THE RELATIONSHIP BETWEEN BODY MASS INDEX AND ANEMIA WITH PRIMARY DYSMENORRHEA IN ADOLESCENT GIRLS

Septi Indah Permata Sari[1], Iis Dahlia[2]

*Korespondensi email: septiindahps07@gmail.com
[12]Faculty of Midwifery, Poltekkes Kemenkes Riau

ABSTRAK: HUBUNGAN INDEKS MASSA TUBUH DAN ANEMIA TERHADAP DISMENORE PRIMER PADA REMAJA PUTRI

Latar Belakang: Dismenore primer merupakan nyeri haid yang terjadi tanpa kelainan organik dan sering dialami remaja putri. Prevalensi global mencapai 60–90%, sedangkan di Indonesia sekitar 64,25% remaja melaporkannya. Faktor risiko yang berperan antara lain status gizi (Indeks Massa Tubuh/IMT) dan anemia. IMT yang tidak normal (underweight maupun overweight) berhubungan dengan gangguan hormonal yang dapat memperburuk nyeri, sementara anemia defisiensi besi memperparah kontraksi uterus melalui hipoksia jaringan endometrium.

Tujuan Untuk Mengetahui hubungan IMT dan anemia terhadap kejadian dismenore primer pada remaja putri.

Metode: Penelitian ini di lakukan bulan Januari-Mei 2020 di Desa Babussalam Kabupaten Rokan Hulu. Jenis penelitian ini adalah analitik observasional dengan pendekatan cross sectional. Populasi dalam penelitian ini adalah remaja putri usia 12-16 tahun di Desa Babussalam Kabupaten Rokan Hulu. Pengambilan sampel menggunakan teknik total sampling sebanyak 50 orang remaja putri yang memenuhi kriteria insklusi.

Hasil : Hasil penelitian didapatkan 64,0% remaja putri mengalami dismenore primer. Sebagian besar remaja putri tidak anemia (58,0%) dan 62,0% memiliki indeks massa tubuh kategori normal. Hasil analisis uji chi square test dengan derajat kepercayaan 95% menunjukkan ada hubungan yang signifikan antara indeks massa tubuh (p=0,001) dan anemia (p=0,003) terhadap kejadian dismenore primer pada remaja putri.

Kesimpulan: IMT dan anemia berhubungan signifikan dengan kejadian dismenore primer pada remaja putri, dengan anemia sebagai faktor paling berpengaruh.

Saran : Remaja putri disarankan menjaga status gizi ideal serta rutin mengonsumsi makanan bergizi dan tablet tambah darah untuk mencegah anemia. Pihak sekolah dan tenaga kesehatan perlu meningkatkan edukasi tentang kesehatan reproduksi, manajemen nyeri haid, dan pencegahan anemia. Penelitian lebih lanjut disarankan dengan desain longitudinal dan intervensi gizi.

Kata Kunci : Remaja, Indeks Massa Tubuh (IMT), Anemia, Dismenore

ABSTRACT

Background: Primary dysmenorrhea is menstrual pain that occurs without any organic disorder and is often experienced by adolescent girls. The global prevalence reaches 60–90%, while in Indonesia, approximately 64.25% of adolescents report it. Risk factors include nutritional status (Body Mass Index/BMI) and anemia. An abnormal BMI (either underweight or overweight) is associated with hormonal disorders that can worsen pain, while iron deficiency anemia exacerbates uterine contractions through endometrial tissue hypoxia.

Objective : To determine the relationship between BMI and anemia and the incidence of primary dysmenorrhea in adolescent girls.

Methods: This study was conducted from January to May 2020 in Babussalam Village, Rokan Hulu Regency. This study was an observational analytic study with a cross-sectional approach. The population in this study were adolescent girls aged 12-16 years in Babussalam Village, Rokan Hulu Regency. Sampling used a total sampling technique of 50 adolescent girls who met the inclusion criteria.

Results: The study found that 64.0% of adolescent girls experienced primary dysmenorrhea. Most of the adolescent girls were not anemic (58.0%), and 62.0% had a normal body mass index. The chi-square test analysis with a 95% confidence interval showed a significant relationship between body mass index (p=0.001) and anemia (p=0.003) and the incidence of primary dysmenorrhea in adolescent girls.

Conclusion : BMI and anemia are significantly associated with the incidence of primary dysmenorrhea in adolescent girls, with anemia as the most influential factor.

