Relationship between sedentary lifestyle and body mass index with the risk of endometriosis among adolescent girls at a senior high school

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Abstract

A significant portion (52.60%) of individuals with endometriosis are classified as obese. Obesity often results from a lifestyle characterized by minimal physical activity. This sedentary behavior encompasses using electronic devices, watching television, playing video games, and spending long periods sitting or reclining, all of which demand minimal energy expenditure. Consequently, excess energy is stored as body fat, leading to obesity. This research aimed to investigate the connections between sedentary habits, Body Mass Index (BMI), and endometriosis risk in teenage girls. The study employed an observational cross-sectional approach. The research sample consisted of 102 participants, selected through purposive sampling techniques. Data analysis was conducted using the chi-squared test. The dependent variable was the risk of endometriosis, while the independent variables were sedentary lifestyle and BMI. The results of the analysis showed that the relationship between sedentary lifestyle and endometriosis risk had a p-value of 0.001, and the relationship between BMI and endometriosis risk had a p-value of 0.003. Based on the analysis results, it can be concluded that there is a significant relationship between sedentary lifestyle, BMI, and the risk of endometriosis. This suggests that teenagers should modify their lifestyle and uphold healthy eating habits.

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Introduction

Endometriosis is a disease in which tissues similar to the uterus lining grow outside the uterus.[1] According to the World Health Organization (WHO) in 2023, approximately 10% (190 million) of women of reproductive age and girls experience endometriosis.[2] Some researchers estimate that endometriosis occurs in 10-16% of adolescent girls who often experience chronic pelvic pain and dysmenorrhea in adolescence.[3]

According to the American Society of Reproductive Medicine, the overall prevalence of endometriosis among adolescent girls with moderate to severe endometriosis is 32%.[4] Secondary dysmenorrhea is a common symptom of endometriosis.[5] Data from the Indonesian Health Profile in 2016 indicates that the incidence rate of dysmenorrhea was 64.25%, comprised of 54.89% primary dysmenorrhea and 9.36% secondary dysmenorrhea.[6] The factors affecting the risk of endometriosis include low physical activity (sedentary lifestyle) and excess body weight.[7,8] A sedentary lifestyle is characterized by light activity or sedentary behavior, with an energy expenditure of approximately 1-1.5 Metabolic Equivalents (METs).[9] People who live this lifestyle rarely exercise or engage in significant activities.

A sedentary lifestyle is a relaxed way of living that includes activities such as watching television, playing video games, sitting, or lying down, all of which require little energy. The excess energy is then stored as body fat.[10] According to the results of the Basic Health Research in 2013, 44.2% of adolescents in DKI Jakarta were inactive.[11] Data from the Basic Health Research in 2018 indicates that 47.81% of the population aged 10 years and older in DKI Jakarta and 46.17% in the East Jakarta area were inactive,[12] reflecting an increase of nearly 3.61% in inactive adolescents in Jakarta. A study conducted in Bangladesh revealed that 64.3% of 217 adolescent respondents preferred not to play outdoors or engage in physical activities.[13] Additionally, a study found that 44.3% of adolescent girls with low activity levels are at risk of developing endometriosis.[14]

Endometriosis can affect women of childbearing age with different body weights based on Body Mass Index (BMI), including thin, normal, overweight, and obese women. Eighteen percent of obese women have endometriosis.[7] In 2013, 32.9% of adult

women in Indonesia over 18 years of age were classified as obese, while 17.85% of individuals in DKI Jakarta were identified as centrally obese.[12] A study conducted by Holdsworth-Carson *et al.*[15] reported that 51 women (52.6%) with a BMI≥25 were at risk of endometriosis. Currently, the underlying mechanism in obese women with endometriosis who may have severe dysmenorrhea remains unknown, as both endometriosis and obesity cause decreased stromal cell decidualization.[16] Therefore, obesity can be a risk factor for severe dysmenorrhea.[16] The factors influencing the risk of endometriosis include low physical activity (sedentary lifestyle) and excess body weight.[7] A sedentary lifestyle is characterized by minimal physical activity, which can lead to an increase in BMI. Given this background, researchers are motivated to further investigate the relationship between sedentary lifestyle and body mass index with the risk of endometriosis in adolescent girls.

