

Association of Residential Factors and Platelet-to-Lymphocyte Ratio with Uterine Leiomyoma Occurrence

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ABSTRACT

Uterine leiomyoma is the most common benign gynecological tumor and is influenced by various individual, environmental, and inflammatory factors. Residential environmental characteristics and the Platelet-to-Lymphocyte Ratio (PLR) have been proposed as potential factors associated with leiomyoma occurrence. This study aimed to analyze the association between residential factors and PLR with the occurrence of uterine leiomyoma. This study used an observational analytic design with a case-control approach. The study included 256 histopathological medical records from 2020-2023, consisting of 185 patients with uterine leiomyoma as the case group and 71 patients with adenomyosis as the control group. Residential characteristics were classified into urban and rural areas based on the Central Bureau of Statistics (BPS) classification. PLR was calculated by dividing the absolute platelet count by the absolute lymphocyte count, with a cut-off value of 216.86 based on the 75th percentile. Bivariate analysis was performed using the Chi-Square test or Fisher's Exact Test. Ethical clearance from the Health Research Ethics Committee of PKU Muhammadiyah Hospital, Surakarta, under number 08/KEPK/RS.PKU/IX/2025. Most respondents in both groups lived in urban areas, accounting for 93.51% of the leiomyoma group and 91.55% of the adenomyosis group. No significant association was found between residential area and uterine leiomyoma occurrence ($p=0.590$). Similarly, PLR was not significantly associated with uterine leiomyoma occurrence ($p=0.878$). Residential factors and PLR were not significantly associated with the occurrence of uterine leiomyoma in this study.

Keywords: Leiomyoma; Residential; Urban-Rural; Platelet-to-Lymphocyte Ratio; Inflammation

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INTRODUCTION

Uterine leiomyoma is the most common benign gynecological tumor and has a substantial impact on women's quality of life. The *World Health Organization* (WHO) estimates that more than 80% of women of reproductive age will develop leiomyoma by the age of 50 (Jing et al., 2020). The disease burden is also evident from several studies, including a study conducted at *Kaiser Permanente Northern California*, which reported 84,206 fibroid diagnoses during the 2009-2022 period (Mitro et al., 2025). In Indonesia, uterine leiomyoma accounts for approximately 2.39-11.7% of all gynecological cases and represents one of the major reproductive health problems (Maharizdihar & Kurniati, 2025). Cases of uterine leiomyoma have also been reported at several Indonesian hospitals, including 119 cases at Undata Regional General Hospital in 2022, 978 cases at Dr. Kariadi Central General Hospital in Semarang in 2023, and 289 patients at PKU Muhammadiyah Gamping Hospital during 2021-2023 (Farma & Kurniati, 2024; Mutmainnah et al., 2023; Prasetyo et al., 2025).

The occurrence of leiomyoma is influenced by various factors, including early menarche, low parity, obesity, and family history (Maharizdihar & Kurniati, 2025). In addition to individual factors, the residential environment may also play a role through exposure to pollutants and *endocrine-disrupting chemicals*, such as phthalates and organochlorine pesticides, which may affect estrogenic and inflammatory pathways (Cho et al., 2021; Dong et al., 2024; Zhang et al., 2024). Differences in urban and rural environmental characteristics may influence the level of exposure to these substances.

Evidence suggests that exposure to phthalates, especially the DEHP metabolite MEHHP, activates the aryl hydrocarbon receptor (AHR) signaling cascade, resulting in elevated kynurenine production, reduced apoptotic activity, and increased proliferation of myometrial smooth muscle cells (Cho et al., 2021; Lizuka et al., 2022). Furthermore, phthalate exposure has been linked to hypomethylation of the ESR1 and PGR genes, which may enhance tissue sensitivity to estrogen and progesterone signaling (Cho et al., 2021).

In addition to environmental factors, systemic inflammation is thought to contribute to the pathogenesis of leiomyoma. The *Platelet-to-Lymphocyte Ratio* (PLR) is a relatively simple hematological biomarker that may reflect systemic inflammatory responses. Several studies have demonstrated that elevated PLR is associated with the occurrence of uterine leiomyoma and may reflect the involvement of platelets in the release of pro-inflammatory cytokines and angiogenic factors that support the proliferation of uterine smooth muscle cells (Cho et al., 2021; Jing et al., 2020; Suh et al., 2021; Jeong et al., 2021). Duan et al. (2023) also reported that PLR values were significantly higher among patients with leiomyoma than among healthy controls.

