relationship between dietary iron intake and the presence and severity of dysmenorrhea among female students of Universiti Sains Malaysia, Kubang Kerian?

1.5 Research Objectives

1.5.1 General Objective

To investigate the relationship between body mass index (BMI), dietary iron intake with the presence and severity of dysmenorrhea among female students in Universiti Sains Malaysia (USM), Kubang Kerian.

1.5.2 Specific Objective

1. To determine the presence and severity of dysmenorrhea among female students in USM Kubang Kerian.
2. To determine the BMI status of female students in USM Kubang Kerian.
3. To assess the dietary iron intake of the female students in USM Kubang Kerian.
4. To investigate the relationship between the BMI status and the presence and severity of dysmenorrhea among female students in USM Kubang Kerian.

5. To investigate the relationship between dietary iron intake and the presence and severity of dysmenorrhea among female students in USM Kubang Kerian.

1.6 Research Hypothesis

Hypothesis of the relationship between BMI status and the presence and severity of dysmenorrhea among female students in USM Kubang Kerian

H_0 = There is no significant relationship between BMI status and the presence and severity of dysmenorrhea among female students in USM Kubang Kerian.

H_1 = There is a significant relationship between BMI status and the presence and severity of dysmenorrhea among female students in USM Kubang Kerian.

Hypothesis of the relationship between dietary iron intake and the presence and severity of dysmenorrhea among female students in USM Kubang Kerian

H_0 = There is no significant relationship between dietary iron intake and the presence and severity of dysmenorrhea among female students in USM Kubang Kerian.

H_1 = There is a significant relationship between dietary iron intake and the presence and severity of dysmenorrhea among female students in USM Kubang Kerian.

CHAPTER 2: LITERATURE REVIEW

2.1 Dysmenorrhea in Malaysia

Dysmenorrhea is defined as recurring lower abdominal, sharp, spasmodic, and intermittent pain that occurs just before or during menstruation due to uterine contraction that is not associated with any medical condition. The major symptoms associated with dysmenorrhea are nausea, vomiting, diarrhea, headache, and syncope. In addition, dysmenorrhea can cause psychological symptoms such as anxiety, depression, and irritability (Chua et al., 2020; Kyaw et al., 2025).

In Malaysia, epidemiological data indicate that dysmenorrhea is widely reported among the female population, with a prevalence rate of 62.3% (Mohammad Bakro et al., 2023). Similarly, a 2024 cross-sectional study further highlights that women aged between 18 and 50 have a substantial impact of dysmenorrhea on their daily lives. This condition often disrupts their routine tasks and reduces overall productivity (Kyaw et al., 2025). These consistent findings across different groups suggest that dysmenorrhea affects women's quality of life.

Dysmenorrhea is due to prostaglandin-mediated uterine ischemia. A sharp decrease in progesterone at the end of the luteal phase subsequently increases the prostaglandin levels. The increase in prostaglandin levels leads to uterine contraction and uterine ischemia. Ultimately, this mechanism increases sensitivity to pain fibres and causes pelvic pain (Chua et al., 2020).

Previous studies have highlighted the consequences of dysmenorrhea. Beyond physical discomfort, severe dysmenorrhea is linked to disabilities, inefficiency, and secondary psychological problems in some women. This results in depression and

inactive engagement in multiple social relationships as well as economic losses due to healthcare costs and decreased productivity (Mohammad Bakro et al., 2023).

Despite the high prevalence of dysmenorrhea, there is a significant gap in knowledge and health-related practices about dysmenorrhea among Malaysian females. It has been observed that low awareness and a lack of evidence-based management strategies contribute directly to prolonged symptoms and poor self-care (Mohamad Bakro et al., 2023).

In conclusion, current findings show that dysmenorrhea is highly prevalent among Malaysian women, which affects their physical and psychological well-being. While awareness and management practices are improving through health education, challenges remain in treatment-seeking behaviour. Continued research and public health initiatives are important to reduce the burden of dysmenorrhea and enhance women's health outcomes in Malaysia.

