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The Association Between Body Mass Index, Waist to Hip Ratio and Mid-Upper Arm Circumference with Endometriosis

Alyssa Vania Hanifah[1], Uki Retno Budihastuti[1,2] ✉, Balgis[1]

[1]Faculty of Medicine, Universitas Sebelas Maret, Surakarta 57126, Jawa Tengah, Indonesia
[2]Department of Obstetrics and Gynaecology, Dr. Moewardi General Hospital 57126, Jawa Tengah, Indonesia

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Abstract

Endometriosis is characterized by the presence of endometrial tissue outside the uterus in the form of glands and stroma. Increased fat distribution is one of the risk factors for endometriosis. This study aimed to determine the relationship between body mass index (BMI) and endometriosis because BMI only measures overall body mass and not fat tissue mass. The study performed anthropometric tests, including waist-to-hip circumference ratio (WHR) and mid-upper arm circumference (MUAC). This study was analytical observational research with a case control. Between October 2018 and October 2020, 63 patients diagnosed with endometriosis through laparoscopic action and 63 normal women with no symptoms of endometriosis and no abnormalities on ultrasound evaluation of the reproductive organs met both inclusion and exclusion criteria. The measurement result of BMI in kg/m² is categorized into ≤25 and >25, WHR is categorized as <0.85 and ≥0.85, and MUAC in centimetres to ≤23.0 and >23.0. The result showed the relationship of BMI, WHR, and MUAC with endometriosis incidence obtained BMI with endometriosis (b=0.824, CI 95%=0.99 to 5.25, p=0.053), WHR (b=0.893, CI 95%=1.03 to 5.82, p=0.044), and MUAC (b=-0.246, CI 95%=0.10 to 6.09, p=0.814). BMI and WHR are associated with an increased risk of endometriosis.

INTRODUCTION

Endometriosis is one of the chronic diseases in obstetrics that affects 10-15% of women of productive age worldwide (Guardo et al., 2019). Endometriosis is characterized by the presence of endometrial tissue outside the uterus in the form of glands and stroma (Mahnaz et al., 2016). The frequently felt endometriosis effects include pain during menstruation, chronic dysmenorrhea, and infertility (Shahbazi & Shahrabi-Farahani, 2016). In addition, women with endometriosis experienced a 20% decrease in quality of life compared to those who did not have endometriosis (Backonja et al., 2016). Several studies have examined the relationship between body mass index (BMI) and endometriosis but show varying results. Moini et al. showed an inverse relationship between endometriosis and BMI, where obese infertile women had a lower risk for endometriosis (Moini et al., 2013). In his study, Shah et al. found that

✉ Corespondence Address:
Department of Obstetrics and Gynaecology, Faculty of Medicine
Universitas Sebelas Maret / Dr. Moewardi General Hospital 57126,
Jawa Tengah, Indonesia Jl. Kolonel Sutarto No.132,
Jebres, Surakarta, Jawa Tengah, Indonesia. 57126
E-mail: ukiretno@staff.uns.ac.id

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BMI in infertile women over 18 was significantly inversely proportional to endometriosis rates and that changes in weight and waist circumference since the age of 18 were associated with endometriosis (Shah et al., 2013). A commonly used parameter to measure definitions of overweight, normal weight, and obesity is BMI (Ahmad et al., 2016). Obesity is linked to a lower incidence of endometriosis, implying an inverse relationship between endometriosis and BMI (Moini et al., 2013; Shah et al., 2013; Shahbazi & Shahrabi-Farahani, 2016). The inverse relationship between endometriosis and BMI is associated with impaired immunological function in people with endometriosis (Backonja et al., 2016). Therefore, early detection of endometriosis should be treated and not continued in advanced endometriosis. People's understanding of diet behaviour and lifestyle can prevent endometriosis as early as possible because the impact of endometriosis on women can lead to loss of productivity and decreased quality of life (Rodrigues et al., 2020).