Furthermore, PLR may serve as an additional biomarker for distinguishing benign leiomyoma from malignancies such as uterine sarcoma because it can be readily assessed through routine blood testing (Jeong et al., 2021; Liu et al., 2025). Research in Indonesia has also demonstrated an association between immune cell ratios and the occurrence of uterine leiomyoma among women of reproductive age (Farma & Kurniati, 2024).

Although the relationships between environmental factors, systemic inflammation, and leiomyoma have been investigated separately, studies integrating residential environmental characteristics, particularly urban-rural classification, with PLR as an indicator of systemic inflammation in relation to the occurrence of uterine leiomyoma remain limited.

METHODS OF RESEARCH

This study was an analytical observational study with a case-control design. The case group consisted of patients diagnosed with *leiomyoma uteri*, while the control group consisted of patients diagnosed with adenomyosis. Adenomyosis was selected as the control group because both conditions are benign uterine diseases commonly identified in hysterectomy specimens. In addition, this approach was considered ethically appropriate because obtaining uterine specimens from healthy women would not be feasible (Farma & Kurniati, 2024; Kurniati et al., 2024).

The study was conducted at the Anatomical Pathology Department of PKU Muhammadiyah Surakarta Hospital and the Anatomical Pathology Laboratory, Faculty of Medicine, Universitas Muhammadiyah Surakarta. The study population was obtained from medical records of histopathological specimens with diagnoses of benign uterine tumors during the 2020-2023 period. Samples were selected using total sampling. The inclusion criteria were medical records containing histopathological examination results with a diagnosis of *leiomyoma uteri* or adenomyosis and complete identification data. Medical records with a histopathological diagnosis of malignancy in uterine tumors were excluded. Based on these criteria, 256 samples were obtained, consisting of 185 cases of *leiomyoma uteri* and 71 adenomyosis controls.

The independent variables in this study were residential characteristics and PLR values, while the dependent variable was the occurrence of *leiomyoma uteri*. Residential characteristics were determined based on the urban and rural classification established by the Central Bureau of Statistics (BPS) (BPS, 2021). Residential areas were identified based on the addresses recorded in the medical records and subsequently verified according to the BPS urban-rural classification. Referencing the Statistics Indonesia (BPS) publication “*Urban and Rural Village Classification in Indonesia*” corresponding to the respondent's residential subdistrict as recorded in the medical records. The workflow for classifying respondents' residence according to the BPS urban rural classification is presented in Figure 1:

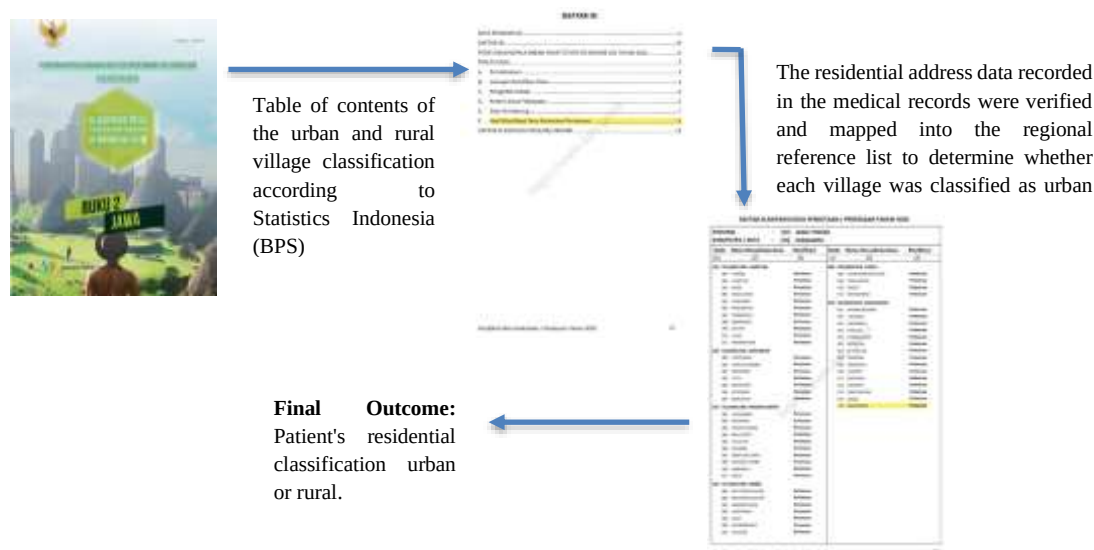


Figure 1. Workflow for mapping patient residential data into BPS urban and rural classifications
(Source: *Processed primary data by the author, 2026*)