 DOI 10.33024, http://ejurnalmalahayati.ac.id/index.php/kebidanan

Recommendations: Adolescent girls are advised to maintain ideal nutritional status and regularly consume nutritious foods and iron supplements to prevent anemia. Schools and health workers need to increase education on reproductive health, menstrual pain management, and anemia prevention. Further research is recommended, including longitudinal designs and nutritional interventions.

Keywords: Adolescents, Body Mass Index (BMI), Anemia, Dysmenorrhea

INTRODUCTION

Primary dysmenorrhea is painful menstruation that occurs without existence underlying reproductive organ disorders . This pain usually arise a number of year after menarche and generally caused by contractions myometrium triggered by prostaglandins and inflammatory mediators , so that cause endometrial ischemia and pain abdominal cramps below . Primary dysmenorrhea is problem health reproduction is very common in adolescents daughter and impact on quality life , absence school and activities social (American College of Obstetricians and Gynecologists, 2018)

Prevalence dysmenorrhea varies between studies and countries, but Lots study report high numbers in the population teenagers — range report global prevalence between 50% to >80% depending definitions and methods survey . In Indonesia, the 2018 Riskesdas data recorded number substantial dysmenorrhea ; some report national and study local quoting prevalence total dysmenorrhea is around 64.2% (with proportion primary dysmenorrhea that is large in most population teenagers). This figure confirm that dysmenorrhea is problem health necessary reproduction health program attention schools and teenagers (Katib et al., 2024).

Body Mass Index (BMI) as nutritional status indicators (underweight, normal, overweight/ obese) play a role in physiology reproduction and hormonal balance (World Health Organization, 2017) . Evidence from studies observational and review systematic show relationship that is not consistent but real between BMI/BMI and dysmenorrhea : several studies report correlation positive between high BMI (overweight/ obesity) and severity dysmenorrhea , some others reported correlation on the contrary , and some find U-shaped pattern (risk increased in both extreme BMI). Therefore That important research BMI– dysmenorrhea relationship in the population teenager Because change pattern nutrition teenagers (e.g., increase in prevalence of overweight) can influence burden dysmenorrhea (Takata et al., 2023) .

Anemia specifically anemia deficiency iron often found in adolescents daughter consequence improvement need substance iron during growth and loss blood recurring menstruation (Rohmawati & Wulandari, 2019). Anemia characterized by low hemoglobin (Hb) concentration so that capacity transportation decreased plasma oxygen , which can make things worse hypoxia network including uterine tissue (Amelia et al., 2019) . Some study observational show connection between anemia / deficiency iron and intensity painful menstruation ; patient with anemia reported experience frequency or severity more dysmenorrhea high , possibility through mechanism decline tolerance pain , hypoxia network , and changes metabolic . WHO recommends Hb limit for define anemia in adolescents non- gestational women (generally Hb < 12.0 g/dL) and provide guidelines evaluation and strategies for dealing with it (World Health Organization, 2024, 2025) .

In a way theoretical , BMI and anemia can influence dysmenorrhea through track physiological interrelationships related : nutritional status (deficiency or excess) affects production hormones , peripheral fat composition (which influences metabolism) estrogen and prostaglandins), as well as inflammatory status systemic ; whereas anemia influence capacity oxygenation network and tolerance to stress ischemic – so that combination second factor this is in teenagers daughter potential increase likelihood and severity dysmenorrhea (Oktaviana et al., n.d.) . However , the results study empirical Still diverse so that required studies structured in the population teenager For test connection statistics between BMI, anemia , and incidence / severity primary dysmenorrhea (Takata et al., 2023)

Based on things mentioned above , research with title " Connection Body Mass Index and Anemia to Primary Dysmenorrhea in Adolescent Girls" relevant and important to : (1) measure magnitude problem (prevalence dysmenorrhea , BMI distribution and anemia) in the population teenager local ; (2) testing strength connection between BMI and anemia to incident as well as severity primary dysmenorrhea ; and (3) provide proof For intervention health schools (e.g. nutrition programs , supplementation iron ,

education management pain) which is based proof (Riskesdas, 2018).

