

Menstrual Cycle Disorders and Anemia as Predictors of Polycystic Ovary Syndrome Risk Among Reproductive-Age Female Workers

Gangguan Siklus Menstruasi dan Anemia sebagai Prediktor Risiko Sindrom Ovarium Polikistik pada Pekerja Perempuan Usia Reproduksi

Lia Kurniasari^{1*}, Fatma Zulaikha²

¹Public Health Study Program, Universitas Muhammadiyah Kalimantan Timur, Samarinda, Indonesia

²Nursing Study Program, Universitas Muhammadiyah Kalimantan Timur, Samarinda, Indonesia

Abstract

Female workers in entertainment venues are at higher risk of experiencing reproductive health problems due to shift work patterns, lack of rest, exposure to cigarette smoke, and unhealthy diets. This study aimed to analyze the relationship between menstrual cycles and anemia status with the risk of PCOS in female billiard workers in Samarinda City. The study used an observational analytical design with a cross-sectional approach. The study sample consisted of 96 subjects selected using simple random sampling. Data were collected through closed questionnaires and hemoglobin level examinations. Data analysis was performed univariately and bivariately using the Chi-Square test with a 95% confidence level and the strength of the association with the PR value. The results showed that the majority of subjects experienced irregular menstrual cycles (54%) and anemia (76%). Subjects at risk of PCOS were 39.6%. There was a significant association between anemia status and PCOS risk ($p = 0.045$; PR = 2.08), meaning that subjects with anemia had a 2.08-fold higher prevalence of PCOS risk. In addition, irregular menstrual cycles were also significantly associated with the risk of PCOS ($p = 0.001$; PR = 3.75). Irregular menstrual cycles were associated with a 3.75-fold higher prevalence of PCOS risk than regular menstrual cycles. This study concluded that menstrual cycle and anemia status are factors associated with PCOS risk in female billiard workers. Reproductive health education, monthly menstrual cycle monitoring, and routine Hb level checks are needed as an effort for early detection and prevention of PCOS in women of reproductive age.

Keywords: billiard workers, maternal health, PCOS, reproductive health

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Address:

Jl. Dr. Ratulangi No. 75A, Baju Bodoa, Maros Baru,
Kab. Maros, Provinsi Sulawesi Selatan, Indonesia

Email:

info@salnesia.id, jika@salnesia.id

Phone:

+62 85255155883



Abstrak

Pekerja perempuan di tempat hiburan memiliki risiko lebih tinggi mengalami gangguan kesehatan reproduksi akibat pola kerja shift, kurang istirahat, paparan asap rokok, serta pola makan yang kurang sehat. Penelitian ini bertujuan untuk menganalisis hubungan siklus menstruasi dan status anemia dengan risiko PCOS pada pekerja perempuan biliar di Kota Samarinda. Penelitian menggunakan desain observasional analitik dengan pendekatan cross-sectional. Sampel penelitian berjumlah 96 subjek yang dipilih menggunakan simple random sampling. Data dikumpulkan melalui kuesioner tertutup dan pemeriksaan kadar hemoglobin. Analisis data dilakukan secara univariat dan bivariat menggunakan uji Chi-Square dengan tingkat kepercayaan 95% dan kekuatan hubungan dengan nilai PR. Hasil penelitian menunjukkan sebagian besar subjek mengalami siklus menstruasi tidak teratur (54%) dan anemia (76%). Sebanyak 39,6% subjek berada pada kategori berisiko PCOS. Terdapat hubungan yang signifikan antara status anemia dengan risiko PCOS ($p = 0,045$; $PR = 2,08$), yang bermakna subjek dengan anemia memiliki prevalensi risiko PCOS 2,08 kali lebih tinggi. Selain itu, siklus menstruasi yang tidak teratur juga berhubungan signifikan dengan risiko PCOS ($p = 0,001$; $PR = 3,75$). Siklus menstruasi yang tidak teratur meningkatkan risiko PCOS 3,75 kali lebih besar dibandingkan subjek dengan siklus menstruasi teratur. Penelitian ini menyimpulkan bahwa siklus menstruasi dan status anemia merupakan faktor yang berhubungan dengan risiko PCOS pada pekerja perempuan biliar. Edukasi kesehatan reproduksi, pemantauan siklus menstruasi setiap bulan, serta pemeriksaan kadar Hb secara rutin diperlukan sebagai upaya deteksi dini hingga pencegahan PCOS pada wanita usia reproduktif.

