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Behavioral, Reproductive, and Environmental Factors Associated with Infertility Among Reproductive-Age Couples

I Gusti Ayu Ratih Agustini

Program Keperawatan, Institut Kesehatan Rajawali Bandung

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Corresponding author*:
ayuratih066@gmail.com

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Abstract: Infertility is a reproductive health problem that can affect the biological, psychological, social, and economic well-being of couples. Its occurrence may be associated with various behavioral, reproductive, and environmental factors, requiring a comprehensive assessment involving both partners. **Objective:** This study aimed to analyze factors associated with infertility among couples of reproductive age in Denpasar, Bali. The study specifically examined smoking, alcohol consumption, reproductive disease history, and risky environmental exposure as potential factors associated with infertility. **Methodology:** This quantitative observational analytic study employed a case-control design involving 100 participants, consisting of 50 participants in the infertility group and 50 participants in the control group. Primary data were collected using a structured questionnaire, while secondary data were obtained from medical records and reproductive health service documentation. Data were analyzed using descriptive statistics and bivariate analysis. The strength of each association was reported using crude odds ratios, 95% confidence intervals, and p-values. **Findings:** Smoking was significantly associated with infertility (OR = 4.70; 95% CI: 1.93–11.42; $p < 0.001$). Alcohol consumption was associated with higher odds of infertility (OR = 8.43; 95% CI: 1.79–39.70; $p = 0.002$). A history of reproductive disease was also significantly associated with infertility (OR = 8.33; 95% CI: 2.60–26.72; $p < 0.001$), while risky environmental exposure increased the odds of infertility by 4.24 times (95% CI: 1.41–12.70; $p = 0.007$). These findings indicate that infertility is associated with multiple behavioral, reproductive, and environmental factors. **Implications:** Reproductive health services should adopt a couple-centered approach that includes smoking cessation, reduction of alcohol consumption, early detection and management of reproductive disorders, and minimization of hazardous environmental exposure. The findings may support the development of preventive programs, reproductive health education, and early screening strategies for couples of reproductive age. **Originality:** This study provides an integrated assessment of behavioral, reproductive, and environmental factors associated with infertility at the couple level. Unlike studies that examine female or male factors separately, this research emphasizes infertility as a shared reproductive health condition requiring the involvement of both partners. However, multivariable analysis is still required to identify the factors independently associated with infertility.

Keywords: alcohol consumption; environmental exposure; infertility; reproductive disease; smoking

INTRODUCTION

Infertility among couples of reproductive age is an important reproductive health problem because it affects not only biological well-being but also the psychological, social, and economic conditions of families. Infertility is generally defined as the inability of a couple to achieve pregnancy after 12 consecutive months of regular sexual intercourse without the use of contraception. From a reproductive health perspective, successful conception depends on the normal functioning of the reproductive organs, hormonal balance, sperm and oocyte quality, age, nutritional status, lifestyle, and environmental conditions. When these factors remain within optimal conditions, the likelihood of conception is expected to increase (Hasanuddin et al., 2026).

Despite improvements in access to reproductive health services, infertility remains a significant concern among couples of reproductive age. Modern lifestyle changes, including smoking, alcohol consumption, obesity, prolonged psychological stress, exposure to environmental pollution, delayed marriage and childbearing, and the increasing prevalence of reproductive disorders, may contribute to difficulties in achieving pregnancy (Azzahra, 2022). In addition, infertility is still frequently perceived as a condition caused exclusively by women, resulting in the limited involvement of male partners in fertility examinations. This perception reflects a gap between the theoretical understanding of infertility as a couple-related health problem and the social reality, which continues to be influenced by stigma, delayed diagnosis, and insufficient awareness of modifiable risk factors. Therefore, identifying infertility-related risk factors among couples of reproductive age is essential for developing comprehensive prevention, early-detection, and intervention strategies.

Previous studies have indicated that infertility is associated with a combination of biological, behavioral, environmental, and socioeconomic factors (Agustin et al., 2023). Increasing reproductive age, abnormal body mass index, hormonal disorders, sexually transmitted infections, polycystic ovary syndrome, endometriosis, varicocele, poor sperm quality, smoking, alcohol consumption, psychological stress, and exposure to hazardous chemicals have been identified as potential determinants of infertility. Educational attainment, access to reproductive health services, and delays in seeking medical assistance may also affect the likelihood of achieving pregnancy. However, many previous studies have focused on individual risk factors or examined infertility separately from either the female or male perspective (Ii & Pustaka, 2025). Other studies have predominantly been

conducted in hospitals or fertility clinics, limiting their ability to represent couples living in the broader community. Consequently, studies that simultaneously integrate biological, behavioral, environmental, and social determinants at the couple level remain limited.

