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Nutritional Status and Dietary Patterns as Determinants of Infertility Among Reproductive-Age Couples: A Cross-Sectional Analysis

Erna Yovi Kurniawati[1]✉ , Lia Dian Ayuningrum[2]
[1, 2] Midwifery Professional Program, Department of Midwifery, Faculty of Medicine and Health Sciences, Alma Ata University, Yogyakarta, Indonesia.
✉Penulis Korespondensi: yovi.raharjanto@gmail.ccom

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ABSTRAK
Infertilitas merupakan masalah kesehatan reproduksi multifaktorial yang memengaruhi semakin banyak pasangan di seluruh dunia. Status gizi dan pola makan semakin diakui sebagai faktor yang dapat dimodifikasi yang berpengaruh terhadap fertilitas, namun dampaknya masih belum banyak diteliti, terutama di berbagai wilayah dengan sumber daya terbatas, termasuk Indonesia. Penelitian ini bertujuan untuk menilai hubungan antara status gizi dan pola makan dengan kejadian infertilitas pada pasangan usia reproduksi di Bantul, Yogyakarta. Penelitian ini menggunakan desain analitik potong lintang (cross-sectional) yang melibatkan 204 partisipan (102 pasangan infertil dan 102 pasangan fertil) yang dipilih menggunakan teknik stratified random sampling. Status gizi ditentukan berdasarkan indeks massa tubuh (IMT), sedangkan pola makan dinilai menggunakan kuesioner frekuensi makanan yang telah tervalidasi. Analisis statistik meliputi uji chi-square dan regresi logistik multivariat untuk mengevaluasi hubungan serta menghitung odds ratio (OR) yang telah disesuaikan dengan interval kepercayaan 95% (CI). Hasil penelitian menunjukkan bahwa individu dengan status gizi kurus maupun kelebihan berat badan/obesitas memiliki peluang infertilitas yang secara signifikan lebih tinggi dibandingkan dengan individu dengan IMT normal (OR = 2,00 dan 1,98; $p < 0,05$). Partisipan dengan pola makan yang tidak adekuat memiliki kemungkinan 3,29 kali lebih besar mengalami infertilitas ($p < 0,001$). Analisis multivariat menunjukkan bahwa status gizi dan pola makan merupakan prediktor independen terhadap infertilitas. Ketidakseimbangan status gizi dan kebiasaan makan yang kurang baik berhubungan kuat dengan kejadian infertilitas. Temuan ini menegaskan pentingnya integrasi penilaian status gizi dan konseling nutrisi dalam pelayanan fertilitas untuk meningkatkan luaran reproduksi. Penelitian intervensi lebih lanjut direkomendasikan untuk menetapkan hubungan kausal dan mendukung praktik klinis.

ABSTRACT
Infertility is a multifactorial reproductive health issue that affects a growing number of couples globally. Nutritional status and dietary patterns have been increasingly recognized as modifiable factors influencing fertility, yet their impact remains

underexplored in many low-resource settings, including Indonesia. This study aimed to assess the association between nutritional status and dietary patterns with infertility among reproductive-aged couples in Bantul, Yogyakarta. A cross-sectional analytical study was conducted involving 204 participants (102 infertile and 102 fertile couples) selected using stratified random sampling. Nutritional status was determined based on body mass index (BMI), while dietary patterns were assessed using a validated food frequency questionnaire. Statistical analyses included chi-square tests and multivariate logistic regression to evaluate associations and calculate adjusted odds ratios (ORs) with 95% confidence intervals (CIs). The findings indicate that underweight and overweight/obese individuals had significantly higher odds of infertility compared to those with normal BMI (OR = 2.00 and 1.98, respectively; $p < 0.05$). Participants with inadequate dietary patterns were 3.29 times more likely to experience infertility ($p < 0.001$). Multivariate analysis confirmed both nutritional status and dietary patterns as independent predictors of infertility. Nutritional imbalance and poor dietary habits are strongly associated with infertility. These findings underscore the need to integrate nutritional assessment and counseling into fertility care to improve reproductive outcomes. Further interventional studies are recommended to establish causal relationships and guide clinical practice.