PLR values were obtained from preoperative complete blood count results by calculating the ratio of the absolute platelet count to the absolute lymphocyte count using the following formula: $PLR = \text{Absolute platelet count} / \text{Absolute lymphocyte count}$. PLR values were subsequently categorized based on the 75th percentile (P75) of the study data distribution, following the approach used by Duan et al. (2023). The resulting cut-off value was 216.86. Therefore, a $PLR > 216.86$ was categorized as elevated, whereas a $PLR \leq 216.86$ was categorized as normal.

The data were analyzed using bivariate analysis to determine the association between residential characteristics and PLR with the occurrence of *leiomyoma uteri*. The Chi-square test was used with a significance level of $p < 0.05$. When the assumptions of the Chi-square test were not met, specifically when an *expected count* of < 5 was present in a contingency table cell, Fisher's Exact Test was used as an alternative. A p -value < 0.05 indicated a statistically significant association, whereas a p -value ≥ 0.05 indicated no statistically significant association.

RESULT AND DISCUSSION

Results

This study analyzed the association between Platelet-to-Lymphocyte Ratio (PLR) and respondent characteristics with the occurrence of *leiomyoma uteri*, confirmed through histopathological examination. The results of the data analysis are presented as follows.

1. Univariate Analysis of Characteristics

Univariate analysis was performed to describe the characteristics of the study sample, including age, Body Mass Index (BMI), parity, menstrual cycle, leukocyte count, lymphocyte percentage, and residential characteristics. The categorization of variables was based on previous studies. Age was categorized into reproductive age (25-50 years) and non-reproductive age (> 50 years) (Prasetyo et al., 2025). BMI was categorized as obese ($> 27 \text{ kg/m}^2$), overweight (25-27 kg/m^2), and normal (18-25 kg/m^2) (Syarifah et al., 2023). Leukocyte count was categorized as leukopenia ($< 4,000 \text{ cells}/\mu\text{L}$), normal (4,000-11,000 $\text{cells}/\mu\text{L}$), and leukocytosis ($> 11,000 \text{ cells}/\mu\text{L}$) (Kaushansky et al., 2021). Lymphocyte percentage was categorized as lymphocytosis ($> 40\%$), normal (20-40%), and lymphocytopenia ($< 20\%$) (Agnes et al., 2024; Paramarta & Kurniati, 2025). Meanwhile, residential characteristics were categorized into urban and rural areas based on the classification established by the Central Bureau of Statistics (BPS, 2021). The distribution of the study sample characteristics is presented in Table 1.

Table 1. Characteristics of the Study Sample

Variable	Category	Leiomyoma Uteri (n=185) n (%)	Adenomyosis (n=71) n (%)
Age	At-risk (25-50 years)	169 (91.35)	55 (77.46)
	Not at-risk (> 50 years)	16 (8.65)	16 (22.54)
BMI	Obese ($> 27 \text{ kg/m}^2$)	68 (36.76)	18 (25.35)
	Overweight (25-27 kg/m^2)	28 (15.14)	17 (23.94)
	Normal (18-25 kg/m^2)	89 (48.11)	36 (50.70)
Parity	Nulliparous	47 (25.41)	12 (16.90)
	Primiparous & multiparous	138 (74.59)	59 (83.10)
Menstrual Cycle	Irregular	1 (0.54)	0 (0.00)

	Regular	184 (99.46)	71 (100.00)
Leukocyte Count	Leukocytosis (>11,000 cells/ μ L)	19 (10.27)	7 (9.86)
	Normal (4,000-11,000 cells/ μ L)	164 (88.65)	64 (90.14)
Lymphocytes	Leukopenia (<4,000 cells/ μ L)	2 (1.08)	0 (0.00)
	Lymphocytosis (>40%)	6 (3.24)	1 (1.41)
	Normal (20-40%)	136 (73.51)	53 (74.65)
Residential Characteristics	Lymphocytopenia (<20%)	43 (23.24)	17 (23.94)
	Urban	173 (93.51)	65 (91.55)
	Rural	12 (6.49)	6 (8.45)

(Source: Primary data, 2026)