Increased fat distribution is one of the risk factors for endometriosis. Findings of the fat distribution-related waist to hip ratio (WHR) also showed varying results. Smaller WHR is linked to women's health and reproductive status (Butovskaya et al., 2017). However, research (Shah et al., 2013) showed an inverse relationship between WHR and endometriosis. In contrast, women with smaller WHR increased the risk of endometriosis, while the study (Vercellini et al., 2013) does not indicate a significant relationship. Furthermore, women with a smaller mid-upper arm circumference (MUAC) have a higher risk of endometriosis than women with a larger MUAC (Backonja et al., 2017)we examined associations among body composition, endometriosis, and physical activity. MATERIALS AND METHODS: Women from 14 clinical sites in the Salt Lake City, Utah and San Francisco, California areas and scheduled for laparoscopy/laparotomy were recruited during 2007-2009. Participants (N = 473.

This study aimed to find out the relationship between BMI and endometriosis. The research was accompanied by other anthropometric examinations, including the WHR and mid-upper arm circumference (MUAC), because BMI only reflects the overall body mass and does not reflect the mass of fat tissue (Backonja et al., 2017),

METHOD

Observational analytical research with a case-control approach was conducted in Sekar Fertility Clinic, Dr. Moewardi General Hospital. The sampling used was purposive sampling. Between October 2018 and October 2020, 63 patients diagnosed with endometriosis through laparoscopic action and 63 normal women with no symptoms of endometriosis and no abnormalities on ultrasound evaluation of the reproductive organs met both inclusion and exclusion criteria. Inclusion criteria included cover (1) patients diagnosed with endometriosis through laparoscopic action, (2) Women of childbearing age (20-49 years). Meanwhile, exclusion criteria covers (1) patients with metabolic disorders (diabetes mellitus, metabolic syndrome) and (2) patients with cardiovascular disease (Hypertension and coronary heart disease). BMI measurement was done by measuring the weight ratio compared to the height square. WHR with waist was circumference compared with the hip circumference. The waist circumference was measured in the middle between the last ribs that can still be palpable with crista illiaca, whereas the hip circumference was measured at the widest part of the buttock and at the end of normal expiration. WHR cut-off point in women is <0.80 (Gadekar et al., 2020). MUAC is a measurement of the circumference of the middle part of an inactive arm. MUAC measures the circumference of the upper arm at the midpoint between the acromion of the

Table 1. Characteristics of Research Subjects

Characteristic	N	Minimum	Maximum	Mean	Standard Deviation
Age of Menarche (years)	126	9	18	12.86	1.34
Weight (kg)	126	40	78	56.78	7.79
Height (cm)	126	140	168	155.00	5.73
Waist Circumference (cm)	126	60	104	82.60	8.55
Hip Circumference (cm)	126	80	122	98.83	7.82
BMI (kg/m²)	126	16.8	32.0	23.75	3.37
WHR	126	0.68	0.98	0.83	0.06
MUAC (cm)	126	16	39	29.14	3.89

BMI= Body Mass Index; WHR= Waist to Hip Ratio; MUAC= Mid-upper Arm Circumference

shoulder (the protruding part of the shoulder) and the olecranon (elbow section). Cut-off points for MUAC in the range of ≤23.0 cm to ≤25.5 cm can be an indicator of low BMI (<18.5) in both men and women who are not pregnant (Tang et al., 2017). MUAC cut-off for overweight and obese patients is >28 cm or >29 cm (following BMI ≥25 and 29.9 kg / m², respectively) (Van Tonder et al., 2019). Data analysed Chi-Square test and multivariate logistic regression using IBM SPSS Statistics Version 25 (IBM Corp. ©Copyright IBM Corporation and its licensors 1989, 2017).

Ethical Clearance

The ethics health research commission approved this research of the Faculty of Medicine, Universitas Sebelas Maret, Surakarta, Jawa Tengah, Indonesia, Number: 089/UN27.06.6.1/KEPK/2020, dated July 20, 2020.