Kata Kunci: kesehatan ibu, PCOS, pekerja, reproduksi

*Correspondence Author:

Lia Kurniasari, email: liakesmas@umkt.ac.id



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Highlight:

- Irregular menstrual cycles act as a primary predictor that significantly increases the risk of Polycystic Ovary Syndrome (PCOS) among female workers.
- Anemia status shows a significant correlation with an increased risk of PCOS, although its predictive strength remains an initial indication due to sample size limitations.
- Circadian rhythm disruption caused by shift work and exposure to the entertainment work environment exacerbates hormonal imbalances, highlighting the need for workplace-based reproductive health interventions.

INTRODUCTION

Polycystic ovary syndrome (PCOS) is one of the most common endocrine disorders in women of reproductive age, with a global prevalence of 5–20% (Mirza, 2022). It often affects not only reproductive health through infertility but also may contribute to metabolic disorders and raises the long-term risk of metabolic syndrome, type 2 diabetes, hypertension, and cardiovascular disease (Greger et al., 2020). Identifying easily observable early indicators in women of reproductive age is therefore important.

In Indonesia, PCOS has received insufficient attention compared with other reproductive health issues, even though it affects 4–6% of the female population. An irregular menstrual cycle can be one early indicator of PCOS (Meer et al., 2023). At work, women with PCOS tend to have higher absenteeism, lower productivity, and often need long-term medical care (Huddleston et al., 2024), creating an economic burden for both individuals and the health system. Psychological burdens such as anxiety, depression, and reduced quality of life are also common, making PCOS a public health problem that must be addressed promptly (Mahdang and Arsad, 2022; Fasitasari et al., 2024).

Apart from menstrual cycle irregularities, women's health conditions such as anemia are common health issues in women of reproductive age that can pose a potential risk for PCOS. Women with PCOS experience hormonal imbalances, dietary changes, and nutritional status shifts that contribute to anemia (Brady et al., 2009; Barlampa et al., 2021; Ee et al., 2021; Yang and Chen, 2024). Furthermore, anemia can worsen reproductive health conditions by reducing body work capacity (Shamsi et al., 2022; Xiang et al., 2023; Bai et al., 2024). Anemic women experience aggravated menstrual cycle disorders, which are closely linked to PCOS driven by hormonal imbalances. Female billiard workers represent a vulnerable group frequently facing reproductive health issues due to workplace environments and lifestyles. Irregular working hours, insufficient rest, high stress, unbalanced diets, and limited access to regular workplace health screenings significantly elevate PCOS risks. The combination of environment, agent, and host factors creates synergistic conditions that significantly increase PCOS risks among female entertainment workers.

The urgency of this study lies in the need to understand the interaction between agent and host factors in the context of the entertainment work environment. Previous research has largely addressed PCOS from clinical and hormonal angles, but few studies have highlighted specific risk factors among female entertainment workers in Indonesia. This study aimed to analyze whether menstrual cycle and anemia status were associated with PCOS risk among billiard workers who have particular working hours.

METHODS

This study used an observational analytical design with a cross-sectional approach to identify agent and host risk factors for PCOS. The population was female entertainment workers aged 18–45 years who worked at billiard venues in Samarinda City. The study was conducted in February 2026. The sample was drawn by simple random sampling using the Lemeshow sample-size formula for an unknown population. With a 95% confidence level and a 10% sampling error, the total number of subjects studied was 96. Inclusion criteria were: (1) women of reproductive age, and (2) having worked at the entertainment venue for at least 3 months. Exclusion criteria were: (1) pregnant women, and (2) women undergoing treatment for a chronic disease, specifically cancer.