RESEARCH METHODS

This type of research is an observational analytical study with a cross-sectional approach to determine the relationship between body mass index and anemia to primary dysmenorrhea in adolescent girls. The population in this study were all adolescent girls aged 12-16 years in Babussalam Village, Rokan Hulu Regency in 2020. The sampling technique used a total sampling technique based on the inclusion criteria: having experienced menstruation, not having gynecological diseases and not experiencing menstruation at the time of data collection, namely 50 people. Body Mass Index (BMI) was measured by weighing respondents using a digital scale and then measuring their height using a microtoise while standing upright, barefoot. BMI was calculated by dividing body weight (kg) by height (m^2). This measurement was taken at the beginning of data collection before the respondents experienced their menstrual period to obtain an accurate picture of their nutritional status. Dysmenorrhea levels were measured using a pain scale questionnaire (e.g., Numeric Rating Scale/NRS or Visual Analog Scale/VAS) completed by respondents on the first to second day of menstruation, when pain intensity is typically highest. Respondents were asked to rate their pain level on a given scale, thus representing the actual degree of dysmenorrhea according to the phase of the menstrual cycle.This study was conducted in January-May 2020. The research tool used to collect dysmenorrhea data was a questionnaire, while for data collection of body mass index (BMI) and anemia, using a step scale (secca), a height measuring instrument (microtoise) and an easy touch hemoglobin measuring instrument. The data analysis method in this study used the chi-square test in SPSS.

RESEARCH RESULT AND DISCUSSIONS

This research was conducted at Babussalam Village, Rokan Hulu Regency in 2020. This research began in January-May 2020 with a total of 32 respondents. Data collection on dysmenorrhea used a questionnaire, while data collection on body mass index (BMI) and anemia used a step scale (secca), a height measuring instrument (microtoise) and an easy touch hemoglobin measuring instrument.. The results obtained are presented in the tables below:

Table 1
Overview of Primary Dysmenorrhea, Anemia, and Body Mass Index in Adolescent Girls in Babussalam Village, Rokan Hulu Regency in 2020

Variables	N	%
Occurrence of Primary Dysmenorrhea:		
Dysmenorrhea	32	64.0
No dysmenorrhea	18	36.0
Anemia Occurrence:		
Anemia	21	42.0
No Anemia	29	58.0
Body Mass Index:		
Abnormal	19	38.0
Normal	31	62.0

Table 1 shows that the incidence of primary dysmenorrhea in adolescent girls is 64.0%, most of the adolescent girls do not experience anemia (58.0%), and most of the body mass index (BMI) of adolescent girls is normal (62.0%).

Table 2
Relationship between Anemia and Primary Dysmenorrhea in Adolescent Girls in Babussalam Village, Rokan Hulu Regency in 2020

Anemia Status	Dysmenorrhea				Amount		*P Value*	OR
	Yes		No					
	N	%	N	%	N	%		
Anemia	19	90.5	2	9.5	21	100	0.003	11,692
No Anemia	13	44.8	16	55.2	29	100		

Table 2 shows that dysmenorrhea in adolescent girls is higher in adolescents with anemia, namely 90.5% compared to adolescents who do not experience anemia, only 44.8%. The results of statistical tests using *chi square* showed a relationship between anemia status and primary dysmenorrhea in adolescent girls (p = 0.003) with an OR value of 11.692, which means that adolescent girls with anemia are 11.692 times more

 DOI 10.33024, http://ejurnalmalahayati.ac.id/index.php/kebidanan

likely to experience primary dysmenorrhea than adolescents who are not anemic.

Table 3
Relationship between Body Mass Index (BMI) and Primary Dysmenorrhea in Adolescent Girls in Babussalam Village, Rokan Hulu Regency in 2020

Body Mass Index	Dysmenorrhea				Amount		*P Value*	OR
	Yes		No					
	N	%	N	%	N	%		
Abnormal	18	94.7	1	5.3	19	100	0.001	21,857
Normal	14	45.2	17	54.8	31	100		

Table 3 shows that primary dysmenorrhea in female adolescents is higher in adolescents with an abnormal body mass index (BMI) category, namely 94.7% compared to adolescents with a normal body mass index (BMI) category, only 45.2%. The results of the *chi-square* statistical test showed a relationship between body mass index (BMI) and primary dysmenorrhea in female adolescents (p = 0.001) with an OR value of 21.857, which means that adolescents with an abnormal body mass index (BMI) are 21.857 times more likely to experience primary dysmenorrhea than adolescents with a normal body mass index (BMI).

