

Research Article

Optimal Omega-3 Intake: A Natural Way to Ease Primary Dysmenorrhea Severity

Asupan Omega-3 yang Optimal: Cara Alami untuk Mengurangi Derajat Dismenore Primer

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Abstract

Objective: To examine the link between adequate omega-3 intake and degree of primary dysmenorrhea in Atma Jaya preclinical medical students

Methods: This cross-sectional study of 126 female students who experienced primary dysmenorrhea started from August to October 2022. Data was collected through the distribution of google forms containing the Working ability, Location, Intensity, Days of pain, Dysmenorrhea (WaLLID) score and Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ). According to Recommended Dietary Allowance (RDA), daily intake of omega-3 fatty acids is sufficient if it is ≥ 1.1 g/day. Data were processed using Microsoft Excel and SPSS and analyzed by a 2x3 Chi-square test.

Results: The findings showed that the majority of the respondents who consumed optimal omega-3 fatty acids, 17.5% (22 people), had primary dysmenorrhea with mild pain and also had a low percentage of severe primary dysmenorrhea, 3.2% (4 people). The link between adequate intake of omega-3 fatty acids with the degree of primary dysmenorrhea in female medical students showed significant test results ($p=0.046$).

Conclusion: There is a significant link between optimal intake of omega-3 and degree of primary dysmenorrhea in Atma Jaya preclinical medical students ($p<0.005$).

Keywords: intake, medical student, menstruation, primary dysmenorrhea, omega-3 fatty acids.

Abstrak

Tujuan: Mengetahui hubungan asupan omega-3 yang optimal dengan derajat dismenore primer pada mahasiswa prelinik kedokteran Atma Jaya.

Metode: Penelitian potong lintang terhadap 126 mahasiswa yang mengalami dismenore primer ini di mulai sejak Agustus hingga Oktober 2022. Pengumpulan data dilakukan melalui penyebaran google form secara daring berisi kuesioner Working ability, Location, Intensity, Days of pain, Dysmenorrhea (WaLLID) score dan Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ). Asupan asam lemak omega-3 dikategorikan menjadi cukup apabila asupan harian ≥ 1.1 g/hari sesuai dengan Angka Kecukupan Gizi (AKG). Program yang digunakan untuk pengolahan data adalah Ms. excel dan SPSS, sedangkan untuk uji analisis data menggunakan Chi-square 2 x 3.

Hasil: Penelitian menunjukkan bahwa mayoritas responden dengan asupan asam lemak omega-3 yang optimal yaitu 17.5% (22 orang) merupakan penderita dismenore primer dengan derajat nyeri ringan serta memiliki persentase dismenore primer berat yang sangat kecil yaitu 3.2% (4 orang). Hubungan antara kecukupan asupan asam lemak omega-3 dengan derajat dismenore primer pada mahasiswa kedokteran menunjukkan hasil uji yang signifikan ($p=0.046$).

Kesimpulan: Adanya hubungan yang signifikan antara asupan omega-3 yang optimal dengan derajat dismenore primer pada mahasiswa prelinik Kedokteran Atma Jaya ($p<0.005$).

Kata kunci: asupan, asam lemak omega-3, dismenore primer, mahasiswa kedokteran, menstruasi.

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INTRODUCTION

Dysmenorrhea, commonly referred to as lower abdominal pain, is a common occurrence in the majority of women during menstruation.¹ Primary dysmenorrhea is caused by changes in prostaglandin levels and uterine contraction activity, which affect the narrowing of uterine blood vessel and active contractions.² Within the Indonesian population, approximately 64.25% of women experience dysmenorrhea, with primary dysmenorrhea resulting in 54.89%.³ Primary dysmenorrhea affects 87.5% of young women in Central Jakarta.⁴ The presence of primary dysmenorrhea can significantly affect an individual's quality of life. Some women complained on impaired mobility, as well as a feeling of discomfort in carrying out their daily activities.⁵