2.2 Dysmenorrhea among Female Students in Malaysia

When focus is narrowed to the academic setting, the prevalence of dysmenorrhea is alarming. A study focusing on university students reported an overall dysmenorrhea prevalence of approximately 78% (Chua et al., 2020) and 73.2% in more recent studies with students reporting moderate to severe pain (Mohammad Bakro et al., 2023),

Beyond identifying high prevalence, these studies also explore the negative impact on students' lives. Dysmenorrhea is linked to absenteeism, impaired concentration, and decreased academic participation among female students, which result in significant social and educational setbacks. The severity of dysmenorrhea

symptoms correlates with these adverse effects (Mohamad Bakro et al., 2023). This becomes a barrier to optimal student performance and well-being.

Several studies reveal that socio-demographic and familial influences are associated with dysmenorrhea. According to Lie et al. (2024), age, living arrangement, and maternal education level, which affect the prevalence and intensity of dysmenorrhea among female students in Malaysia. These findings suggest that dysmenorrhea is multifactorial, such as lifestyle, age, and socioeconomic status, where certain groups of students may be at high risk. However, the causal mechanism is lacking (Mohamad Bakro et al., 2023).

In conclusion, dysmenorrhea has a high prevalence among female students in Malaysia and requires more awareness. This is because it affects the majority to varying degrees and impacts daily academic and social functioning. It requires the implementation of supportive institutional measures and targeted health education to alleviate the pervasive burden on female students.

2.3 Body Mass Index and Dysmenorrhea

Body Mass Index (BMI) represents one of the most widely used anthropometric measurements for assessing nutritional status in a population. In Malaysia, BMI is used as a public health indicator due to the increasing obesity crisis among the adult population (Pannerselvam et al., 2021). The World Health Organization has recommended an Asian-specific BMI classification, which differs from the Western standard (Casadei et al., 2022). Based on Pannerselvam et al (2025), the prevalence of obesity has increased from 50.1% in 2019 to 54.4% in 2020.

Previous studies have reported inconsistent findings regarding the relationship between dysmenorrhea and BMI. Several studies have suggested that abnormal BMI is

associated with increased menstrual pain. However, research demonstrates a U-shaped relationship where both underweight and overweight women have increased dysmenorrhea risk due to hormonal imbalance and elevated prostaglandin activity (Wu et al., 2022). This suggests that both extremes of BMI, underweight and overweight, may influence dysmenorrhea. Similarly, Kway et al. (2024) observed that both underweight and obese women have experienced severe dysmenorrhea compared to individuals with a normal BMI.

Table 2.1: Proposed Physiological Mechanism of BMI Status

BMI Status	Proposed Physiological Mechanisms
Underweight (18.5kg/m ²)	<ul style="list-style-type: none"> • Low adipose tissue that suppresses the production of estrogen. This contributes to menstrual irregularities and increases prostaglandin release (Mitsuhashi et al., 2023). • Low energy availability suppresses the hypothalamic-pituitary-ovarian axis, which increases the likelihood of severe menstrual pain (Wu et al., 2022). • Poor nutritional status and low muscle mass heighten the central pain sensitivity, which intensifies menstrual cramp perception (Mitsuhashi et al., 2023).
Overweight/obese (>23kg/m ²)	<ul style="list-style-type: none"> • Excess adipose tissue promotes inflammation through the release of cytokines such as TNF-α and IL-6 that increase prostaglandin production and worsen menstrual pain (Donayeva et al., 2023). • Oxidative stress and reduced uterine blood flow also increase pain severity (Donayeva et al., 2023). • Increases estrogen levels through aromatase activity in adipose tissue, which leads to heavier menstrual bleeding and stronger uterine contractions (Mariappen et al., 2023)

Table 2.1 shows the physiological mechanism of BMI status that leads to dysmenorrhea. On the other hand, Liu et al (2025) argue that there is no consistent

relationship between dysmenorrhea, which emphasizes the mixed nature of current evidence. However, a large-scale meta-analysis by Wu et al. (2022) concluded that being underweight shows greater odds of experiencing dysmenorrhea compared to being overweight and obese. Conversely, localized Malaysian data reported that a significant prevalence of dysmenorrhea among adolescents in Klang (Mariappen et al., 2022). These mixed findings indicate that the interaction between BMI and dysmenorrhea within Malaysian women remains complex and requires further localized research to clarify.