DISCUSSIONS

Primary dysmenorrhea is a complaint of menstrual pain that arises from physiological processes in the endometrium and myometrium without any apparent organic abnormalities. The primary mechanism involves the release of prostaglandins (primarily $PGF_2\alpha$ and PGE_2) during the endometrial desquamation phase, which trigger excessive myometrial contractions and vasoconstriction, resulting in uterine ischemia, resulting in cramping pain. This condition is very common in adolescent girls and has the potential to disrupt quality of life, school attendance, and social activities(Itani et al., 2022).

Anemia—especially iron deficiency anemia—is common in women of reproductive age, including adolescents, due to a combination of menstrual blood loss and increased iron requirements during growth. Body Mass Index (BMI) is also a relevant indicator of nutritional status because changes in body weight (whether underweight or overweight) influence hormonal status, micronutrient status (including iron stores), and chronic inflammatory status—factors that may modulate the experience of menstrual pain (Guideline on Haemoglobin Cutoffs to Define Anaemia in Individuals and Populations, 2024; World Health Organization, 2025).

Reduced oxygen-carrying capacity → tissue hypoxia, anemia reduces the blood's oxygen-carrying capacity. When uterine contractions occur during menstruation, myometrial and endometrial perfusion decreases; when Hb is low, the tissue is more susceptible to relative hypoxia, exacerbating ischemia and increasing the formation of anaerobic metabolites and inflammatory mediators that increase pain sensation . This provides a rational pathophysiological basis for the relationship between low Hb and menstrual pain intensity (Itani et al., 2022).

Pain sensitization and non-hematologic effects of iron deficiency, Iron deficiency, even before reaching severe anemia, has been associated with changes in central and peripheral nervous system function (e.g., neurotransmitters, pain threshold), which can lower the pain threshold and increase the subjective perception of menstrual pain. Studies of non-hematologic symptoms of iron deficiency indicate that these conditions affect energy, cognitive function, and possibly modulate the pain response (Fernandez-Jimenez et al., 2020).

Interactions with inflammatory mediators, tissue hypoxia and iron deficiency can modulate the local inflammatory response—e.g., by affecting the production of prostaglandins or inflammatory cytokines—which in turn worsens uterine contractions and pain. While the specific molecular pathways are still under investigation, this inflammation–ischemia–pain framework is consistent with the dysmenorrhea literature (Kirsch et al., 2024) .

Empirical evidence, Several cross-sectional studies and studies of adolescent populations have reported an association between low hemoglobin levels (or anemia status) and the prevalence/severity of primary dysmenorrhea. However, the majority of these studies are observational and therefore cannot prove causality—whether anemia worsens dysmenorrhea

or heavy menstrual bleeding → anemia. Local studies of adolescents in various countries (including studies in Indonesia) have reported a significant correlation between low hemoglobin and dysmenorrhea, strengthening the clinical relevance of this issue in school settings and adolescent services (Hasnia et al., 2024; Katib et al., 2024).

BMI influences dysmenorrhea through several different pathways, which explains why the literature shows mixed results (increased risk in underweight, obesity, or a U-shaped pattern) Underweight (low BMI), Chronic energy deprivation and malnutrition in underweight adolescents can disrupt reproductive hormone production (e.g., decreased estrogen/cycle alterations), reduce fat stores important for hormonal homeostasis, and cause micronutrient deficiencies (including iron). This combination of hormonal changes and nutritional deficiencies may increase susceptibility to prostaglandin production or lower pain threshold, thus contributing to dysmenorrhea (Mizgier et al., 2025).

Overweight/Obesity, Adipose tissue produces adipokines and increases aromatase activity, which alters estrogen metabolism; obesity is also associated with a low-grade chronic inflammatory state (e.g., elevated CRP, IL-6), which may increase pain sensitization and modulate the production of pain mediators such as prostaglandins. Therefore, obesity may exacerbate or modulate dysmenorrhea symptoms through hormonal and inflammatory pathways. However, epidemiological evidence regarding the obesity-dysmenorrhea relationship is heterogeneous; some studies have found an association, others have not (Wu et al., 2022).

U-shaped pattern, Because the mechanisms differ at either end of the BMI spectrum, many studies and meta-analyses report a U-shaped pattern—a higher risk of dysmenorrhea in underweight and obese groups compared to those with normal BMI—which underscores the need to consider BMI as a non-linear variable in analyses. The largest meta-analysis examining BMI categories showed heterogeneity in results but confirmed that extreme BMI statuses were associated with an increased risk of dysmenorrhea in most studies (Wu et al., 2022).