Primary dysmenorrhea is the most frequent problem that occurs during menstruation due to prostaglandin hypersecretion and uterine myometrial contractions.⁶ Age at menarche, duration of menstruation, body mass index (BMI), food intake, and physical activity are all risk factors for primary dysmenorrhea. Consuming foods rich in omega-3 decreases the likelihood of experiencing pain associated with dysmenorrhea and based on a systematic review, omega-3 contribute in inhibiting the production of arachidonic acid, thereby inhibiting the production of prostaglandins and reducing myometrial and vessel contraction.⁷ There are three primary forms of omega-3 fatty acids: Alpha Linolenic Acid (ALA), Eicosapentaenoic Acid (EPA), and Docosahexaenoic Acid (DHA). Plant oils contain a rich amount of ALA including flaxseed, soybean, and canola oil. Meanwhile, DHA and EPA can be found in a variety of seafoods, including salmon, tuna, and others.⁸ Based on PERMENKES no. 28 of 2019 regarding the Recommended Dietary Allowance (RDA) for Indonesian Society, adequate intake of omega-3 fatty acids for women over 13 years is 1.1 g/day.⁹

A previous study found that giving omega-3 rich fish oil supplements for two months resulted in a significant reduction in the intensity of menstrual pain. This is linked to the formation of EPA omega-3 fatty acids from series 3 prostaglandins and thromboxanes (PGE₃ and TXA₃) and series 5 leukotrienes (LT₅), both of which are anti-inflammatory mediators.¹⁰ Aside of being anti-inflammatory, omega-3 fatty acids are also analgesic, inhibiting pain transmission

by blocking the activity of mitogen-activated protein kinase, which is involved in modulating central sensitization caused by inflammation and neuropathic pain.¹¹ However, there are only few studies that show that consuming omega 3 through daily food intake can reduce the severity of primary dysmenorrhea, so based on this and existing theory, the primary objective of this study is to examine the potential association between sufficient intake of omega-3 and the degree of primary dysmenorrhea.

METHODS

This study employs an analytical observational design, specifically a cross-sectional approach. The target of this study was preclinical students at the Atma Jaya School of Medicine and Health Sciences with a sample selection system, such as purposive sampling technique which is a technique for matching samples according to the respondent's criteria. The inclusion criteria for this study were students from School of Medicine and Health Sciences Atma Jaya Class of 2019-2021 who have primary dysmenorrhea during menstruation. The exclusion criteria for this study were female students who are unwilling to be respondents, fill inaccurate information, or have gynecological diseases. This filtration from the respondent's criteria resulted 126 respondents in total.

The research procedure begins with the distribution of dysmenorrhea history and working ability, location, intensity, days of pain, and dysmenorrhea (WaLIDD) questionnaires to select respondents who meet the criteria. The severity of dysmenorrhea pain is categorized using the WaLIDD score. A score of 0 signifies an absence of dysmenorrhea, while scores ranging from 1 to 4 represent mild dysmenorrhea, scores from 5 to 7 indicate moderate dysmenorrhea, and scores from 8 to 12 indicate severe dysmenorrhea. The validity and reliability of this WaLIDD questionnaire have been tested (Cronbach's alpha = 0.723).¹²

Furthermore, a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) was distributed to determine the adequacy of omega-3 fatty acid intake.¹³ This questionnaire includes a list of foods high in omega-3 fatty acids culled from the USDA's Nutrisurvey and Food Central databases (USDA). Respondents will be asked to fill out a questionnaire based on the frequency of consumption of each food.

The data collected will represent daily intake of omega-3 that will be categorized as sufficient if it is greater than 1.1 grams/day according to the Recommended Dietary Allowance (RDA).⁹ The data analysis will involve Microsoft Excel and the Statistical Package for Social Science (SPSS) with a 2 x 3 Chi-square test.

RESULTS

Table 1. Subject Characteristics

Characteristics	N	%
Age (years old)		
17-18	39	30.9
19-20	74	58.7
21-23	13	10.3
Age at Menarche		
10-11	35	27.7
12-13	67	53.1
14-15	24	19.0
Menstrual cycle		
Regular	91	72.2
Irregular	35	27.8
Period length (days)		
3-4	4	3.2
4-5	36	28.6
5-6	61	48.4
>6	25	19.8
Analgesic use		
Yes	20	15.9
No	106	84.1
Total	126	100

There were 126 respondents who satisfied the specified inclusion and exclusion criteria. The subjects' characteristics in this study included

their age, menarche, regularity of the menstrual cycle, period length, and use of analgesics during menstruation (Table 1). The respondents' ages ranged from 17 to 23, with the majority (58.7%) between the ages of 19 and 20. Most of the respondents had menarche at age 12-13 years (53.1%), experienced menstruation with regular cycles (72.2%), had a menstrual duration of 5-6 days (48.4%), and did not require analgesics (84.1%).