Based on Table 1, the majority of respondents in both the *leiomyoma* group (91.35%) and the adenomyosis group (77.46%) were within the at-risk age range of 25-50 years. Regarding BMI, the proportion of respondents with a normal BMI (18-25 kg/m²) was relatively similar between the *leiomyoma uteri* group (48.11%) and the adenomyosis group (50.70%). Most respondents in both groups were primiparous or multiparous, accounting for 74.59% of the *leiomyoma* group and 83.10% of the adenomyosis group. Almost all respondents had regular menstrual cycles, comprising 184 respondents (99.46%) in the *leiomyoma* group and 71 respondents (100%) in the adenomyosis group. Normal leukocyte counts were found in 88.65% of respondents in the *leiomyoma* group and 90.14% in the adenomyosis group, while normal lymphocyte percentages were observed in 73.51% and 74.65% of respondents, respectively. In addition, the majority of respondents in both groups lived in urban areas, accounting for 93.51% of the *leiomyoma* group and 91.55% of the adenomyosis group.

2. Bivariate Analysis

Analysis of *Leiomyoma Uteri* Occurrence Based on Residential Area

The results of the bivariate analysis examining the association between residential area and the occurrence of *leiomyoma uteri* are presented in Table 2. Fisher's Exact Test was used because there was a cell with an *expected count* <5.

Table 2. Analysis of *Leiomyoma Uteri* Occurrence Based on Residential Area

Characteristics	Adenomyosis		Uterine Leiomyoma		OR	95% CI		p
Place of Residence	F(n)	(%)	F(n)	(%)		Lower	Upper	
Urban (City)	65	91.5	173	93.5				
Rural (Countryside)	6	8.5	12	6.5	1.331	0.480	3.693	0.590
Total	71	100	185	100				

(Source: Primary data, 2026)

Based on the analysis presented in Table 2, there was no statistically significant association between residential area and the occurrence of *leiomyoma uteri*, as indicated by a *p*-value of 0.590 (*p* > 0.05). In both the adenomyosis and *leiomyoma uteri* groups, the majority of respondents lived in urban areas.

Analysis of *Leiomyoma Uteri* Occurrence Based on Platelet-to-Lymphocyte Ratio

The results of the bivariate analysis examining the association between PLR values and the occurrence of *leiomyoma uteri* are presented in Table 3. The Chi-square test was used for this analysis.

Table 3. Analysis of *Leiomyoma Uteri* Occurrence Based on Platelet-to-Lymphocyte Ratio

Characteristics	Adenomyosis		Uterine Leiomyoma		95% CI		p
Place of Residence	F(n)	(%)	F(n)	(%)	OR	Lower	Upper
Normal (<216.86)	54	76.1	139	75.1			
Increased (>216.86)	17	23.9	46	24.9	1.051	0.555	1.991
Total	71	100	185	100			

(Source: Primary data, 2026)

Based on the analysis presented in Table 3, there was no statistically significant association between PLR values and the occurrence of *leiomyoma uteri*, as indicated by a p -value of 0.878 ($p > 0.05$). In both the adenomyosis and *leiomyoma uteri* groups, the majority of respondents had PLR values within the normal category.

B. Discussion

1. Association Between Residential Factors and the Occurrence of *Leiomyoma Uteri*

The results of this study showed no significant association between residential area and the occurrence of uterine leiomyoma. Based on Fisher's exact test, which accounted for the distributional assumptions of the data, patients in both the case and control groups predominantly resided in urban areas. Figure 2 presents the geographical distribution of the 256 patients identified from medical records between 2020 and 2023, comprising 185 uterine leiomyoma cases and 71 adenomyosis cases. The majority of cases were concentrated in Surakarta and adjacent regions of Central Java, with 93.51% of the uterine leiomyoma group and 91.55% of the adenomyosis group residing in urban settings.