Anemia and BMI are interrelated and can work together (synergistically or as confounders) in influencing primary dysmenorrhea:

Underweight → risk of anemia → worsening dysmenorrhea**,** adolescents with a low BMI are more susceptible to energy and micronutrient deficiencies, including iron and low ferritin stores. Because iron deficiency can lower the pain threshold and increase tissue hypoxia during contractions, underweight adolescents who are anemic may be at greater risk of dysmenorrhea than those who are simply underweight without anemia (Fernandez-Jimenez et al., 2020b).

Overweight/obesity and non-hematologic anemia, although obesity does not directly cause iron deficiency anemia, chronic inflammation in obesity can alter iron metabolism (e.g., high hepcidin → reduced iron absorption), resulting in impaired iron status in some obese individuals, which can influence symptoms. Furthermore, the inflammatory and hormonal effects of obesity can increase pain sensitization, so if obesity is combined with suboptimal iron status, the impact on dysmenorrhea may be greater (Kleber Yotsumoto Fertrin, 2020).

Confounding and mediation, because BMI influences (1) nutrient intake/absorption, (2) hormonal status, and (3) inflammatory status, it is important to include both variables (Hb and BMI) in multivariate analyses. Without controlling for both, estimates of the association between anemia and dysmenorrhea or between BMI and dysmenorrhea may be biased. Studies that control for these factors are likely to provide more valid estimates of independent and interaction effects (Wu et al., 2022b) .

Meta-analysis and review, Wu et al. (2022) conducted a systematic review and meta-analysis examining the association of each BMI category with primary dysmenorrhea; they reported heterogeneous findings but showed an increased risk in extreme BMI categories across studies, supporting a U-shaped pattern (Wu et al., 2022b).

Studies on anemia**,** various observational studies (including studies of adolescent populations in Indonesia and international studies) reported an association between low Hb (or anemia) and the incidence/severity of dysmenorrhea. However, the effect size and strength of the association varied across studies—partly due to variations in anemia measurement methods (Hb vs. ferritin), definitions of dysmenorrhea, and control for confounders such as BMI, physical activity, or underlying gynecological disorders (Hasnia et al., 2024) .

Overall, biological evidence (hypoxia, pain sensitization, inflammation) and empirical observational evidence support an association between anemia and dysmenorrhea, as well as between extremes of BMI and dysmenorrhea; the combination of these two factors strengthens the plausibility that adolescents with abnormal BMI who

 DOI 10.33024, http://ejurnalmalahayati.ac.id/index.php/kebidanan

are also anemic are at higher risk for moderate–severe dysmenorrhea.

CONCLUSION

BMI and anemia are significantly associated with the incidence of primary dysmenorrhea in adolescent girls, with anemia as the most influential factor.

SUGGESTIONS

Adolescent girls are advised to maintain ideal nutritional status and regularly consume nutritious foods and iron supplements to prevent anemia. Schools and health workers need to increase education on reproductive health, menstrual pain management, and anemia prevention. Further research is recommended, including longitudinal designs and nutritional interventions.

REFERENCES

Amelia, P. K., Arisani Prodi DIII Kebidanan Jurusan Kebidanan, G., Kesehatan Kemenkes Palangka Raya, P., & DIII Kebidanan Jurusan Kebidanan, P. (2019). *Hubungan Indeks Massa Tubuh (IMT), Kadar Hemoglobin dan Paparan Asap Rokok dengan Kejadian Dismenore*.

American College of Obstetricians and Gynecologists. (2018). *Dysmenorrhea and Endometriosis in the Adolescent*.

Fernandez-Jimenez, M. C., Moreno, G., Wright, I., Shih, P.-C., Vaquero, M. P., & Remacha, A. F. (2020a). Iron Deficiency in Menstruating Adult Women: Much More than Anemia. *Women's Health Reports*, *1*(1), 26–35. https://doi.org/10.1089/whr.2019.0011

Fernandez-Jimenez, M. C., Moreno, G., Wright, I., Shih, P.-C., Vaquero, M. P., & Remacha, A. F. (2020b). Iron Deficiency in Menstruating Adult Women: Much More than Anemia. *Women's Health Reports*, *1*(1), 26–35. https://doi.org/10.1089/whr.2019.0011

Guideline on haemoglobin cutoffs to define anaemia in individuals and populations. (2024). World Health Organization.