Table 2. Degree of Primary Dysmenorrhea and Omega-3 Intake

	N	%
Degree of Primary Dysmenorrhea		
Mild pain	53	42.1
Moderate pain	46	36.5
Severe pain	27	21.4
Omega-3 Intake		
Adequate	37	29.4
Inadequate	89	70.6

Table 2 shows the distribution of primary dysmenorrhea degrees among respondents, with mild pain (N=53;42.1%), moderate pain (N=46;36.5%), and severe pain (N=27;21.4%). The distribution of omega-3 fatty acid intake in Table 2 shows that a large percentage of respondents, 89 people (70.6%), had inadequate omega-3 intake. The average intake per day of omega-3 fatty acids was 0.89 grams/day among 126 respondents. The average intake is classified into the low intake category (<1.1 grams/day).

Table 3. Average Intake of Omega-3 Food Sources in Respondents

Omega-3 Food Sources	Average Daily Intake (mg)	Omega-3 Food Sources	Average Daily Intake (mg)
Fried rice	27.31	Goat meat	0.09
White bread	5.65	Cow meat	15.25
Biscuit	36.24	Meatball	8.52
Biscuit with cream	62.41	Meat sausage	6.56
Instant noodles	15.75	Chicken sausage	5.92
Tofu	194.08	Catfish	4.55
Fried tofu	135.53	Gurame (fish)	22.65
Tempeh	10.45	Mujaer (fish)	0.50
Mungbean milk	0.18	Tongkol (fish)	5.79
Mungbean porridge	0.02	Salmon (fish)	11.19
Soybeans	1.45	Tuna (fish)	18.34
Deep-fried peanuts wrapped with flour	1.00	Mackarel (fish)	24.53
Peanut wrapped with flour	0.25	Sarden (fish)	11.32
Greenpeas	0.08	Chicken egg	76.24
Chicken liver	0.24	Chicken egg (raw)	0.88
Cooked chicken	29.77	Instant cereal	19.24
Fried chicken	27.99	Avocado	0.83
Fried chicken breast (fast-food)	23.74	Ambon banana	3.51
Fried chicken thigh (fast-food)	14.92	Kepok banana	0.15
Chicken intestine satay	0.49	Ice cream	12.14
Chicken feet	0.23	Fish oil	45.67

According to the SQ-FFQ analysis, there are 43 omega-3 fatty acid food sources in total, which are classified as carbohydrates, plant protein sources, animal protein, cereals, fruit, snacks, and supplements. Based on Table 3, the food source of omega-3 fatty acids with the highest average daily intake of omega-3 is tofu (194 mg/day), which is classified as a plant protein source.

Following tofu, the highest average daily intake of omega-3s is found in chicken eggs (76.2 mg/day), biscuits (62.4 mg/day), cereals (19.2 mg/day), fish oil (45.6 mg/day), and chicken meat (29.7 mg/day). Other than that, high omega-3 intake was found in mackerel (24.53 mg/day), tuna (18.34 mg/day), and gurame (22.65 mg/day) in the fish group.

Table 4. Crosstabulation of Omega-3 Fatty Acids Intake and Primary Dysmenorrhea Degree

Variable		Primary Dysmenorrhea Degree			Total (%)	P-value
		Mild N (%)	Moderate N (%)	Severe N (%)		
Omega-3 Fatty Acids Intake	Adequate	22 (17.5)	11 (8.7)	4 (3.2)	37 (29.4)	0.046
	Inadequate	31 (24.6)	35 (27.8)	23 (18.3)	89 (70.6)	
	Total	53 (42.1)	46 (36.5)	27 (21.4)	126 (100)	

According to Table 4, there were 37 respondents (29.4%) who had an adequate intake of omega-3 fatty acids. The majority of those who had an adequate intake had mild primary dysmenorrhea, which was 21 respondents (17.5%). Meanwhile, 11 respondents (8.7%) went through moderate primary dysmenorrhea, and 4 respondents (3.2%) experienced severe primary dysmenorrhea. There were 89 people (70.6%) among those who had inadequate omega-3 fatty acids, with 31 respondents (24.6%) experiencing mild primary dysmenorrhea, 35 respondents (27.8%) experiencing moderate primary dysmenorrhea, and 23 respondents (18.3%) experiencing severe primary dysmenorrhea. The results from Chi-square test table 2 x 3 shows a significance value (p) of 0.046 ($p < 0.05$), indicating a statistically significant link between omega-3 fatty acid intake and the degree of primary dysmenorrhea.