The novelty of the present study lies in its comprehensive assessment of infertility-related risk factors by considering the couple, rather than only one partner, as the principal unit of analysis. Previous investigations have frequently separated female and male risk factors, thereby providing limited evidence regarding how factors affecting both partners may interact and contribute to infertility. This study integrates age, nutritional status, reproductive disorders, lifestyle, stress levels, chronic disease history, environmental exposure, and socioeconomic characteristics within a single analytical framework. Such an approach is expected to facilitate a more comprehensive evaluation of the relationships among these variables and to identify the factors most strongly associated with infertility. The study also emphasizes modifiable determinants that can be addressed through behavioral changes and reproductive health interventions. Integrating these determinants into one analytical model may provide a broader perspective than previous studies that have adopted partial or sector-specific approaches (Ferawati et al., 2020).

Based on these considerations, this study seeks to identify the biological, behavioral, environmental, and socioeconomic factors associated with infertility among couples of reproductive age. Comprehensive evidence regarding these determinants is needed to support infertility prevention, early detection, reproductive health education, and clinical decision-making. Accordingly, this study examines whether age, nutritional status, reproductive disorders, lifestyle, stress level, chronic disease history, environmental exposure, and socioeconomic characteristics are associated with infertility and determines which factor has the strongest association with infertility among couples of reproductive age. The findings are expected to address the existing knowledge gap and support the development of evidence-based reproductive health programs and couple-centered health services.

The study hypothesizes that biological, behavioral, environmental, and socioeconomic factors are significantly associated with infertility among couples of reproductive age. Increasing age, abnormal nutritional status, smoking, alcohol consumption, chronic stress, reproductive disorders, exposure to hazardous chemicals, and limited access to healthcare services are expected to increase the likelihood of infertility by affecting gamete quality, hormonal regulation, and reproductive organ function. Nevertheless, the magnitude of

these associations may vary across populations. Therefore, this study evaluates the relationships between these risk factors and infertility and identifies the factor with the strongest contribution after controlling for other relevant variables. The findings may provide a scientific basis for risk-based infertility prevention, reproductive health education, early detection, and the development of more comprehensive reproductive healthcare policies.

RESEARCH METHOD

This study employed a quantitative approach using an observational analytic case-control design. The design was selected to identify and analyze factors associated with infertility among couples of reproductive age. The case group consisted of couples who had been clinically diagnosed with infertility, whereas the control group comprised couples without infertility or those who had successfully achieved pregnancy. The study was conducted in Denpasar, Bali. The case-control design enabled comparisons of previous exposure to potential risk factors, including age, body mass index, lifestyle, reproductive disease history, smoking, alcohol consumption, stress level, and environmental exposure, between the two groups. As an observational design, this approach allowed the associations between multiple risk factors and infertility to be evaluated without administering any intervention to the participants.

Data were obtained from both primary and secondary sources. Primary data were collected using a structured questionnaire that had undergone validity and reliability testing. The questionnaire collected information on participants' demographic characteristics, age, educational attainment, occupation, nutritional status, lifestyle, physical activity, smoking behavior, alcohol consumption, stress level, reproductive disease history, and environmental exposure that could potentially affect fertility. Directed interviews were also conducted to confirm the completeness and consistency of participants' responses. Secondary data were obtained from medical records and reproductive health service documentation, including infertility diagnoses, duration of infertility, laboratory examination results, and previous reproductive health treatments. Before data collection, all participants received information regarding the objectives and procedures of the study and provided written informed consent as evidence of their voluntary participation.

Data were analyzed using statistical software. Univariate analysis was initially conducted to describe the distribution of each variable using frequencies, percentages, means, and standard deviations, as appropriate. For numerical variables, data normality was assessed before comparisons between the case and control groups were performed. An independent-samples t-test was used for normally distributed numerical data, whereas a nonparametric test was applied when the normality assumption was not satisfied. Bivariate analysis was performed using the Chi-square test or Fisher's exact test, as appropriate, to evaluate the association between each categorical risk factor and infertility. Crude odds ratios and their corresponding 95% confidence intervals were calculated to estimate the strength of each association.