1. INTRODUCTION

Infertility is a global reproductive health concern that requires multidisciplinary attention, encompassing medical, nutritional, and behavioral dimensions. It is estimated that approximately 15% of couples of reproductive age worldwide experience infertility, with increasing trends observed in both high- and low-income settings. In Indonesia, the prevalence of primary and secondary infertility remains substantial, contributing not only to health burdens but also to broader psychosocial consequences. In many communities, infertility is highly stigmatized particularly among women leading to emotional distress, marital instability, and reduced quality of life. These challenges underscore the need for comprehensive approaches that extend beyond clinical treatment and address underlying determinants of reproductive health.[1,2]

Among the emerging determinants of infertility, nutritional status and dietary patterns have gained increasing attention. Evidence suggests that both undernutrition and overnutrition can disrupt reproductive function through mechanisms such as hormonal imbalance, ovulatory dysfunction, and impaired spermatogenesis[3,4]. In addition, unhealthy dietary patterns characterized by high intake of trans fats and refined sugars, along with inadequate consumption of essential micronutrients, contribute to oxidative stress and systemic inflammation, which are known to adversely affect fertility outcomes.[5]. Despite these advances, existing studies have largely examined nutritional status and dietary factors separately, limiting the understanding of their combined and interactive effects on infertility[5,6].

This limitation is particularly relevant in low- and middle-income countries such as Indonesia, where the double burden of malnutrition coexistence of undernutrition and obesity poses unique challenges for reproductive health. However, evidence integrating both nutritional status and dietary patterns within a single analytical framework among couples of reproductive age remains limited. To date, no study has comprehensively examined the combined influence of nutritional status and dietary patterns on infertility among couples of reproductive age in community-based settings. This gap creates uncertainty in identifying the most influential modifiable risk factors and hinders the development of targeted, context-specific interventions. Furthermore, few studies have incorporated local sociocultural and demographic factors that may shape dietary behaviors and reproductive health outcomes [5,6].

To address this gap, the present study adopts a novel integrated approach by simultaneously examining nutritional status and dietary patterns in relation to infertility among couples of reproductive age within a community-based setting. This study represents one of the few community-based investigations integrating nutritional and dietary determinants of infertility in a low- and middle-income context. By combining objective anthropometric measurements including body mass index, waist circumference, and hemoglobin levels with dietary assessment using a validated food frequency questionnaire, this study provides a comprehensive evaluation of modifiable nutritional determinants of fertility. This approach allows for a more nuanced understanding of how nutritional and dietary factors interact in influencing reproductive health within a specific local context.

Therefore, the objective of this study is to analyze the relationship between nutritional status and dietary patterns and the occurrence of infertility among couples of reproductive age, with a focus on identifying modifiable risk factors. The findings are expected to inform the development of targeted, community-based health promotion and prevention strategies, as well as to support the integration of nutrition and reproductive health services within primary healthcare systems. Ultimately, this study aims to contribute to both scientific knowledge and practical interventions by advancing contextually relevant and sustainable approaches to improving reproductive health outcomes.

2. MATERIAL AND METHODS

2.1 Study Design

This study employed a quantitative approach with a cross-sectional analytic design to investigate the relationship between nutritional status, dietary patterns, and infertility among couples of reproductive age. This design allows for data collection at a single point in time and enables simultaneous analysis of associated variables. Ethical clearance was obtained from the Research Ethics Committee (EC Number: KE/AA/IX/078b/EC/2025).

2.2 Population and Sample

The target population consisted of all reproductive-age couples residing within the working area of selected community in Bantul Regency, Yogyakarta Special Region, Indonesia. Eligible participants were couples aged 20 to 45 years who had been married for at least one year. A purposive sampling technique was employed based on pre-established inclusion and exclusion criteria. The minimum required sample size was calculated using a population proportion formula with a 15% assumed prevalence of infertility, a 95% confidence level, and a 5% margin of error, yielding a minimum of 204 couples. The sample was equally distributed between infertile and fertile couples in a 1:1 ratio.

Inclusion criteria were: (1) reproductive-age couples married for ≥1 year, (2) not using any contraceptive methods, (3) willing to participate and sign informed consent, and (4) having available medical records or history regarding fertility status. Exclusion criteria included couples with either partner suffering from severe chronic illness, undergoing active hormonal therapy, or being within <6 months postpartum period.