2.4 Body Mass Index among Female Students in Malaysia

The nutritional status of university students has become an increasing concern due to the growing prevalence of weight-related disorders among young adults. According to a cross-sectional study, most female students, 77.8%, with normal BMI, 18.5-25 kg/m², while there is a small population were classified as underweight, <18.5 kg/m², 14.5%, and overweight, >25 kg/m², 7.7% (Mariappen et al., 2022). This can be supported by a study at Universiti Teknologi MARA, among 255 female students, the majority had normal (56.8%) BMI, 17.5% were overweight, 16.7% were underweight, and 9% were obese (Ahmad et al., 2023). Contrarily, another study found that 44.8% of overweight or obese students were female. This highlights the gendered nature of the issue (Varma et al., 2024).

Sociocultural pressures, body image, and psychological stressors are identified as predictors of BMI and weight-related behaviour (Mohd-Sidik et al., 2021). For instance, emotional and uncontrolled eating, often linked to stress, mediates the relationship between perceived stress and BMI, with sleep quality as a moderating factor. Moreover, overweight and obese students report poorer sleep quality, longer

latency, and more frequent sleep disturbance compared to their normal-weight peers (Du et al., 2022).

Students with greater knowledge of nutrition and a healthy lifestyle tend to have better BMI knowledge, but knowledge alone does not always translate into healthy behaviour (Azhan et al., 2024). Unhealthy dietary practices and a sedentary lifestyle are major contributors to higher BMI. Physical inactivity is prevalent, with female students generally less active than males (Razak et al., 2020). Poor dietary choices, such as frequent consumption of fried foods and sugary drinks, are linked to increased obesity risk (Azhan et al., 2024).

In conclusion, BMI among female students in Malaysia reflects a complex interplay of dietary habits, lifestyle, physiological factors, and social attitudes. While direct study on female students in Malaysia is limited. Intervention should be addressed not only on knowledge but also on behavioural, psychological, and environmental determinants to effectively promote healthy weight management in this population.

2.5 Dietary Iron Intake and Dysmenorrhea Among Female Students

Multiple studies have shown interest in assessing dietary iron intake among the Malaysian population. Iron deficiency remains a significant concern among Malaysian female university students, with studies reporting that many do not meet the recommended intake for iron (Mok et al., 2024). The traditional Malaysian diet tends to be high in protein and sugar but varies in fibre intake. There is no specific association with iron intake and its outcome, such as anemia risk and iron status. However, some patterns suggest the variability in iron consumption across dietary subgroups in the Malaysian population (Ali et al., 2020). Moreover, dietary assessments show that young

women often lack knowledge about iron-rich foods and factors affecting iron absorption, contributing to inadequate intake (Huong et al., 2021).

Anemia, which is characterized by a reduction in the proportion of red blood cells (Turner et al., 2023). The prevalence of anemia among adolescents is rising, especially among females. This is closely linked to inadequate dietary iron intake (Krishnan et al., 2021). Adolescents are defined as aged from 10 to 19 years old (World Health Organization: WHO, 2019). Similarly, International evidence also supports this trend, showing that female university students in other countries also commonly fail to meet daily iron requirements (Gallo et al., 2022). This trend underscores the importance of monitoring iron intake not only in adults but also in the younger population (Nasir et al., 2024). Low iron intake is further linked to reduced cognitive performance among young adults, highlighting potential academic consequences of iron deficiency (Dimas-Benedicto et al., 2023).