Materials and Methods

Research design

This study employed a quantitative, cross-sectional, observational, and analytical approach. It aimed to examine how factors such as sedentary lifestyle and excessive body weight contribute to the risk of endometriosis. Specifically, it explored the relationship between sedentary behavior, body mass index, and the risk of developing endometriosis.

Participants

The study population included adolescent girls at a senior high school in Indonesia. The research sample comprised 102 respondents, and sampling was performed using a purposive sampling technique. The inclusion criteria were adolescent girls aged 15-18 years who had menstruated, were willing to be respondents, and had signed an informed consent form. The exclusion criteria were adolescent girls who used hormone therapy and had been diagnosed with reproductive and hormonal health problems.

Variables, instruments, and data collection

The dependent variable was the risk of endometriosis, whereas the independent variables were sedentary lifestyle and BMI. This study used a questionnaire that was modified, developed, and tested for validity and reliability in 34 adolescent female respondents in accordance with the inclusion and exclusion criteria. Several questionnaires were used, including demographic data (age, class, BMI), a sedentary lifestyle questionnaire, and the endometriosis risk questionnaire (ESAT-21).[17] ESAT was developed, and its construct validity was supported. Exploratory factor analysis indicated four components (gastrointestinal symptoms, dysmenorrhea, usual symptoms, and the amount and characteristics of menstrual bleeding), with a variance of 61.6%. The variance in quality-of-life scores, as explained by the ESAT scores, was relatively high. Receiver operating characteristic curve analysis indicated that ESAT scores significantly differentiated endometriosis from non-endometriosis with fair discriminatory power at a cut-off score of 50 (sensitivity, 0.76; specificity, 0.72; area under the curve>0.75; p<0.001). This indicates that patients with ESAT scores >50 were more likely to have endometriosis. Thus, the reliability of the ESAT was confirmed.[17]

Data collection was performed by measuring BMI and providing questionnaires directly to respondents according to the inclusion and exclusion criteria. BMI was estimated by calculating body weight in kilograms divided by height squared.

A sedentary lifestyle was measured using a questionnaire containing daily activities and then classified as light, moderate, and heavy.

Data analysis

Univariate analysis was used to identify the characteristics of the respondents, and bivariate analysis using the chi-square test was used to determine the relationship between sedentary lifestyle, body mass index, and endometriosis risk.

Ethical clearance

Before the study, the researcher passed the ethical feasibility test stage of the Health Research Ethics Commission of Polyteknik

Table 1. Characteristics of respondents by age, focusing on sedentary lifestyle, body mass index, and endometriosis risk.

Characteristic	Frequency (n)	Percentage (%)
Age (years)		
15	31	30.4
16	55	53.9
17	16	15.7
18	0	0
Sedentary lifestyle		
Low	16	15.7
Medium	20	19.6
High	66	64.7
Body mass index		
Skinny	27	26.5
Normal	47	46.1
Obesity	28	27.5
Risk of endometriosis		
No risk	46	45.1
At risk	56	54.9

Table 2. Relationship between sedentary lifestyle, body mass index, and endometriosis risk.

	Risk of endometriosis						p	OR
	No risk		At risk		Total			
Sedentary lifestyle	n	%	n	%	n	%		
Low	5	93.8	1	8.8	16	100	0.000	3.846
Medium	1	55	9	11	20	100		
High	20	30.3	46	69.7	66	100		
BMI	n	%	n	%	n	%		
Skinny	16	59.3	11	40.7	27	100	0.003	1.971
Normal	25	53.2	22	46.8	47	100		
Obesity	5	17.9	23	82.1	28	100		

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Results

The results of this study show that 69 adolescent girls (67.6%) are from grade 10, with the majority being 16 years old, comprising 55 adolescent females (53.95%). Moreover, up to 66 teenage girls (64.7%) exhibited a high level of sedentary lifestyles, a trend attributed to lifestyle changes among adolescents, which are marked by significant advancements in technology. The prevalences of obesity and endometriosis were 27.5% and 54.9 %, respectively (Table 1).