2.3 Study Procedures

Prior to data collection, research permissions were obtained from the Sleman District Health Office and related health centers. Participants were recruited according to inclusion criteria. Data collection was conducted by trained enumerators through structured interviews and anthropometric assessments. Nutritional status was assessed using body mass index (BMI), waist circumference, and hemoglobin levels measured with a digital hemoglobinometer. Dietary patterns were assessed using a locally validated semi-quantitative Food Frequency Questionnaire (FFQ). Infertility status was defined according to WHO criteria as the inability to conceive after ≥12 months of regular unprotected sexual intercourse.

Research instruments included a demographic questionnaire, semi-quantitative FFQ, nutritional status assessment forms, and reproductive history forms. The FFQ was validated by experts in nutrition and midwifery, and instrument reliability was tested using Cronbach's alpha ($\alpha \geq 0.75$). Anthropometric measurements followed WHO standards and were performed using calibrated equipment.

2.4 Data Analysis

Data were analyzed using the latest version of the Statistical Package for the Social Sciences (SPSS). Univariate analysis was conducted to describe respondent characteristics using appropriate summary measures. Bivariate analysis was performed to examine the relationship between independent variables and infertility status. The Chi-square test was applied for categorical variables, as it is appropriate for assessing associations between two categorical variables and allows identification of differences in proportions across groups. For continuous variables, the Independent t-test was used to compare mean differences between groups, assuming normal distribution of the data.

Multivariate analysis was performed using logistic regression to identify independent predictors of infertility while controlling for potential confounding variables. Logistic regression was considered appropriate because the dependent variable (infertility status) was dichotomous, enabling estimation of the strength of association through odds ratios (OR) and their corresponding 95% confidence intervals (CI). This approach allows simultaneous evaluation of multiple risk factors and determination of their relative contributions to infertility outcomes. A p-value of less than 0.05 was considered statistically significant.

3. RESULT AND DISCUSSION

3.1 Result

This study involved a total of 204 reproductive-age couples, divided into two groups: 102 infertile couples and 102 fertile couples as controls. Statistical analyses were conducted to assess the association between nutritional status and dietary patterns with infertility.

As shown in Table 1, most of respondents in the fertile group had a normal nutritional status (68.6%), whereas the infertile group demonstrated higher proportions of both underweight (17.6%) and overweight/obese individuals (31.4%). Chi-square analysis revealed a statistically significant association between nutritional status and infertility ($p = 0.037$). Specifically, being overweight/obese increased the odds of infertility by nearly twofold (OR = 1.98; 95% CI: 1.05–3.74), and being underweight similarly increased the odds (OR = 2.00; $p = 0.045$), indicating that both forms of nutritional imbalance are associated with reproductive dysfunction.

Table 1. Distribution of Nutritional Status

Nutritional Status	Fertile	Infertile	Odds Ratio (OR)	p-value
Underweight	10 (9.8%)	18 (17.6%)	2.00	0.045
Normal (Reference)	70 (68.6%)	52 (51.0%)	1.00	–
Overweight/Obese	22 (21.6%)	32 (31.4%)	1.98	0.037

Source: Primary data collected from reproductive-aged couples in Bantul District, (2025)

Table 2 indicates that 74.5% of the fertile group had an adequate dietary pattern, compared to only 47.1% in the infertile group. Conversely, more than half of the infertile group exhibited inadequate dietary intake (52.9%). This difference was statistically significant ($p < 0.001$), with an odds ratio of 3.29 (95% CI: 1.78–6.08), suggesting that individuals with inadequate dietary patterns were more than three times as likely to experience infertility than those with adequate nutrition.

Table 2. Distribution of Dietary Patterns

Dietary Pattern	Fertile	Infertile	Odds Ratio (OR)	p-value
Adequate	76 (74.5%)	48 (47.1%)	1.00	<0.001
Inadequate	26 (25.5%)	54 (52.9%)	3.29	

Source: Primary data collected from reproductive-aged couples in Bantul District, (2025)

Multivariate logistic regression was performed to adjust for potential confounders. The results showed that overweight/obese individuals had a 1.92-fold increased risk of infertility compared to those with normal nutritional status ($p = 0.045$). Inadequate dietary pattern emerged as an even stronger independent risk factor, with an adjusted OR of 3.31 ($p < 0.001$). These findings highlight that dietary behavior plays a critical role in reproductive health, beyond the impact of anthropometric status alone.