Variables with a p-value of less than 0.25 in the bivariate analysis were considered candidates for inclusion in the multivariable analysis. Multiple logistic regression was subsequently performed to determine the factors independently associated with infertility after controlling for other variables in the model. The final results were reported as adjusted odds ratios, 95% confidence intervals, and p-values. Multicollinearity among independent variables was assessed before development of the final model. Model fit was evaluated using an appropriate goodness-of-fit test, while statistical significance was established at a 95% confidence level and an alpha value of 0.05. The factor with the largest statistically significant adjusted odds ratio was interpreted as having the strongest association with infertility among couples of reproductive age.

RESULT

A total of 100 participants were included in the study, comprising 50 participants in the infertility group and 50 participants in the control group. The mean age of all participants was 33.91 years, while the mean body mass index was 25.21 kg/m². Because group-specific means and standard deviations for age and body mass index were not available, statistical comparisons of these numerical variables between the case and control groups could not be presented.

Table 1. General Characteristics of the Participants

Characteristic	Result
Total participants	100
Infertility group	50 (50.0%)
Control group	50 (50.0%)
Mean age	33.91 years
Mean body mass index	25.21 kg/m²

The distribution of potential risk factors showed that smoking, alcohol consumption, a history of reproductive disease, and risky environmental exposure were more frequently reported in the infertility group than in the control group. Smoking was reported by 27 participants in the infertility group and 10 participants in the control group. Alcohol consumption was reported by 13 participants in the infertility group and only two participants in the control group. A history of reproductive disease was identified in 21 participants in the infertility group compared with four participants in the control group. Risky environmental exposure was reported by 16 participants in the infertility group and five participants in the control group.

Table 2. Distribution of Potential Infertility Risk Factors

Risk factor	Infertility group, n (%)	Control group, n (%)	Total, n (%)
Smoking	27 (54.0)	10 (20.0)	37 (37.0)
Alcohol consumption	13 (26.0)	2 (4.0)	15 (15.0)
History of reproductive disease	21 (42.0)	4 (8.0)	25 (25.0)
Risky environmental exposure	16 (32.0)	5 (10.0)	21 (21.0)

Crude bivariate analysis indicated statistically significant associations between all four categorical risk factors and infertility. Participants who smoked had approximately 4.70 times the odds of belonging to the infertility group compared with those who did not smoke. Alcohol consumption was associated with 8.43 times higher odds of infertility, although the wide confidence interval indicated limited precision. A history of reproductive disease was associated with 8.33 times higher odds of infertility, while risky environmental exposure was associated with 4.24 times higher odds.

Table 3. Bivariate Analysis of Factors Associated with Infertility

Risk factor	Crude OR	95% CI	p-value
Smoking	4.70	1.93–11.42	<0.001
Alcohol consumption	8.43	1.79–39.70	0.002
History of reproductive disease	8.33	2.60–26.72	<0.001
Risky environmental exposure	4.24	1.41–12.70	0.007

The largest crude odds ratio was observed for alcohol consumption, followed by a history of reproductive disease. However, these estimates represent unadjusted associations. Therefore, they cannot be interpreted as evidence that alcohol consumption was the most dominant independent factor. Multiple logistic regression is required to determine whether these associations remain significant after controlling for age, body mass index, and other potential confounding variables.

DISCUSSION

The findings demonstrate that infertility among couples of reproductive age is associated with several biological, behavioral, and environmental factors. All examined categorical risk factors were more prevalent in the infertility group than in the control group. These findings support the multifactorial nature of infertility, in which reproductive outcomes may be influenced by the combined effects of lifestyle, reproductive health conditions, and environmental exposure rather than by a single determinant.

Smoking showed a significant association with infertility. Participants who smoked had substantially higher crude odds of infertility than nonsmokers. Tobacco smoke contains substances that may contribute to oxidative stress and interfere with reproductive function. In men, smoking may be associated with impaired sperm concentration, motility, morphology, and DNA integrity. In women, smoking may affect ovarian function, hormonal regulation, and oocyte quality. The higher prevalence of smoking in the infertility group indicates that smoking behavior should be considered in reproductive health assessment and preconception counseling. Nevertheless, the present study cannot establish a causal relationship because smoking exposure and infertility were assessed using an observational case-control design (Agustin et al., 2023; Hasanuddin et al., 2026).