The relationship between iron intake and dysmenorrhea is a bidirectional biological cycle. Mechanically, iron deficiency restricts oxygen delivery to the uterine muscle, inducing localized uterine ischemia. This intensifies menstrual pain by stimulating the overproduction of vasoconstricting prostaglandin and vasopressin (Damayanti et al., 2022). This pathway establishes a loop where heavy menstrual bleeding depletes iron stores. This results in a deficiency that progressively worsens dysmenorrhea severity (Mansour et al., 2020). Furthermore, sub-optimal iron status heightened central and peripheral pain sensitivity (Dimas-Benedicto et al., 2023) while simultaneously impairing neuromuscular signaling to cause localized muscle fatigue and cramping (Fernandez-Jimenez et al., 2020). Hence, this shows that low iron status directly amplifies menstrual distress through compromised tissue oxygenation, altered muscular function, and elevated pain perception.

Nutrient intake patterns among university students are influenced by socio-environmental factors, including living arrangements, socio-economic circumstances, and irregular dietary patterns such as overreliance on convenience foods (Marriappen et al., 2021; Rizwan et al., 2023). For female students, these lifestyle-induced behaviours intersect critically with biological demands such as menstrual blood loss, thereby exponentially increasing their vulnerability to iron deficiency (Mansour et al., 2020; Gallo et al., 2022). Inadequate iron intake compromises daily functioning, immunity, and academic engagement with high cognitive demand environments (Fernandez-Jimenez et al., 2020; Gallo et al., 2022). While public health strategies like dietary diversification, such as including legumes in daily meal intake and biofortified food, show promise in improving iron biomarkers globally and within Malaysia. This can be confirmed with long-term data that shows a reduction in clinical outcomes remains scarce (Mutwiri et al., 2020).

Overall, studies indicate that inadequate dietary iron intake remains prevalent among female students and contributes to the high burden of iron deficiency and anemia. Although evidence regarding the direct association between dietary iron intake and dysmenorrhea remains limited, particularly among Malaysian female students. This highlights the need for further research to clarify the role of dietary iron intake in menstrual health and to inform targeted nutritional interventions aimed at improving the well-being of young women.

2.6 Conceptual Framework

Figure 1 shows the association of BMI and dietary iron intake with dysmenorrhea. Dysmenorrhea is painful menstruation that can be influenced by both physiological and nutritional factors. BMI reflects the nutritional and metabolic status

of an individual. This is because being underweight, overweight, or obese may cause menstrual irregularities and painful menstruation (Donayeva et al., 2023; Wu et al., 2022). Hence, BMI can influence the presence and severity of dysmenorrhea. On the other hand, inadequate iron intake may also be a determinant of dysmenorrhea severity (Damayanti et al., 2022). Inadequate iron intake can reduce hemoglobin levels, which limits the blood's ability to carry oxygen to tissues. This causes tissue hypoxia in the uterus, increasing prostaglandin production. This leads to stronger uterine contractions (Damayanti et al., 2022). As a result, with inadequate iron intake, severe dysmenorrhea is experienced (Dimas-Benedicto et al., 2022; Fernandez-Jimenex et al., 2020).

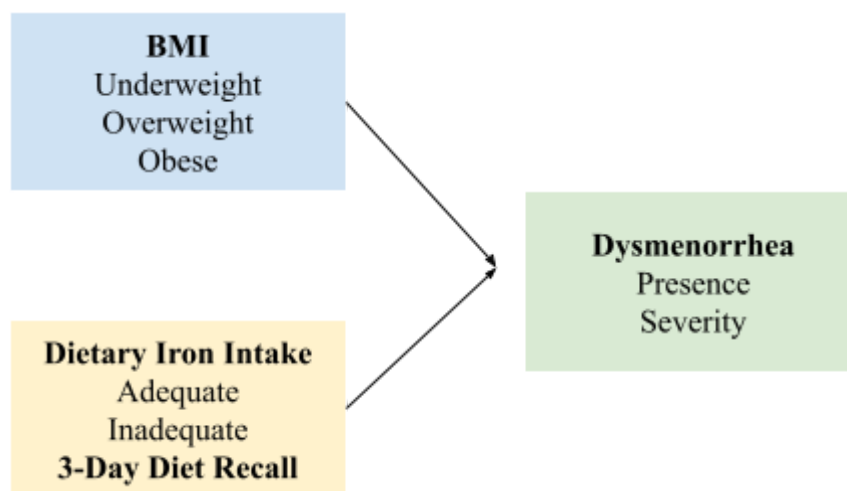


Figure 1: Conceptual framework of the association of dysmenorrhea with BMI and dietary iron intake.