Table 3. Multivariate Logistic Regression Analysis

Variable	Adjusted OR	95% CI	p-value
Nutritional Status (Overweight/Obese vs Normal)	1.92	1.01–3.65	0.045
Dietary Pattern (Inadequate vs Adequate)	3.31	1.73–6.34	<0.001

Source: Primary data collected from reproductive-aged couples in Bantul District, (2025)

3.2 Discussion

The findings of this study demonstrate a statistically significant association between both nutritional status and dietary patterns with the incidence of infertility among reproductive-aged couples[7,8]. Inadequate dietary intake, as well as extremes in nutritional status underweight or overweight/obese emerged as critical determinants of reproductive dysfunction[9]. These results reinforce the notion that nutritional and dietary factors play a central role in human fertility[10]. A diverse, balanced, and nutrient-rich diet serves as the foundation for hormonal equilibrium and the optimal functioning of the reproductive system[8]. Previous studies have shown that adherence to healthy dietary patterns, such as the Mediterranean diet characterized by high consumption of vegetables, fruits, whole grains, lean proteins, and healthy fats enhances natural conception rates[11,12]. Diets high in saturated fats, refined sugars, and low in antioxidants have been linked to increased oxidative stress and systemic inflammation, which adversely affect gametogenesis and endometrial receptivity[13,14].

Micronutrient deficiencies, particularly in folate, iron, vitamin D, zinc, and selenium, have been associated with ovulatory dysfunction, poor embryo quality, and increased miscarriage risk[15,16]. In men, inadequate intake of antioxidants and vitamins C and E is linked to DNA fragmentation, reduced sperm motility, and altered morphology[17–19]. Dietary patterns also play a significant role in the pathophysiology of metabolic conditions underlying infertility, such as polycystic ovary syndrome (PCOS) and insulin resistance[20,21]. Diets high in simple sugars exacerbate hyperinsulinemia and contribute to androgen excess, leading to chronic anovulation. This aligns with our study findings, in which individuals with inadequate dietary patterns were 3.3 times more likely to be infertile than those with healthy eating habits[22,23].

Undernutrition and overnutrition negatively impact the reproductive endocrine axis. Underweight individuals often present with hypothalamic suppression due to low leptin and estrogen levels, resulting in functional hypothalamic amenorrhea. Longitudinal studies in low-income settings have documented higher rates of menstrual disturbances and infertility among women with chronic energy deficiency[23,24]. Overweight and obesity are known to disrupt reproductive function through peripheral conversion of androgens to estrogens in adipose tissue via aromatase activity, leading to negative feedback on gonadotropin secretion. Obesity also induces insulin resistance, elevates luteinizing hormone (LH) levels, and impairs follicular maturation and ovulation[25,26]. In males, obesity contributes to hypogonadism, oxidative stress, and deteriorating semen parameters, including reduced motility and abnormal morphology[27]. Cohort studies have further shown that obese women experience lower success rates in assisted reproductive technologies (ART), increased miscarriage rates, and higher obstetric complication risks.

Dietary patterns have a bidirectional relationship with nutritional status. Poor dietary quality over time contributes to abnormal body composition, whether through excessive caloric intake leading to obesity or restrictive intake resulting in underweight[28,29]. High-energy, nutrient-poor diets can lead to metabolically obese but malnourished individuals a state linked to inflammation, hormonal imbalance, and impaired gamete quality[29]. Experimental studies have found that dietary modifications can alter fertility markers within weeks, demonstrating that nutrition has both short- and long-term reproductive implications[5,30]. Dietary habits are not merely independent factors, but also mediators of nutritional status with direct impacts on fertility[31].

Nutritional imbalances affect fertility through oxidative stress, chronic inflammation, and epigenetic changes in genes involved in reproduction. Disruptions in sex hormones such as estrogen, progesterone, insulin, and leptin act as key mediators in the development of infertility[32,33]. Infertility can lead to profound psychosocial consequences including emotional distress, marital strain, and significant financial burdens due to prolonged treatment. At a population level, infertility impacts demographic structure and increases the burden on reproductive health services[34,35].