Hasnia, F., Rize Budi Amalia, Lestari Sudaryanti, & Annas, J. Y. (2024). Correlation Between Anemia And The Incidence Of Dysmenorrhea In Adolescent Girls. *Indonesian Midwifery and Health Sciences Journal*, *8*(3), 230–238. https://doi.org/10.20473/imhsj.v8i3.2024.230-238

Itani, R., Soubra, L., Karout, S., Rahme, D., Karout, L., & Khojah, H. M. J. (2022). Primary Dysmenorrhea: Pathophysiology, Diagnosis, and Treatment Updates. In *Korean Journal of Family Medicine* (Vol. 43, Issue 2, pp. 101–108). Korean Journal of Family Medicine. https://doi.org/10.4082/kjfm.21.0103

Latib, Y., Almehmadi, M., Alhajaji, F., Alqorashi, S., Almajnooni, F., Alshinawi, M. A., & Marghalani, R. A. (2024). Prevalence of Primary Dysmenorrhea and Its Effect on the Quality of Life Among Female Students at Umm Al-Qura University. *Cureus*. https://doi.org/10.7759/cureus.72136

Lirsch, E., Rahman, S., Kerolus, K., Hasan, R., Kowalska, D. B., Desai, A., & Bergese, S. D. (2024). Dysmenorrhea, a Narrative Review of Therapeutic Options. In *Journal of Pain Research* (Vol. 17, pp. 2657–2666). Dove Medical Press Ltd. https://doi.org/10.2147/JPR.S459584

Lleber Yotsumoto Fertrin. (2020). *Diagnosis and management of iron deficiency in chronic inflammatory conditions (CIC): is too little iron making your patient sick?* https://doi.org/10.1182/hematology.2020000132

Mizgier, M., Więckowska, B., Sansoni, V., Malvandi, A. M., Jarząbek-Bielecka, G., Drejza, M., Mruczyk, K., Cisek-Woźniak, A., & Lombardi, G. (2025). Risk Factors of Primary Dysmenorrhea in Female Adolescent Basketball Players Related to Dietary, Hormonal, and Immuno-Metabolic Factors and Disordered Eating Attitudes. *Nutrients* , *17*(7). https://doi.org/10.3390/nu17071190

Oktaviana, A., Imaniar, N., Dwi Widyana, E., & Yuliani, I. (n.d.). Hubungan Antara Lemak Subkutan, Indeks Massa Tubuh, Kadar Hemoglobin Dengan Dismenore Primer Pada Remaja Putri Di Sma N 1 Sumberpucung The Relationship Between Subcutaneous Fat, Body Mass Index and Hemoglobin Level With Primary Dysmenorrhea in Female Adolescents in SMAN 1 Sumberpucung. In *OKTOBER* (Vol. 8, Issue 2).

Riskesdas. (2018). *Laporan Riskesdas 2018 Nasional*.

Rohmawati, W., & Wulandari, D. A. (2019). Faktor-Faktor yang Berhubungan dengan Nyeri Dismenore Primer pada Siswi Di SMA Negeri 15 Semarang. *Jurnal Bidan Cerdas (JBC)*, *2*(2), 84. https://doi.org/10.33860/jbc.v2i2.188

Sakata, K., Kotani, K., & Umino, H. (2023). The Relationship Between Body Mass Index and Dysmenorrhea in the General Female Population. *Journal of Clinical Medicine Research*, *15*(4), 239–242. https://doi.org/10.14740/jocmr4893

World Health Organization. (2017). *Global Accelerated Action for the Health of Adolescents (AA-HA!) Guidance to Support Country Implementation*.

World Health Organization. (2024). *Guideline on haemoglobin Cutoffs to Define Anaemia in Individuals and Populations*. World Health Organization.

World Health Organization. (2025). *WHO Global Anaemia Estimates: Key Findings, 2025.*

Wu, L., Zhang, J., Tang, J., & Fang, H. (2022a). The relation between body mass index and primary dysmenorrhea: A systematic review and meta-analysis. In *Acta Obstetricia et Gynecologica Scandinavica* (Vol. 101, Issue 12, pp. 1364–1373). John Wiley and Sons Inc. https://doi.org/10.1111/aogs.14449

Wu, L., Zhang, J., Tang, J., & Fang, H. (2022b). The relation between body mass index and primary dysmenorrhea: A systematic review and meta-analysis. In *Acta Obstetricia et Gynecologica Scandinavica* (Vol. 101, Issue 12, pp. 1364–1373). John Wiley and Sons Inc. https://doi.org/10.1111/aogs.14449