DISCUSSION

The respondents in this study varied in age from 17 to 23, with the majority of respondents aged 19-20 years (58.7%). Discovered the highest prevalence of primary Dysmenorrhea occurred within the age range of 19 to 20 (42.6%).¹⁴ 53.1% of respondents had menarche at age 12-13 years. This findings aligns with RISKESDAS analysis regarding the mean age of menarche in women in DKI Jakarta Province, which is 12.44 years, and in North Jakarta districts/cities, which is 12.58 years.¹⁵

In terms of menstrual cycle regularity, the majority of respondents reported having regular menstrual cycles (72.2%). Similar findings were reported in a study on female students at

Faculty of Medicine Universitas Andalas, where most respondents (86%) had regular menstrual cycles.¹⁶ The distribution of period length showed the highest number at 5-6 days (34.9%). Women experience menstrual bleeding for an average of 5 days, with heavier bleeding occurring during the initial 3 days of menstrual cycle.¹⁷ Analgesics are used to relieve pain in some people who have primary dysmenorrhea or pain. According to statistical information, 15.9% of all respondents required analgesics during menstruation.

Degree of Primary Dysmenorrhea

Based on the results, 53 respondents (42.1%) had primary dysmenorrhea with a mild degree of pain, followed by 46 respondents (36.5%) had moderate pain, and 27 respondents (21.4%) had severe pain. This is consistent with the findings of a study, which showed that the majority of respondents, 29 respondents (40.3%), experienced mild primary dysmenorrhea pain.¹⁸ Research conducted on medical students at the University of HKBP Nommensen Medan using the WaLLID scoring system, the average primary dysmenorrhea was 4.48. This score of 4.48 indicates mild primary dysmenorrhea.¹⁹

Primary dysmenorrhea is related to various factors, such as biological, psychological, and lifestyle factor. Biological factors vary in menarche age, menstrual duration, and dysmenorrhea in the family. Psychological factors are generally related to stress, depression, and anxiety. Social factors can be affected by a lack of social support. Daily dietary intake is an example of a lifestyle factor. According to a study conducted on female students at a Chinese University woman

with early menarche and irregular menstrual cycles have more intense menstrual pain.²⁰ The majority of respondents in this study had primary dysmenorrhea with mild pain, which can be attributed to the previously mentioned factors. As shown by Table 1, most of the respondents in this study had normal menarche age and period length, as well as a regular menstrual cycle, which can contribute to a mild degree of dysmenorrhea. In the end, the variation in the degree of primary dysmenorrhea in women is due to the production of different prostaglandin hormones.

Omega-3 Fatty Acids Intake

According to the result of a univariate test for omega-3 fatty acid intake, 89 respondents (70.6%) had inadequate intake (1.1 gram/day) and 37 respondents (29.4%) had adequate intake (>1.1 gram/day). Similar findings were found in R. Suzan's (2018) study of students at the Faculty of Medicine, University of Jambi, who discovered that 70% of the respondents, or 42 respondents, did not get enough omega-3 fatty acids.²¹ However, discovered that the results are opposite where the respondents have an average intake of omega-3 in the adequate category, 1.18 grams/day (> 1.1 grams/day).²² This could be due to differences in the SQ-FFQ used to assess omega-3 fatty acids intake.

A lack of omega-3 fatty acid intake in college students can be affected by various factors, including a lack of nutrition knowledge and a high fast-food diet. research conducted through interviews with samples, most people had insufficient knowledge about good eating habits, such as eating a lot of fast food.²³

Relationship between Omega-3 Fatty Acids Intake and Degree of Primary Dysmenorrhea

According to the result of a univariate test for omega-3 fatty acid intake, 89 respondents (70.6%) had inadequate intake (1.1 grams/day) and 37 respondents (29.4%) had adequate intake (>1.1 grams/day). Based on Table 4 showed that the majority of those who consumed adequate omega-3 fatty acids, 21 respondents (17.5%), had primary dysmenorrhea with mild pain. Respondents who consumed adequate omega-3 fatty acids had a very low percentage of severe primary dysmenorrhea, 3.2% (4 respondents). Meanwhile, respondents with an inadequate intake of omega-3 fatty acids in the severe primary

dysmenorrhea group were 23 respondents (18.3%) out of a total of 27 respondents (21.4%). The 2 x 3 Chi-square test results indicated a significant ($p=0.046$) correlation between adequate omega-3 fatty acid intake and the degree of primary dysmenorrhea in medical students.