Data collection was conducted through the distribution of closed-ended questionnaires and health examinations, including hemoglobin level and blood pressure measurements. The questionnaire met the validity requirements tested on female workers in a children's entertainment venue, accounting for 10% of the total research subjects. Validity test results were processed using the Pearson Product-Moment correlation, where items meeting the criteria of r calculated $> r$ table were declared valid. Reliability testing was performed using Cronbach's Alpha, with values exceeding

0.70 indicating that all questionnaire items were reliable for use. The dependent variable was PCOS risk, evaluated through an observational checklist assessing PCOS signs such as hirsutism, abdominal adiposity, and other clinical symptoms. The independent variables consisted of menstrual cycle patterns, assessed via self-reported menstrual history over the preceding three months, and anemia status, measured using an EasyTouch hemoglobinometer with a threshold of 12 g/dL defining anemia, alongside direct visual inspection of the conjunctiva. Blood pressure measurements were recorded solely to obtain supplementary physiological data and were not subjected to further statistical analysis. Data were analyzed using univariate and bivariate approaches, employing the Chi-Square test with a 95% confidence interval (CI). Risk magnitude was expressed as the Prevalence Rate (PR), where a $PR > 1$ indicated a potential risk factor for PCOS occurrence. Furthermore, this study was conducted in strict compliance with ethical research principles, including informed consent, anonymity, and data confidentiality.

RESULTS AND DISCUSSIONS

Subject characteristics

The study was conducted at several billiard venues in Samarinda City that had been operating for over a year and were actively frequented by the community. The descriptive characteristics of the subjects analyzed are presented in Table 1. Based on age groups, the majority of subjects were aged 21–35 years (75%), followed by the 18–20 age group numbering 20 individuals (21%), with the 36–45 age group representing the smallest proportion (4%). Regarding educational attainment, the majority of subjects (73 individuals or 76%) had a high level of education (high school and university graduates), while 23 subjects (24%) had a low level of education (junior high school).

Table 1. Subject characteristics and independent variables (n = 96)

Variabel	n	%
Age category		
18–20 years	20	21
21–35 years	72	75
36–45 years	4	4
Education category		
Low education	23	24
High education	73	76
Length of work category		
Long-term worker (> 3 months)	70	73
New worker (≤ 3 months)	26	27
Work position category		
Ball server	59	62
Cashier	20	21
Kitchen	6	6
Admin	6	6
Barista	2	2
Supervisor	1	1
OB	1	1
Manager	1	1

Variabel	n	%
Menstrual cycle category		
Irregular	52	54
Regular	44	46
PCOS risk among workers		
Not at risk	58	60.4
At risk	38	39.6
Anemia status category		
Not anemic	23	24
Anemic	73	76

Sumber: Data primer, 2026

Table 1 also shows that most subjects 70 (73%) were long-term workers. The most common work position was ball server (59 subjects, 62%), followed by cashier (20 subjects, 21%). For the menstrual cycle, 52 subjects (54%) had an irregular cycle and 44 (46%) had a regular cycle. In terms of anemia, 73 subjects (76%) were anemic and 23 (24%) were not. The data show that 38 subjects (39.6%) were at risk of PCOS and 58 (60.4%) were not.

Association of anemia status and menstrual cycle with PCOS risk

Table 2 presents the analysis of the relationship between anemia status and PCOS risk among billiard workers. Out of 73 anemic subjects, 33 individuals (34%) were at risk for PCOS. Conversely, among the 23 non-anemic subjects, only 5 individuals (5.2%) were at risk for PCOS.

Table 2. Association between anemia status and PCOS risk

Anemia Status	Not at risk of PCOS	At risk of PCOS	p-value	PR	95% CI
Not anemic	18 (19%)	5 (5.2%)	0.045*	2.08	0.91–4.75
Anemic	40 (42%)	33 (34%)			
Total	58 (60%)	38 (40%)	100%		

Note: *Chi-square, significant if $p < 0.05$

The statistical analysis yielded a p-value of 0.045 ($p < 0.05$), indicating a significant association between anemia status and PCOS risk. A PR value of 2.08 demonstrates that anemic subjects have a 2.08-fold higher prevalence of PCOS risk compared to non-anemic subjects. Nevertheless, the 95% confidence interval (95% CI: 0.91–4.75) includes a lower bound that falls below the neutral threshold of 1.00.