Table 2 presents the results of these analyses. It reported that adolescent girls have a high risk of endometriosis, with a sedentary lifestyle accounting for 69.7% of cases. This study indicated a significantly sedentary lifestyle associated with a heightened risk of endometriosis (p=0.000). Additionally, this research revealed that 23 adolescents (82.1%) with an obese BMI were at risk of endometriosis. Furthermore, this study established a relationship between body mass index and the risk of endometriosis (p=0.003).

Discussion

The results indicated that the study participants were mostly adolescents, with a majority being 16 years old. Most were high school students who had experienced menarche. Generally, the first menstrual period in female adolescents occurs between the ages of 11 and 13, with an average of 12 years.[18] Research by El-Hadad *et al.* suggests that when menstruation begins 1-4 years after menarche, there is an increased risk of secondary dysmenorrhea developing more than 3 years post-menarche, which may indicate endometriosis.[19] As a result, scientists propose that the risk of endometriosis can be observed three years after menarche, particularly in the 15-18 age group. Endometriosis can develop as early as 16 years old.

The study findings revealed that 47 adolescents (46.1%) had a regular BMI, indicating proper physical growth, mental well-being, and ideal functional abilities. This outcome aligns with a study conducted by Syahfitri *et al.*, which found that 172 out of 290 teenagers (59%) had a normal BMI.[20] Research conducted by Putra *et al.* suggested that obesity can result from a combination of insufficient physical activity and excessive calorie consumption.[21] Multiple factors contribute to an elevated BMI, such as genetics, dietary habits, exercise routines, socioeconomic conditions, and emotional aspects. Technological advancements have led to more sedentary lifestyles among adolescents.[22] For female teenagers, obesity may be influenced by genetic predisposition, consumption of high-fat and sugary foods, such as fast food, and inadequate daily physical activity. It is crucial to promote healthy and balanced eating habits through educational initiatives within families, schools, and broader communities.

The findings indicated that the majority of participants (64.7%) exhibited high levels of sedentary behaviors. This observation corresponds with a study by Pradifa *et al.*, which indicated that the majority of adolescents are classified within the high category of sedentary lifestyle.[22] The WHO identifies sedentary behavior as a leading cause of mortality worldwide.[23] A sedentary lifestyle, according to the Republic of Indonesia's Ministry of Health, is defined as having a minimum energy expenditure of 1.5 METs.[24] Examples of sedentary activities include long periods of sitting or lying down, extended television watching, and excessive computer use – essentially, any lifestyle marked by low physical activity. The proliferation of digital technology, which provides easy access to various services, has contributed to an increase in sedentary behavior. The current trend is the growing popularity of social media and other online activities. Sedentary lifestyles can lead to metabolic disturbances that cause the body to store fat rather than utilize it for energy, potentially resulting in obesity. Consequently, it is crucial to modify sedentary behavior, as it not only contributes to obesity but can also lead to various health issues and premature death.

The study findings revealed that 56 young women (54.9%) were potentially at risk for endometriosis, as determined by the ESAT-21 questionnaire criteria in research conducted by Cho *et al.*[17] This finding aligns with a study by Hirsch *et al.*, which found that 64% of young women were at risk of endometriosis, presenting with pelvic pain symptoms. As a result, researchers have determined that women at risk of endometriosis are usually affected by pelvic pain and irregular menstrual cycles.[25]

The research results indicated a relationship between BMI and endometriosis risk, aligning with the findings of Hanina *et al.* at Dr. Mohammad Hoesin Hospital. Their investigation showed a connection between obesity and endometriosis (p=0.018), with a 2.813 times higher risk.[8] Furthermore, a study by Milla *et al.* established a link between obesity and menstrual irregularities in teenage girls (p=0.004), with a 0.613 times increased risk.[26] Vitonis *et al.* noted that obesity can elevate the risk of endometriosis by 18%.[7] Although women of various BMIs may face reproductive challenges like endometriosis, those who are obese are more prone to these issues.[7] Obese women, when compared to those with regular BMI, have a greater chance of experiencing irregular menstrual cycles, dysmenorrhea, and anovulation.[26,27] The growth of endometrial tissue outside the uterus is linked to hormonal imbalances and chronic inflammation surrounding the lesion. There is a prevalence of estrogen dominance or elevated estrogen levels, both systemically and locally, as well as resistance.