The findings of this study are consistent with a growing body of recent international evidence demonstrating a significant association between nutritional status, dietary patterns, and infertility outcomes. Recent studies have reported that both inadequate nutrient intake and imbalanced dietary patterns are significantly associated with increased risk of female infertility, particularly through disruptions in hormonal regulation and metabolic pathways[36]. Similarly, a systematic review and meta-analysis highlighted that overweight and obesity are strongly linked to infertility, while lifestyle interventions targeting weight reduction and dietary improvements can significantly enhance reproductive outcomes[37]. In line with our findings, large population-based analyses have also shown that metabolic abnormalities associated with obesity, including visceral adiposity, are independently associated with infertility risk among reproductive-aged women[38]. Furthermore, recent evidence confirms that dietary patterns play a crucial role in fertility, with healthy diets improving reproductive outcomes, whereas poor dietary quality exacerbates oxidative stress and inflammation that impair reproductive function. Notably, while previous studies have predominantly examined either nutritional status or dietary intake separately, the present study provides a more comprehensive perspective by integrating both dimensions within a community-based population. This integrated approach strengthens existing evidence and addresses important limitations in earlier research, particularly those relying on clinical samples or single-factor analyses, thereby offering a more holistic understanding of modifiable determinants of infertility[39].

These findings underscore the importance of incorporating dietary and nutritional interventions into the clinical management of infertility. Nutritional counseling, weight management, and micronutrient supplementation should be considered essential components of fertility treatment, particularly before initiating pharmacologic or assisted reproductive procedures[40–42]. Importantly, pregnancies achieved under optimal nutritional conditions are associated with favorable obstetric outcomes and improved fetal development. Children born to mothers with good nutritional status are at lower risk for intrauterine growth restriction, preterm birth, metabolic disorders, and cognitive impairments. This aligns with the “Developmental Origins of Health and Disease” (DOHaD) framework, highlighting how maternal nutrition shapes long-term health trajectories[13,43,44].

4. CONCLUSION

The findings of this study demonstrate that nutritional status and dietary patterns are significant determinants of infertility among reproductive-aged couples. Individuals with non-optimal nutritional status whether underweight or overweight/ obese as well as those with inadequate dietary intake, exhibited a significantly higher risk of infertility. Nutritional imbalances adversely affect hormonal regulation, oxidative stress, and the overall functioning of the reproductive system. These results reinforce the growing body of evidence that nutrition-focused approaches should be integrated into multidisciplinary strategies for infertility prevention and management. Optimizing nutritional status and improving dietary quality not only enhance the likelihood of conception but also contribute to better pregnancy outcomes and long-term offspring health. Therefore, evidence-based nutritional interventions should be considered a core component of reproductive healthcare services, both in clinical practice and in public health policy. Further prospective and interventional studies are warranted to confirm causal relationships and to evaluate the effectiveness of dietary modifications in improving fertility outcomes and pregnancy success.

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BIODATA PENULIS

Nama	:	Dr. Erna Yovi Kurniawati, S.ST., M.Tr.Keb
Tempat, Tangal Lahir	:	Bantul, 17 Mei 1987
Jenis Kelamin	:	Perempuan
Riwayat Pendidikan	:	Doktor Ilmu Kedokteran dan Kesehatan UNDIP
Instansi	:	Universitas Alma Ata
Alamat	:	Jl Brawijaya Jadan Tamantirto Bantul Yogyakarta
HP/WA	:	087739122352
Email	:	yovi.raharjanto@gmail.com
Judul Artikel	:	*Nutritional Status and Dietary Patterns as Determinants of Infertility Among Reproductive-Age Couples: A Cross-Sectional Analysis*

Nama	:	Lia Dian Ayuningrum
Tempat, Tangal Lahir	:	-
Jenis Kelamin	:	Perempuan
Riwayat Pendidikan	:	S2 Kebidanan
Instansi	:	Universitas Alma Ata
Alamat	:	Kasihan, Bantul, D.I Yogyakarta
HP/WA	:	+62 856-2922-278
Email	:	liadianayuningrum@almaata.ac.id
Judul Artikel	:	*Nutritional Status and Dietary Patterns as Determinants of Infertility Among Reproductive-Age Couples: A Cross-Sectional Analysis*