Table 3. Association between the menstrual cycle and PCOS risk

Menstrual Cycle	Not at risk of PCOS	At risk of PCOS	p-value	PR	95% CI
Irregular	21 (40%)	31 (60%)	0.001*	3.75	1.82–7.71
Regular	37 (84%)	7 (16%)			
Total	58 (60%)	38 (40%)	100%		

Note: *Chi-square, significant if $p < 0.05$

Analysis in Table 3 indicates that among 52 subjects with irregular menstrual cycles, 31 individuals (60%) were at risk for PCOS, while 21 individuals (40%) were not. Conversely, among subjects with regular menstrual cycles, 37 individuals (84%) were not at risk for PCOS, and only 7 individuals (16%) were at risk. Statistical testing yielded a p -value of 0.001 ($p < 0.05$), demonstrating a significant association between menstrual cycle patterns and PCOS risk. A PR value of 3.75 indicates a 3.75-fold increase in the prevalence of PCOS risk among subjects with irregular menstrual cycles compared to those with regular cycles (95% CI: 1.82–7.71).

Based on observations at the research site, many women of reproductive age are still unfamiliar with the term PCOS, as evidenced by their complete lack of prior awareness when the term was mentioned. PCOS is closely related to menstrual health. The menstrual cycle serves as a primary window into women's overall health, where cycle irregularities are largely driven by hormonal imbalances (Meer et al., 2023; Bai et al., 2024; Joshi, 2024). PCOS itself is intrinsically linked to female hormonal dynamics. This study was conducted on women of reproductive age, among whom over 50% experienced irregular menstrual cycles (Sengupta et al., 2024). These menstrual irregularities are caused by various factors, such as inadequate rest among female billiard workers who work in rotating morning and night shifts. Although the work schedule follows a two-week morning and two-week night rotation pattern, this arrangement significantly disrupts the rest patterns of female workers. The human body operates on a distinct circadian rhythm; when female workers perform night shifts, this circadian rhythm shifts, directly affecting the hormonal regulation of women of reproductive age (Li et al., 2022). Additionally, researchers identified another factor contributing to menstrual cycle irregularities among these female billiard workers, namely poor dietary habits.

Female workers tend to skip or delay their meals. For instance, during morning shifts, if lunch hour coincides with peak customer traffic, workers choose to postpone eating until the billiard venue becomes less crowded. This behavior is driven by company rules requiring female workers, particularly ball spotters, to remain on standby while their assigned billiard tables are in use, as played balls must be promptly reset after each game. Consequently, when time permits for lunch, they tend to overeat. Furthermore, a large proportion of female workers frequently consume nutrient-poor, high-calorie foods (such as processed meat skewers/pentol, packaged snacks, and bread) while waiting for meal times. If sustained continuously, these unhealthy dietary habits lead to progressive weight gain, thereby increasing the risk of PCOS among these female workers (Wang et al., 2021).

Consistent research on the link between a healthy diet and PCOS risk was shown by Ee et al. (2021), who found that a healthy lifestyle can lower women's PCOS risk; various prevention efforts have also been made, such as by Pinto, who attempted treatment to change brain activity in a way that can lower PCOS risk (Pinto et al., 2024). A poor diet raises the body mass index, which further increases women's PCOS risk, as does insulin resistance when balance is not well maintained (Guevara et al., 2024). Efforts are needed to provide nutritional supplementation that can lower women's stress levels and lipid production in the body (Dubey et al., 2021; Kim et al., 2021; Neubronner et al., 2021).

Polycystic Ovary Syndrome (PCOS) is a hormonal disorder that impairs ovarian function, hindering ovulation and potentially leading to the development of small ovarian cysts. Consequently, this condition often causes fertility issues in women. Clinical manifestations of PCOS include irregular monthly menstruation, severe

inflammatory acne, and hirsutism, which is characterized by excessive hair growth in atypical areas such as a thin mustache and thick, connected eyebrows. Pathophysiologically, this condition is strongly linked to insulin resistance, preventing the body from utilizing insulin effectively and causing elevated blood glucose levels (Bayona et al., 2022; Choudhury and Rajeswari, 2022; Aggarwal and Padey, 2023). In response, the body produces excess insulin, which triggers the ovaries to release higher levels of androgen (Tefagh et al., 2022; Yang and Chen, 2024).