The results of the study showed that there was a relationship between sedentary lifestyle and the risk of endometriosis, in line with research conducted by Apriliya, which stated that there was a significant relationship between sedentary lifestyle and dysmenorrhea (p=0.000), where secondary dysmenorrhea was one of the symptoms of endometriosis.[28] Research conducted by Muselli *et al.* stated that there was a significant relationship between low physical activity and endometriosis (p=0.001).[29] Several studies on endometriosis and physical activity are interrelated because endometriosis is an estrogen-dependent disease, and good physical activity can increase binding globulin levels, which reduces estrogen availability. A sedentary lifestyle results in less energy being released and stored in the body fat. Excessive adipose tissue causes hormonal disorders with high estrogen and low progesterone levels, which trigger the growth of endometrial tissue outside the uterine cavity. Increased physical activity also reduces the insulin resistance and hyperinsulinemia associated with endometriosis.[30] Regular exercise is associated with a 40-80 % reduced risk of endometriosis compared with women who do not exercise.[7] Thus, researchers argue that adolescents with a sedentary lifestyle can have a high incidence of obesity, which can be a risk factor for endometriosis, because adolescents tend to engage in daily physical activities such as exercising. Thus, a lack of physical activity can increase the risk of endometriosis. Therefore, it is important to do daily activities, such as walking, doing light housework, cycling, and going up and down stairs, to avoid a sedentary

lifestyle. The process of endometrial tissue growth is extrauterine, related to the presence of hormonal disorders and chronic inflammatory processes around the lesion. The presence of estrogen dominance or increased estrogen levels, both systemic and local, and resistance to the hormone progesterone, is associated with the process of endometriosis.[31] Both of these conditions, supported by the failure of the immune system to eliminate endometriosis lesions, allow endometrial tissue to grow ectopically and cause pain in the pelvis.[32] Research conducted by Onstad *et al.* stated that the presence of excess adipose tissue in the body of obese people has a relationship with reproductive disorders such as metaplasia in the female reproductive organs.[33]

Thus, researchers argue that adolescents with obesity have a greater risk of endometriosis, which is associated with the impact of obesity that causes irregular menstrual cycles, pain during menstruation, and other menstrual disorders, which are the criteria for assessing the risk of endometriosis. Furthermore, through the Ministry of Health, the government has been encouraging society to perform routines, such as chores and sports. The government has facilitated society by providing bike lanes, car-free days, and city parks. However, many teenagers still choose to live a sedentary lifestyle. Therefore, the government must use more public advertisements to inspire society about healthy lifestyle awareness.

The limitation of this study arises from its narrow focus on just two variables influencing endometriosis risk: sedentary behavior and body mass index. While many other factors contribute to this condition, time constraints have restricted the investigation to these elements.

Conclusions

This research, conducted at a senior high school in Jakarta, Indonesia, investigated the relationship between inactive behavior, BMI, and the risk of endometriosis among adolescent females. The investigation primarily targeted 16-year-old students enrolled in the tenth grade. The results revealed that a significant number of these young women exhibited highly sedentary lifestyles and maintained a normal weight, yet still faced potential endometriosis risks. Statistical evaluations showed a strong link between sedentary behavior and endometriosis risk (p=0.000), as well as between BMI and endometriosis risk (p=0.003). The researchers suggest that future studies investigate additional factors contributing to the risk of endometriosis. These findings highlight the need to promote increased physical activity and balanced nutrition among teenagers.

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