RESULTS AND DISCUSSION

Table 1 shows the characteristics of the study subjects based on menarche age, weight, height, waist circumference, hip circumference, BMI, WHR, and MUAC. Characteristics of 126 respondents who were the subjects of the study with a mean age of menarche are 12.86, a mean weight is 56.78, a mean height is 155.0, a mean waist circumference is 82.60, a mean hip circumference is 99.83, a mean BMI is 23.75, the mean WHR is 0.83, the mean MUAC is 29.14.

Women with a BMI ≤25 kg/m² (79.4%) more than women with a BMI >25 kg/m² (20.6%) with (OR= 2.89, p= 0.007). Women with a WHR of ≤0.80 were significantly associated with the incidence of endometriosis compared to women with a WHR of >0.80 (OR=3.11, p= 0.006). In the MUAC variable, there is a cell with an expected value of less than 5, so the analysis is done using the Fisher exact test and obtained (p= 0.691). Because p>0.05, the analysis results showed an insignificant relationship between the MUAC and the incidence of endometriosis.

There is a relationship between BMI and the incidence of endometriosis. Endometriosis patients and normal women with a BMI of ≤25 kg/m² have a higher probability of 0.824 increase in the risk of endometriosis incidence compared to endometriosis patients and normal women who have a BMI of >25 kg/m². There is a relationship between the WHR and the incidence of endometriosis. Endometriosis patients and normal women with a WHR size of ≤0.80 have a 0.893 higher chance of increasing the risk of endometriosis incidence compared to endometriosis patients and normal women with a WHR size of >0.80. There is no relationship between MUAC and menarche age with endometriosis incidence.

The role of immunological factors is thought to affect BMI in women with endometriosis. The role of immunology is epigenetic changes in endometriosis in the form of miRNA changes, such as inhibition from Let-7b and an increase in miRNA342-3p, which can increase glucose and fat metabolism, increase glucose uptake in skeletal muscles, decrease appetite, and increase insulin sensitivity so that it affects metabolism in women with endometriosis (Zolbin et al., 2019). This study showed a significant association between BMI and the incidence of endometriosis. Women with a BMI ≤25 kg/m² increased the risk of endometriosis than women with a BMI >25 kg/m². This study's results align with research

Table 2. Results of Bivariate Analysis of Body Mass Index Relationship, Waist to Hip Ratio, and Mid-Upper Arm Circumference with Endometriosis

Characteristic	Endometriosis		Normal Women		OR	p-value
	N	%	N	%		
BMI (kg/m²)						
≤25	50	79.4	36	57.1	2.89	0.007
>25	13	20.6	27	42.9		
WHR						
≤0.80	25	39.7	11	17.5	3.11	0.006
>0.80	38	60.3	52	82.5		
MUAC (cm)						
≤23	2	3.2	2	3.2	1.00	0.601
>23	61	96.8	61	96.8		

OR= Odds Ratio; BMI= Body Mass Index; WHR= Waist to Hip Ratio; MUAC= Mid-upper Arm Circumference

Table 3. Results of Multivariate Analysis of Body Mass Index Relationship, Waist to Hip Ratio, Mid-Upper Arm Circumference, and Menarche Age with Endometriosis

Variables	Coefficient (b)	CI (95%)		OR	p-value
		Lower	Upper		
BMI (≤25 kg/m²)	0.824	0.99	5.25	2.28	0.053
WHR (≤0.80)	0.893	1.03	5.82	2.44	0.044
MUAC (≤23.0 cm)	-0.246	0.10	6.09	0.78	0.814
Age of Menarche (≤11 years)	0.084	0.35	3.39	1.09	0.885

OR= Odds Ratio; BMI= Body Mass Index; WHR= Waist to Hip Ratio; MUAC= Mid-upper Arm Circumference

conducted by (Moini et al., 2013; Shah et al., 2013; Shahbazi & Shahrabi-Farahani, 2016), which indicates that the reverse relationship between BMI and endometriosis. There is also a significant relationship between the WHR and the incidence of endometriosis. Women with a smaller WHR of ≤0.80 increased the risk of endometriosis than women with a WHR of >0.80. This study's results align with (Shah et al., 2013), which state that women with a smaller WHR will increase the risk of endometriosis and the speed of diagnosing endometriosis itself.