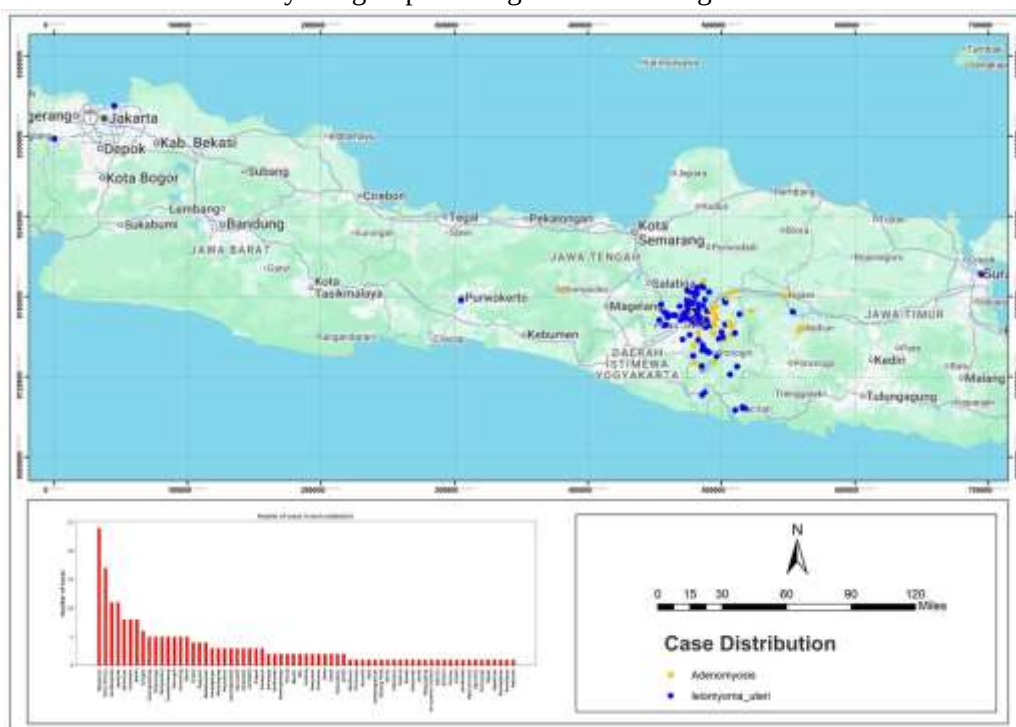


Figure 2. The distribution of Uterine Leiomyoma and Adenomyosis cases
(Source: Processed primary data by the author, 2026)

These findings are not consistent with several previous international studies. Several studies have reported an association between residential environmental exposure and leiomyoma. A study by Cho in South Korea found an association between phthalate exposure and epigenetic changes in leiomyoma tissue. The study also included alternative plasticizers commonly used in urban environments. These exposures were associated with changes in the methylation of the *ESR1* and *PGR* genes. These methylation changes occurred through epigenetic mechanisms in leiomyoma tissue. Exposure was directly assessed by measuring phthalate metabolite concentrations in urine (Cho et al., 2021). This urinary biomarker approach provides a more precise measure of individual exposure. Similarly, a study conducted by Anjos in São Paulo, Brazil, reported significant changes in gene expression among women living in highly polluted metropolitan areas. These changes included the upregulation of *BMP4*, *CTNNB1*, and *WNT5B* in leiomyoma tissue, while *PGR* and *PTEN* showed downregulation (Anjos et al., 2023). These gene expression patterns reflect activation of proliferative pathways and suppression of protective pathways. Other studies have also identified chronic exposure to air pollution as a potential determinant of risk. Endocrine-disrupting chemicals (EDCs) in urban environments may also modulate proliferative signaling pathways. Zannotti further suggested that air pollution may trigger chronic inflammatory pathways in myometrial tissue. These inflammatory pathways may contribute to pathological fibrogenesis through tissue macrophage activation, accompanied by sustained release of pro-inflammatory cytokines (Mukherjee, 2025; Zannotti et al., 2021). Wesselink reported an association between PM_{2.5} exposure and an increased risk of uterine fibroids, with a stronger association observed with long-term exposure (Wesselink et al., 2025). These findings suggest that the duration of exposure may influence the magnitude of risk.

The differences between the findings of this study and those of previous studies may be explained by several methodological factors. The relatively small sample size resulted in an imbalance in the proportions of respondents across residential areas. This imbalance may have reduced the statistical power to detect an existing association. Sample homogeneity may also be an important explanatory factor. Most participants were from urban areas and had relatively homogeneous social demographic characteristics. Environmental quality among urban participants may also have been relatively similar. Such homogeneity would result in minimal variation in environmental exposure. Differences in exposure assessment methods may have also contributed to the inconsistent findings. Previous studies generally used direct monitoring of specific pollutants, allowing individual exposure to be quantified more accurately. In contrast, this study used administrative residential-area classification as a proxy for environmental exposure. This approach assumes that participants experience relatively similar levels of environmental exposure. Hormonal contraceptive use may also represent a relevant confounding factor (Prasetyo et al., 2025; Ridwan et al., 2021). Differences in study design may further explain inconsistencies across studies. Previous studies have generally used prospective cohort or standardized cross-sectional designs, which allow exposure to be measured more consistently over time.