A systematic review and meta-analysis study found that omega-3 fatty acids could reduce the severity of primary dysmenorrhea ($p<0.001$).²⁴ This is coherent with the research results which show that the more omega-3 fatty acids a person consumes, the less pain they experience from primary dysmenorrhea. Regarding the effect of consuming omega-3 and vitamin E supplements on reducing the degree of primary dysmenorrhea pain on women aged 18-25 years stated that there were significant results from consuming these supplements on reducing primary dysmenorrhea.²⁵ Giving fish oil supplements rich in omega-3 for two months reduced the intensity of menstrual pain significantly.¹⁰ Primary dysmenorrhea is caused by the synthesis of prostaglandins, which can cause strong contractions in the uterus, resulting in cramps, abdominal discomfort, lower back pain, nausea, vomiting, headaches, and other symptoms. Omega-3 fatty acids inhibits the production of arachidonic acid, which then inhibits the production of series 2 prostaglandins and reduces myometrial contraction.⁷

During menstruation, progesterone levels fall, followed by the production of arachidonic acid. Arachidonic acid with cyclooxygenase enzymes produces series 2 prostaglandins, which are proinflammatory to the uterus. Consumption of omega-3 fatty acids increases prostaglandin series 3 by acting as a substrate for the cyclooxygenase enzyme. This results in a decrease in prostaglandin series 2 and an increase in prostaglandin series 3. Prostaglandin series 3 is an anti-inflammatory that also reduces myometrial contractions, reducing ischemia and pain during menstruation.²⁶

CONCLUSIONS

Omega-3 fatty acids intake in respondents seemed to be inadequate or less than the Recommended Dietary Allowance (RDA) (<1.1 grams/day), in as many as 89 people (70.6%). Meanwhile, 37 people (29.4%) reported an adequate intake of omega-3 fatty acids. The majority of respondents had mild primary dysmenorrhea, with the distribution being mild

(42.1%), moderate (36.5%), and severe (21.4%). The majority of respondents with adequate omega-3 intake (17.5%) had mild primary dysmenorrhea, while the percentage of severe primary dysmenorrhea was very low, at 3.2%. The findings of this study provide evidence supporting a link between the consumption of omega-3 fatty acids and primary dysmenorrhea severity. ($p < 0.05$)

Further research can be conducted using more specific and less biased methods, such as the intervention of omega-3 fatty acid intake to see its effect on the degree of primary dysmenorrhea in women. Future research can also measure omega-3 serum levels to compare omega-3 fatty acid intake and the degree of primary dysmenorrhea for each individual.