The results of this study are also supported by systematic review studies conducted by (Backonja et al., 2016), which mention that women with endometriosis have more fat distribution in the hip area. Endometriosis is a disease associated with an increase in the hormone estrogen, affecting the amount and distribution of fat tissue. An increase in estrogen will lead to more subcutaneous fat distribution in pre-menopausal women in the lower body, especially buttocks and with "pear-shaped" thighs (Colleluori et al., 2018). In addition, the dominance of fat in the buttocks and thighs will cause the WHR to be smaller.

This study showed no significant association between MUAC and the incidence of endometriosis (p= 0.691). The results of this study are not in line with previous studies, wherein the study by (Backonja et al., 2017) indicates a significant association between MUAC and the incidence of endometriosis (p<0.05), which means women with smaller MUAC increase the risk of endometriosis compared to women with larger MUAC. There are differences in research results from previous studies because, in previous studies, data analysis used continuous data and was not categorized. In this study, MUAC was categorized as a dichotomy (≤ 23.0 cm and >23 cm) with results obtained in women with endometriosis, MUAC category ≤ 23.0 cm, or entered the category of malnutrition only obtained as much as 3.2%.

Smaller body shapes and smaller amounts of fat tissue are often associated with the incidence of endometriosis. The smaller body shape is related to the type 2 macrophage (M2) role, which generally acts as an anti-inflammatory and increases angiogenesis and tissue remodelling (Backonja et al., 2016). MUAC can also reflect changes in muscle mass, subcutaneous fat, or both, whereas less fat in endometriosis is possible (Van Tonder et al., 2019). The relationship between endometriosis severity and typology with adiposity is more complicated. Increased adiposity plays a role in increasing insulin sensitivity, so it is obtained that women with endometriosis have BMI and lower fat tissue (Byun et al., 2020; Zolbin et al., 2019). In experimental studies, there was an increase in leptin and ppar-□ . Fat tissue produces leptin and regulates energy balance by providing negative feedback signals, reducing food intake, and increasing insulin sensitivity (Goetz, Mamillapalli, & Taylor, 2016).

Endometriosis is a complex disease that has a strong genetic predisposition and is influenced by environmental exposure. Clinical manifestations of endometriosis include dysmenorrhea, dysuria, dyspareunia, chronic pelvic pain, and infertility. Chronic pain is significantly related to the severity of endometriosis (Dai et al., 2018; Rodrigues et al., 2020; Trioloet al., 2013). Genetic factors, immunological factors, hormonal factors, inflammation, menstrual cycle, and prostaglandin metabolism are included in the risk factors for endometriosis (Parazzini et al., 2017). Increased risk of coronary heart disease, hypertension, and hypercholesterolemia is also associated with endometriosis (Holdsworth-Carson & Rogers, 2018). In addition, the pain can negatively affect appetite, affecting BMI and a woman's quality of life (Holdsworth-Carson et al., 2018; Silva et al., 2020). Treating endometriosis pain using NSAIDs can cause side effects such as vomiting

and diarrhea, resulting in a decreased tolerance to food (Holdsworth-Carson et al., 2018).

The study's limitations are that there is no measurement of estrogen, progesterone, and testosterone levels that can affect BMI. Low progesterone levels in women with a BMI of ≥25 can occur when luteinizing hormone (LH) levels are insufficient (Borshuliak et al., 2021). Low testosterone levels have also increased BMI (Shamim et al., 2015). Estrogen also influences the volume and distribution of fat tissue (Frank et al., 2019).

CONCLUSION

There is a significant association between BMI with the incidence of endometriosis, low BMI in women can increase the risk of endometriosis. There is also a significant association between WHR with the incidence of endometriosis, low WHR in women can increase the risk of endometriosis. Furthermore, there is no significant association between MUAC and the incidence of endometriosis.

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