Although this study did not identify a statistically significant association, the potential biological mechanisms remain relevant. Urban areas with high levels of air pollution and phthalate exposure may have biological effects that contribute to hormonal dysregulation in reproductive tissues. Hormonal dysregulation may be accompanied by systemic inflammation that supports leiomyoma growth. Phthalates and DEHP metabolites can activate the *aryl hydrocarbon receptor* (AHR) pathway in myometrial cells.

This activation occurs through increased cellular tryptophan uptake and excessive kynurenine production. Kynurenine may inhibit apoptosis in myometrial smooth muscle cells, thereby promoting uncontrolled cellular proliferation (Cho et al., 2021; Lizuka et al., 2022). Chronic PM2.5 exposure may also act as an endocrine-disrupting factor and gradually alter myometrial cells. Changes in signaling pathways may subsequently induce metabolic and epigenetic alterations in the tissue (Anjos et al., 2023).

On the other hand, sedentary lifestyles in urban areas may also contribute to this risk. Diets high in ultra-processed foods can increase the prevalence of obesity in urban populations, which contributes to leiomyoma risk through hyperketonemia, as adipose tissue converts androgens into estrogen via the action of aromatase. This hormonal conversion often results in chronically elevated circulating estrogen levels (Mutmainnah et al., 2023; Prasetyo et al., 2025). Furthermore, higher psychosocial stress in urban areas is another potential contributing factor, as chronic stress can disrupt the hypothalamic-pituitary-ovarian axis and influence leiomyoma growth (Brissett & Theses, 2025). Meanwhile, rural areas present different environmental risk profiles. Physical activity levels among rural populations tend to be higher than those in urban populations, and diets based on fresh foods are generally more common, thereby supporting the natural regulation of estrogen metabolism. However, rural populations remain exposed to agricultural pesticide residues that function as endocrine-disrupting compounds. Exposure to organochlorine pesticides (OCPs), for instance, has been associated with an increased risk of leiomyoma in several studies (Chen et al., 2025; Mukherjee, 2025). These findings indicate that environmental risk profiles are area-specific rather than uniform. The proposed pathway linking residential factors to uterine leiomyoma occurrence is presented in Figure 3.

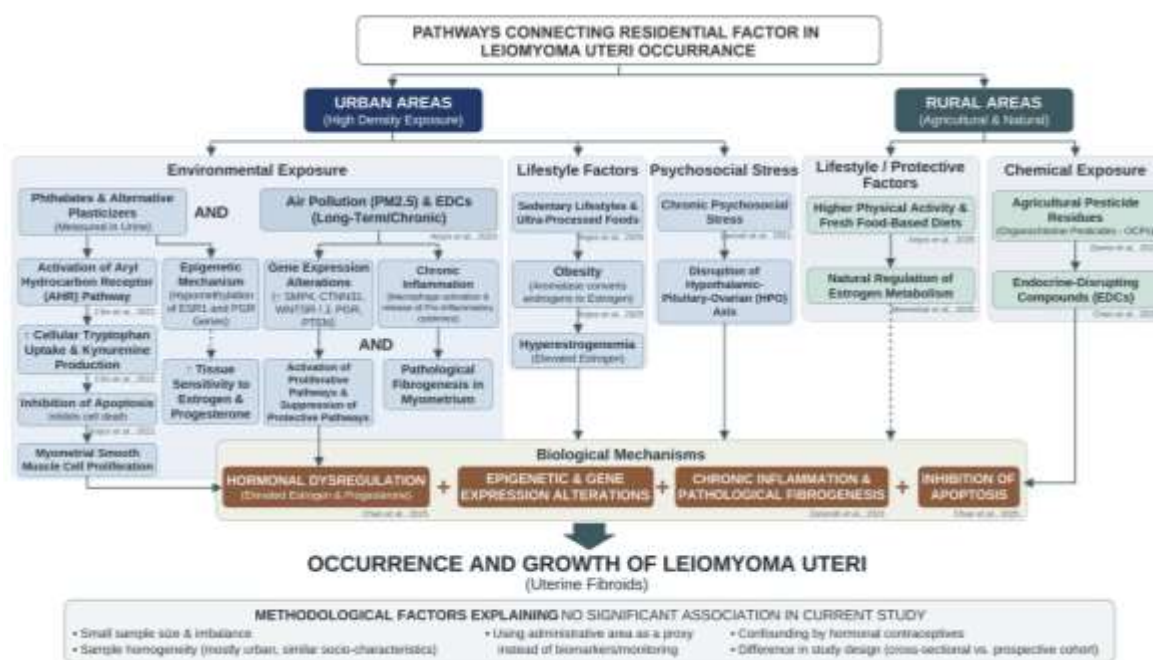


Figure 3. Pathway of Residential factors in leiomyoma uteri occurrence
(Source: Processed primary data by the author, 2026)