CHAPTER 3: METHODOLOGY

3.1 Research Design

This was a cross-sectional study that aimed to determine the relationship between BMI status, dietary iron intake, and dysmenorrhea among female students in USM Kubang Kerian.

3.2 Study Population

This study involved undergraduate female students of USM Kubang Kerian from all three schools of Medical Sciences, Dental Science, and Health Science.

3.3 Subject Criteria

All eligible and consenting subjects are recruited for this study. Ethical approval from the Human Research Ethics Committee of USM was obtained. All the participants were recruited based on the inclusion and exclusion criteria outlined below.

3.3.1 Inclusion Criteria

- Females aged from 19 to 25 years old
- Currently enrolled in USM Kubang Kerian in any academic session
- Experience regular menstruation, which is within 26 to 32 days
- Willing to provide consent
- Able to complete the questionnaire

3.3.2 Exclusion Criteria

- Students with diagnosed gynecological disorders such as endometriosis, chronic illness
- Students with irregular menstrual cycle
- Currently pregnant or lactating students
- Students are currently on hormonal therapy or iron supplements.

3.4 Study Area

The study was conducted at USM Kubang Kerian, Kelantan. Areas involved were all 3 schools, the School of Medicine Sciences, the School of Dental Sciences, and the School of Health Sciences in USM Kubang Kerian.

3.5 Sample Size Calculation

3.5.1 Sample Calculation for Dysmenorrhea

A sample study was selected among female students who are 18 to 25 years old. According to a previous study's report, approximately 92.8% young adults have experienced primary dysmenorrhea (Kway et al., 2025). The sample size was calculated using Cochran's formula,

$$n = \frac{z^2(p)(1-p)}{\Delta^2}$$

Where

n = sample size

Z = confidence level at 1.96 (95%) p == anticipated population proportion (0.928)

Δ= absolute precision at 0.05

$$n = \frac{(1.96)^2 (0.928)(1-0.928)}{(0.05)^2}$$

$$n = 102.7$$

n~ 103 female students

In case of a non-response rate, 10% of the sample size is added.

$$n = 103 + (103 \times \frac{10}{100})$$

$$n = 113.3 \text{ female students}$$

n~ 113 female students

Therefore, the sample size required was 113 female students after adding 10% non-response rate.

3.5.2 Sample Calculation for Body Mass Index

A sample study was selected among female students who have abnormal BMI, underweight, or obese. A previous study shows that 6.8% of females were overweight (Akhtari-Zavare et al., 2025). The sample size was calculated using Cochran's formula.

$$n = \frac{z^2 (p)(1-p)}{\Delta^2}$$

Where

n= sample size

Z = confidence level at 1.96 (95%)

p = anticipated population proportion (0.068)

Δ= absolute precision at 0.05

$$n = \frac{(1.96)^2 (0.068)(1-0.068)}{(0.05)^2}$$

$$n = 97.4$$

n~ 97 female students

In case of a non-response rate, 10% of the sample size is added.

$$n = 97 + (97 \times \frac{10}{100})$$

$$n = 106.7$$

n~ 107 female students

Therefore, the sample size required was 107 female students after adding 10% non-response rate.

3.5.3 Sample Calculation for Dietary Iron Intake

A sample study was selected among female students who do not meet the recommended dietary iron intake. Based on a study, 91% of female adolescents had dietary iron intake less than two-thirds of the recommended intake (Foo et al., 2004).

The sample size was calculated using Cochran's formula,

$$n = \frac{z^2(p)(1-p)}{\Delta^2}$$

Where

n= sample size, Z = confidence level at 1.96 (95%)

p= anticipated population proportion (0.91)

Δ = absolute precision at 0.05

$$n = \frac{(1.96)^2(0.91)(1-0.91)}{(0.05)^2}$$

$$n = 125.9$$

n~ 126 female students

In case of a non-response rate, 10% of the sample size is added.

$$n = 126 + (126 \times \frac{10}{100})$$

$$n = 138.6$$

$n \sim 139$ female students

Therefore, the sample size required was 139 female students after adding 10% non-response rate.