REFERENCES

- Taylor HS, Pal L, Sell E. Speroff's clinical gynecologic endocrinology and infertility. Lippincott Williams & Wilkins; 2019: 1174-8.
- Barcikowska Z, Rajkowska-Labon E, Grzybowska ME, Hansdorfer-Korzon R, Zorena K. Inflammatory markers in dysmenorrhea and therapeutic options. *Int J Environmental Res Public Health*. 2020;17(4):1191.
- Larasati TA, Alatas F. Dismenore primer dan faktor risiko Dismenore primer pada Remaja. *Jur Major*. 2016;5(3):79-84.
- Juniar D. Epidemiology of dysmenorrhea among female adolescents in Central Jakarta. *Makara J Health Res*. 2015;19(1):4.
- Fernández-Martínez E, Onieva-Zafra MD, Parra-Fernández ML. The impact of dysmenorrhea on quality of life among spanish female university students. *Int J Environmental Res Public Health*. 2019;16(5):713.
- Bernardi M, Lazzeri L, Perelli F, Reis FM, Petraglia F. Dysmenorrhea and related disorders. *F1000 Research*. 2017;6.
- Bajalan Z, Alimoradi Z, Moafi F. Nutrition as a potential factor of primary dysmenorrhea: A systematic review of observational studies. *Gynecol Obstet Invest*. 2019;84(3):209-24.
- Calder PC. Functional roles of fatty acids and their effects on human health. *J Parenter Enteral Nutr*. 2015;39(1 suppl):18S-32S. doi: 10.1177/0148607115595980. Epub 2015 Jul 15.
- Kementerian Kesehatan RI. PERMENKES no. 28 tahun 2019 tentang Angka Kecukupan Gizi Untuk Masyarakat Indonesia. Jakarta. Kementerian Kesehatan. 2019.
- Mehrpooya M, Eshraghi A, Rabiee S, Larki-Harchegani A, Ataei S. Comparison the effect of fish-oil and calcium supplementation on treatment of primary dysmenorrhea. *Reviews on recent clinical trials*. 2017 Sep 1;12(3):148-53.
- Tokuyama S, Nakamoto K. Unsaturated fatty acids and pain. *Biol Pharm Bull*. 2011;34(8):1174-8. doi: 10.1248/bpb.34.1174. PMID: 21804202.
- Teherán AA, Piñeros LG, Pulido F, Guatibonza MC. WalIDD score, a new tool to diagnose dysmenorrhea and predict medical leave in university students. *Int J Women's Health*. 2018;10:35-45. doi: 10.2147/IJWH.S143510. PMID: 29398923; PMCID: PMC5775738.
- Astuti T, Surmita, Sirajuddin. *Survey Konsumsi Pangan 2018*. Jakarta:Badan Pengembangan dan Pemberdayaan Sumber Daya Manusia Kesehatan;2018.
- Joshi T, Patil A, Kural M, Noor N, Pandit D. Menstrual characteristics and prevalence of dysmenorrhea in college going girls. *J Fam Med Primary Care*. 2015;4(3):426.
- Riset Kesehatan Dasar (Riskesmas). *Badan Penelitian dan Pengembangan Kesehatan Kementerian RI tahun 2018*. Jakarta: Badan Penelitian dan Pengembangan Kesehatan Kementerian Kesehatan Republik Indonesia. 2018.
- Prathita YA, Syahredi S, Lipoeto NI. Hubungan status gizi dengan siklus menstruasi pada mahasiswi fakultas kedokteran universitas andalas. *Jur Kes Andalas*. 2017;6(1):104-9.
- Dasharathy SS, Mumford SL, Pollack AZ, Perkins NJ, et al, Menstrual bleeding patterns among regularly menstruating women. *Am J Epidemiol*. 2012;175(6):536-45.
- Mau RA, Kurniawan H, Dewajanti AM. Hubungan Siklus dan Lama Menstruasi pada Mahasiswi Fakultas Kedokteran Ukrida dengan Nyeri Menstruasi. *Jur Ked Meditek*. 2020;26(3):139-45.
- Lamtiar RR, Rumahorbo DB, Roderthani IL. Hubungan Stres terhadap Dismenore pada Mahasiswi Fakultas Kedokteran Universitas HKBP Nommensen Medan. *Nommensen J Med*. 2022. Aug 27;8(1):54-7.
- Hu Z, Tang L, Chen L, Kaminga AC, Xu H. Prevalence and risk factors associated with primary dysmenorrhea among Chinese female university students: a cross-sectional study. *J Pediatr Adol Gynecol*. 2020 Feb 1;33(1):15-22.
- Suzan R, Halim R. Korelasi asupan asam lemak omega-3 dengan kemampuan kognisi mahasiswa kedokteran. *Jambi Med J*. 2018;6(2):146-51.
- Famimah F, Margawati A, Fitranti DY. Hubungan Konsumsi Asam Lemak Omega-3, Aktivitas Fisik Dan Persen Lemak Tubuh dengan Tingkat Dismenore pada Remaja. *J Nutr Coll*. 2017 Nov 22;6(4):268-76.
- Aditya SA, Maryusman t. Hubungan asupan asam lemak omega 3, imt/u dan tingkat stres dengan tingkat keparahan premenstrual syndrome (pms) pada remaja putri tunagrahita di kecamatan margaasih. *Indones J Health Develop*. 2022;1 (2).
- Mohammadi MM, Mirjalili R, Faraji A. The impact of omega-3 polyunsaturated fatty acids on primary dysmenorrhea: a systematic review and meta-analysis of randomized controlled trials. *Eur J Clin Pharmacol*. 2022 May;78(5):721-731. doi: 10.1007/s00228-021-03263-1. Epub 2022 Jan 21. PMID: 35059756.

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25. Sadeghi N, Paknezhad F, Rashidi Nooshabadi M, Kavianpour M, Jafari Rad S, Khadem Haghghian H. Vitamin E and fish oil, separately or in combination, on treatment of primary dysmenorrhea: a double-blind, randomized clinical trial. *Gynecol Endocrinol.* 2018;34(9):804-8.
 26. Harel Z, Biro FM, Kottenhahn RK, Rosenthal SL. Supplementation with omega-3 polyunsaturated fatty acids in the management of dysmenorrhea in adolescents. *Am J Obstet Gynecol.* 1996 Apr 1;174(4):1335-8.