2. Association Between Platelet-to-Lymphocyte Ratio and the Occurrence of Leiomyoma Uteri

This study evaluated the association between PLR values and the occurrence of *leiomyoma uteri*. PLR was used as a systemic inflammatory biomarker reflecting the balance between platelet activation and the immune response (Duan et al., 2023; Jing et al., 2020). The bivariate analysis presented in Table 3 showed no significant association between elevated PLR and the occurrence of *leiomyoma uteri*, with a *p*-value of 0.878. The distribution of PLR values in both groups showed that most respondents had PLR values within the normal category.

A study conducted by Duan at The Affiliated Hospital of Qingdao University, China, reported different findings. The study used a cross-sectional design involving 942 patients with *leiomyoma uteri* and 150 healthy female controls undergoing routine health examinations (Duan et al., 2023). Leiomyoma was diagnosed using transvaginal ultrasonography, while the controls were women without a history of gynecological disease. PLR was calculated from complete blood count results and analyzed using a receiver operating characteristic (ROC) curve, resulting in an optimal cut-off value of 190 (Duan et al., 2023). The study found that PLR values were significantly higher among women with *leiomyoma uteri* than among controls and were positively correlated with tumor size (Duan et al., 2023). Similar findings were reported by Suh in a multicenter retrospective study conducted at four gynecologic oncology centers in South Korea. The study included 336 patients with histopathological diagnosed uterine tumors, consisting of 79 patients with leiomyosarcoma and 257 with leiomyoma (Suh et al., 2021). PLR was calculated from preoperative blood test results and analyzed using ROC curves. The results indicated that PLR had diagnostic potential for distinguishing leiomyoma from leiomyosarcoma, with an AUC of 0.754 and an optimal cut-off value of 145.00. PLR values were higher in the leiomyosarcoma group, reflecting a greater degree of inflammation in malignant tumors (Suh et al., 2021).

Another study by Jing at Qilu Hospital, Shandong University, China, also reported increased PLR among patients with leiomyoma (Jing et al., 2020). The study involved 662 women with endometriosis who underwent laparoscopy. Diagnoses of endometriosis, endometrioma, and leiomyoma were confirmed through histopathological examination (Jing et al., 2020). PLR was calculated from preoperative blood test results and compared between patients with and without leiomyoma. Its diagnostic performance was then evaluated using ROC curve analysis. The results showed that PLR was significantly higher among patients with endometriosis accompanied by leiomyoma than among those without leiomyoma ($p < 0.001$), with a cut-off value of 146.15, sensitivity of 56.0%, and specificity of 62.5% (Jing et al., 2020).

This study used histopathological examination as the gold standard for diagnostic confirmation, which may minimize the possibility of misclassification compared with studies using clinical diagnosis or imaging. Differences in the PLR cut-off values used may also have contributed to the differences in findings. The studies by Suh and Jing used different comparison groups: Suh compared leiomyoma with leiomyosarcoma, whereas Jing compared patients with endometriosis with and without leiomyoma (Jing et al., 2020; Suh et al., 2021). Differences in the characteristics of the comparison groups may influence the inflammatory biomarkers observed because each disease has distinct pathogenic mechanisms and inflammatory responses (Zannotti et al., 2021). Other studies used ROC analysis to determine cut-off values based on previously established values, such as 190 (Duan et al., 2023; Suh et al., 2021). The higher cut-off value used in the present study may have resulted in the elevated-PLR group consisting only of subjects with more severe inflammatory responses (Busch, 2021). The use of adenomyosis as the control group may

also be relevant because both leiomyoma and adenomyosis are benign uterine conditions associated with chronic inflammatory processes, potentially making the baseline inflammatory factors more comparable between the groups (Zannotti et al., 2021).