The sample size required for the study was calculated based on two parameters, which are body mass index and dietary iron intake among female students who experience dysmenorrhea, as limited studies were present on the association between BMI, dietary iron intake and dysmenorrhea. Each parameter's sample size was calculated using Cochran's formula, with a 95% confidence interval and a precision of 5%. In total, the study required a sample size ranging from 107 to 139 female students. The variations in sample sizes account for the different prevalence rates of the research variables, incorporating adjustments for anticipated participant dropouts. However, the higher sample size calculation is used to collect the data ($n=139$) to ensure adequate statistical power of the study and provide sufficient participants for subsequent association analyses between BMI, dietary iron intake and dysmenorrhea.

3.6 Sampling Method

The subjects are chosen through convenience sampling from three schools of USM Kubang Kerian. Convenience sampling is a non-probability sampling technique where participants are selected as they are readily available. Based on Golzar et al. (2022), the bias of this sampling can be overcome by evaluating and controlling representativeness, adding diversity, using a larger sample size, and integrating more

data sources. Eligible subjects are selected based on the inclusion and exclusion criteria.

3.7 Research Tools

This study uses a questionnaire adapted from Kway et al (2024). The questionnaire was modified to suit the objective of the present study while retaining the core components to assess dysmenorrhea. A copy of the permission from the corresponding author is in Appendix B. It has 4 parts. The first part is a sociodemographic questionnaire followed by the anthropometry assessment, presence and severity of dysmenorrhea assessment, and a 3-day 24-hour diet recall.

3.7.1 Sociodemographic

This socio-demographic questionnaire collects key information about the students' background. The first part of the questionnaire collected basic details such as age, age of menarche, race, school, year of study, and living environment. In the year of study, the Diploma of Nursing is also included as an option, as they are also undergraduate students within the School of Health Sciences.

3.7.2 Anthropometry Assessment

Body Mass Index (BMI) is the most widely used anthropometric measure to assess the weight-height ratio of individuals. BMI is defined as weight divided by height squared. This is used in epidemiology studies and clinical screening. It is a quick, inexpensive, and non-invasive screening tool that classifies individuals as underweight, normal, overweight, and obese (Wu et al., 2024).

The participants were asked to measure their weight and height. The tools used will be borrowed from the Dietetics Lab of PPSK. The session was conducted in the

DM4 Lobby. Participants were reminded to wear minimal clothing and were requested to come before consuming anything. A stadiometer (SECA 206, Germany) and a digital weighing scale (SECA 808, Germany) are used to assess the participants.

To measure height, the participants were asked to look straight with their hands hanging at their sides. Two readings were taken. To measure the weight, the participants are asked to stand on the weighing scale with their shoes off and asked to look straight, with their hands hanging by their sides. Two readings were recorded. With the results, BMI was calculated (Casadei & Keil., 2022).

The weight of the participants was measured outside their menstrual cycle, ideally during the follicular phase. The follicular phase is a phase shortly after menstruation ends. A study found that women during menstruation have higher body weight compared to the beginning of their cycle. The study suggests that fluid retention causes weight changes. Hence, measuring weight during menstruation could produce an inaccurate weight that does not reflect true body mass (Kanellakis et al., 2023).

3.7.3 Presence and Severity of Dysmenorrhea

The presence and severity of dysmenorrhea were assessed using a set of questions adapted from Kyaw et al. (2024). This set of questions was used to assess dysmenorrhea characteristics, associated factors, and daily functioning. The first question of the set was about the presence of dysmenorrhea. Dysmenorrhea was defined as the presence of menstrual pain experienced during menstruation. Those who responded “Yes” proceeded to further questions about pain characteristics. The subject is classified as having dysmenorrhea when two of these criteria are met: the presence of lower abdominal or pelvic pain occurring before or during the first one to two days of

menstruation, with pain severity measured using the Visual Analogue Scale (VAS) (Karout et al., 2021).