Awareness of this condition remains low among young women. Most female workers at the billiard venue, all of whom are of reproductive age, reported never having heard of PCOS. However, studies conducted by (Gnanadass et al., 2021; Kim et al., 2021) concluded that there are significant associations between age-related female health and PCOS risk, as well as between metabolic conditions and PCOS incidence. Due to minimal education on PCOS, female workers tend to ignore irregular menstrual cycles. When experiencing amenorrhea for up to three months, they typically prefer consuming traditional herbal medicine (*jamu*) or emmenagogues rather than consulting an obstetrician-gynecologist to determine the underlying cause of their menstrual irregularity.

The workplace lacks both standard health schedules and dedicated medical examinations for its employees, preventing crucial reproductive health information from being effectively communicated to female staff. Furthermore, field observations revealed an external contributing factor to the heightened PCOS risk among these female billiard workers: exposure to secondhand smoke. During their daily eight-hour shifts, these workers are continuously exposed to cigarette smoke from customers smoking inside air-conditioned rooms. Prolonged daily exposure to harmful chemicals in tobacco smoke causes damage to vital organs over time. Consequently, these women become passive smokers (secondhand smokers), with a significant portion eventually becoming active smokers.

The health status of the female workers in this study was also assessed by measuring blood hemoglobin (Hb) levels using a portable digital Hb meter (EasyTouch), which required only a small blood sample. Measurements were taken after ensuring that the workers had eaten one hour prior to testing. The evaluation was further supported by direct physical examinations of the lower eyelids (conjunctiva). The results revealed that more than 76% of the female workers experienced anemia. This finding demonstrates the need for further clinical diagnosis by healthcare professionals and the administration of appropriate medical treatment for these workers. Left untreated, anemia leads to reduced immunity, impaired physical fitness, and decreased productivity, while presenting potential complications for future pregnancies. Furthermore, this study established a significant association between anemia status in female workers and the risk of PCOS, which aligns with findings by Arentz et al. (2021), linking lifestyle-induced anemia to PCOS. This interrelationship occurs because women with PCOS are vulnerable to anemia due to infrequent yet abnormally heavy menstrual bleeding when periods occur, depleting iron stores and inducing chronic inflammation that impairs iron absorption. Additionally, this study identified several risk factors contributing to the high prevalence of anemia among these billiard workers, including inadequate rest, sleeping less than 8 hours daily, and irregular iron supplementation, typically taking supplements only during menstruation or when remembered. Furthermore, many female workers erroneously equate anemia with hypotension, despite these being two distinct medical conditions.

Overall, this study showed that the menstrual cycle increases PCOS risk 3.75-fold

among female billiard workers, involving factors such as poor rest patterns that disrupt the body's circadian rhythm, an unhealthy diet, and the external factor of daily exposure to cigarette smoke in an air-conditioned room. Anemia in women also increased PCOS risk 2.08-fold. The lack of health checks or medical check-ups for these workers, not yet provided by the company, is a gap that needs addressing to better attend to their health, especially in entertainment settings such as billiards. Workers in prime health will of course be more productive. From a reproductive health perspective, good understanding of reproductive health through the window of menstruation is very important for female workers in both the formal and informal sectors, to prepare to become healthy mothers and create a healthy generation. Healthy behavior before pregnancy needs to be prepared by prospective mothers, because a healthy uterus is where a fetus grows over nine months of life (Arentz et al., 2021).

Study limitations

However, the confidence interval for anemia status ranged from 0.91 to 4.75, with a lower bound below the neutral value of 1.00. Methodologically, this borderline association indicates limited precision of the risk estimate, most likely influenced by the sample size ($n = 96$). The magnitude of the anemia PCOS risk in this population of female entertainment workers therefore cannot be concluded as an absolute risk factor and should be interpreted prudently as a preliminary finding requiring confirmation through further research with a larger sample.

CONCLUSIONS

An irregular menstrual cycle was significantly associated with increased PCOS risk ($PR = 3.75$). Anemia status was statistically associated with an increased prevalence of PCOS risk ($PR = 2.08$), although the precision of the risk estimate was limited by the available sample size. These two factors underscore the importance of workplace support in ensuring female workers' reproductive health rights. Such support can be provided through regular medical check-ups, such as routine hemoglobin checks, and continuous reproductive health education programs. To improve the precision of the prevalence ratio estimate, future research is encouraged to broaden the subject coverage with a larger sample size.

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