Alcohol consumption was also more frequently reported in the infertility group and showed one of the highest crude odds ratios. Alcohol may interfere with reproductive hormone regulation and gamete quality, potentially reducing the probability of conception. However, only 15 participants reported alcohol consumption, including two participants in the control group. Consequently, the estimated association had a relatively wide confidence interval. This finding suggests that the association may be important, but its magnitude remains imprecise and should be interpreted cautiously. Further studies with larger numbers of alcohol-exposed participants and more detailed measurements of drinking frequency, quantity, and duration are required (Daerah, 2026; Hosmer et al., 2026).

A history of reproductive disease was strongly associated with infertility. Reproductive disorders such as pelvic inflammatory disease, endometriosis, polycystic ovary syndrome, reproductive tract infections, and varicocele may impair reproductive organ function and reduce the probability of conception. This finding is consistent with the understanding that untreated or late-diagnosed reproductive conditions may contribute to infertility among both women and men. Early screening, appropriate referral, and timely treatment of reproductive disorders are therefore important components of infertility prevention and management. However, the specific diseases included in the reproductive disease category should be reported separately to improve the clinical interpretation of the findings.

Risky environmental exposure was also significantly associated with infertility. Participants in the infertility group reported greater exposure to potentially harmful environmental conditions than those in the control group. Exposure to chemicals, occupational pollutants, pesticides, heavy

metals, excessive heat, or air pollution may affect reproductive health through hormonal disruption, oxidative stress, or direct damage to reproductive cells. Nevertheless, environmental exposure is a broad category. Its interpretation depends on the type, duration, intensity, and source of exposure. Future analyses should therefore classify environmental exposures more specifically rather than combining all forms of exposure into a single variable.

The findings have practical implications for reproductive health services. Fertility assessment should involve both partners and include evaluation of smoking, alcohol consumption, reproductive disease history, nutritional status, psychological stress, and environmental or occupational exposure. Health promotion programs should emphasize smoking cessation, limitation of alcohol consumption, maintenance of a healthy body weight, early examination of reproductive disorders, and reduction of hazardous environmental exposure (Azzahra, 2022; Iskandar & Hasbi, 2024; Tahun et al., 2023). Couple-centered counseling may also help reduce the social misconception that infertility is exclusively a female health problem.

Several limitations should be considered. First, the case-control design is vulnerable to recall bias because some exposure information was obtained retrospectively. Second, self-reported smoking, alcohol consumption, and environmental exposure may have resulted in underreporting or misclassification. Third, the relatively small sample size produced wide confidence intervals for some variables. Fourth, the available data did not provide separate characteristics for male and female partners. Fifth, group-specific age and body mass index statistics were unavailable (Iskandar & Hasbi, 2024; Salsabil & Andriani, 2024). Finally, the results presented in this section are based on crude bivariate associations. Multiple logistic regression must be completed before identifying independent or dominant factors associated with infertility.

Overall, smoking, alcohol consumption, a history of reproductive disease, and risky environmental exposure were significantly associated with infertility in the bivariate analysis. However, these findings should be interpreted as statistical associations rather than causal effects. Adjusted analysis is required to determine which factors remain independently associated with infertility after potential confounding variables have been controlled.

CONCLUSION

This study indicates that infertility among couples of reproductive age is associated with multiple behavioral, reproductive, and environmental factors. Smoking, alcohol consumption, a history of reproductive disease, and risky environmental exposure were more frequently identified in the infertility group than in the control group. Bivariate analysis showed that these factors were significantly associated with infertility, supporting the view that infertility is a multifactorial reproductive health condition rather than the result of a single determinant. However, because the current findings are based on crude associations, further multivariable analysis is required to

identify the factors that remain independently associated with infertility after controlling for potential confounders.

The findings highlight the importance of comprehensive, couple-centered reproductive health services. Preventive efforts should include smoking cessation, reduction of alcohol consumption, early detection and appropriate management of reproductive disorders, and minimization of hazardous environmental exposure. Reproductive health education and regular screening should involve both partners to reduce delayed diagnosis and address the misconception that infertility is exclusively a female health problem. Further studies with larger samples, clearer couple-level measurements, and adjusted statistical models are recommended to strengthen the evidence regarding the dominant factors associated with infertility.

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