The severity of dysmenorrhea was assessed using the Visual Analogue Scale (VAS). Visual Analogue Scale (VAS) is a widely used psychometric instrument that offers a simple yet effective method for quantifying the intensity or magnitude of subjective experiences and attitudes. It relies on a continuous line (Koo et al., 2025). It is also freely accessible in the public domain and can be used in research without any licensing or permission requirements (Hawker et al., 2011). The participants were asked to rate their pain from 0 to 10. Based on VAS, dysmenorrhea severity was categorized into four categories: no dysmenorrhea (0), mild dysmenorrhea (1-3), moderate dysmenorrhea (4 - 6), and severe dysmenorrhea (7 - 10).

To assess the characteristics of dysmenorrhea, the duration of menstrual pain, the amount of menstrual flow, and the rhythmicity of the menstrual cycle were assessed. The duration of menstrual pain was assessed by asking the participant to report the number of days they experience pain during menstruation. Next, the amount of flow was assessed based on the frequency of sanitary products changed in a day. Lastly, the rhythmicity of the menstrual cycle was assessed to determine the pattern in menstrual irregularities, which was classified as regular, polymenorrhea and menorrhagia.

Participants were asked to report pain in certain situations that may intensify the menstrual discomfort. This includes pain with a full bladder, during urination, bowel movement, walking, prolonged sitting, lifting weights, and sexual activities. For each situation, participants were required to rate the use of VAS. Lastly, the impact of dysmenorrhea was assessed by investigating the interference with daily life. Participants were required to answer “Yes” or “No” to interference, such as interference

in daily life, interference with attention in class, class work, social activities, sports, family relations, sexual activities, and partner relations.

3.7.4 3 Day 24-Hour Diet Recall

A 24-hour diet recall is a dietary assessment method that asks individuals to recall all food and beverages consumed in the last 24 hours. This also includes portion sizes, preparation methods, and eating occasions. This also includes portion sizes, preparation methods, snacking habits, and eating occasions. A 24-hour diet recall can capture detailed information, which provides a more comprehensive view of actual intake. To capture the habitual diet of participants, 24-hour diet recalls are done on non-consecutive days to be precise (Lepiller et al., 2023).

The participants were interviewed to record everything they had consumed and drunk in the past 24 hours, from midnight to midnight, for 3 non-consecutive days, 2 weekdays and 1 weekend (Saturday, Sunday, and Monday). The interview questions consist of meal time, type of food/beverage, quantity, and method of preparation. Participants were also asked about their snacking habits and their eating occasions (Lepiller et al., 2023). The 3-day diet recalls were compiled and analyzed using NutritionistPro, a nutritional software.

To assess the iron intake, all recorded food and beverages were entered into the software to calculate total daily iron consumption for each participant. The calculated iron intake was compared to the Recommended Nutrient Intake (RNI) 2017 for iron.

3.8 Data Collection Method

As shown in Figure 2, the data collection begins once ethics approval is obtained. First and foremost, the respondents were selected based on their accessibility and willingness to participate. The respondents were contacted through WhatsApp personally. The respondents were informed about the study's goals, benefits, and their rights regarding confidentiality during data collection. The process of gathering data was private and secure. The respondents were provided with a consent form to sign if they agreed to participate in this study and meet the inclusion and exclusion criteria.

The respondents began by answering sociodemographic information, which includes age, year of study, and age of menarche. Menstrual characteristics were assessed using a validated questionnaire including the presence, frequency, and severity of dysmenorrhea. Then they were weighed using a calibrated weighing scale. Their height was also measured by the stadiometer. The measurements were taken at least twice to make sure there is precision. Lastly, the respondents were interviewed to obtain detailed information on their food intake for each day on 3 non-consecutive days, 2 weekdays, and 1 weekend. Then the food intake was analyzed with NutritionistPro. This required 20 minutes for the respondents to answer the questionnaire and the interview.