Theoretically, the PLR reflects the balance between the coagulation system and the adaptive immune response as an integral component of the body's defense system (Dong et al., 2024). Platelets act as inflammatory mediators by releasing various pro-inflammatory cytokines and growth factors, including platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), IL-6, and TNF- α (Jeong et al., 2021; Mukherjee, 2025). The release of these mediators stimulates angiogenesis, cellular proliferation, and extracellular matrix accumulation, which are characteristic features of uterine leiomyoma pathogenesis (Mukherjee, 2025; Septiawati et al., 2021). Conversely, a reduction in lymphocyte counts may reflect a weakened antitumor immune response, creating an environment that supports tumor growth (Mukherjee, 2025). In uterine leiomyoma, an elevated PLR has also been associated with the increased expression of pro-proliferative genes such as *BMP4*, *CTNNB1*, and *WNT5B*, as well as the downregulation of protective genes such as *PGR* and *PTEN*, potentially contributing to alterations in the proliferation and differentiation of myometrial smooth muscle cells (Anjos et al., 2023). The proposed biological pathway linking PLR to uterine leiomyoma occurrence is presented in Figure 4.

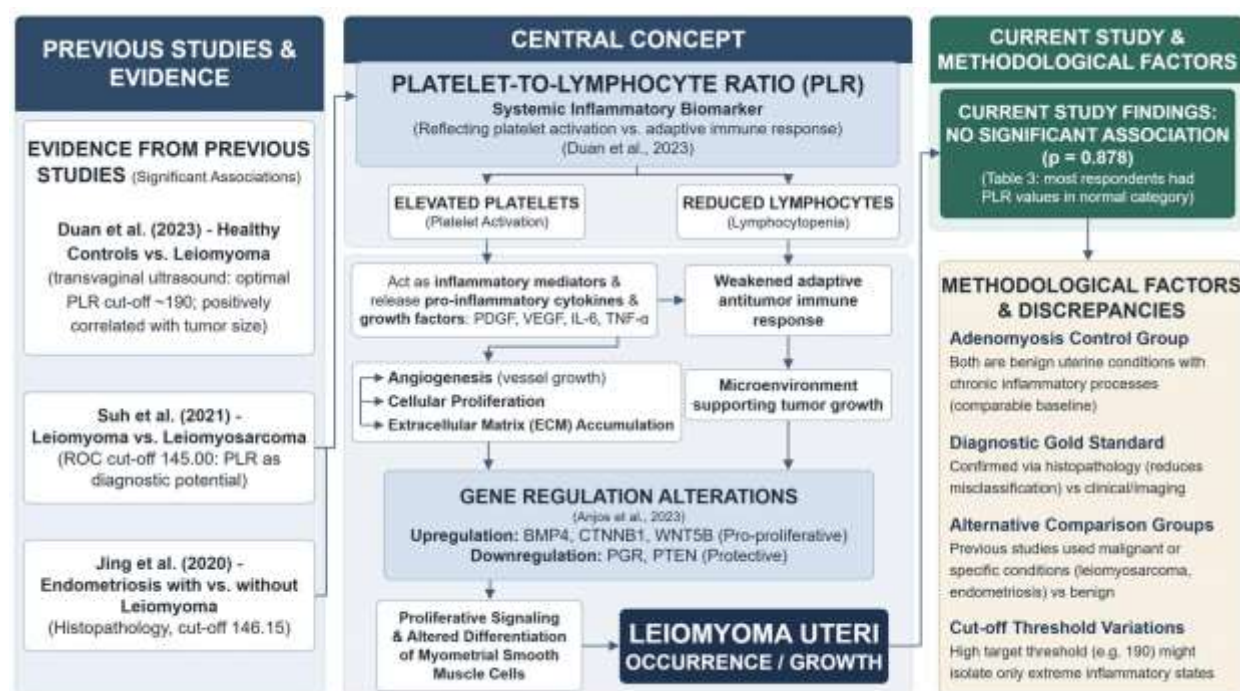


Figure 4. Pathway of Platelet-to-Lymphocyte Ratio in leiomyoma uteri occurrence
(Source: Processed primary data by the author, 2026)

CONCLUSION

There was no significant association between residential factors and the occurrence of *leiomyoma uteri*. Similarly, no significant association was found between PLR values and the occurrence of *leiomyoma uteri*.

Future studies are recommended to use a prospective study design with direct measurements of pollutant and phthalate exposure in Indonesia, include balanced samples from urban and rural areas, and control for potential confounding factors such as age, BMI, parity, and hormonal contraceptive use.

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