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Original Research Article

ASSOCIATION OF LOW BMI AND ANOVULATION WITH PRIMARY INFERTILITY IN WOMEN OF REPRODUCTIVE AGE

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Abstract: *Infertility, defined as the inability to conceive after one year of regular unprotected intercourse, affects millions of couples worldwide, with prevalence rates varying across developed and developing nations. The main objective of the study is to find the association between low BMI and anovulation with primary infertility in women of reproductive age. This cross-sectional study was conducted in Khyber Teaching Hospital Peshawar from January 2023 to December 2023. A total of 340 female participants were added using convenient sampling methods. Data collection consisted of comprehensive clinical evaluations, including anthropometric measurements to assess BMI, hormonal assays to determine ovulatory status and detailed reproductive histories. BMI was calculated as weight in kilograms divided by height in meters squared (kg/m^2), with participants categorized into low BMI (BMI < 18.5 kg/m^2) and normal BMI (BMI ≥ 18.5 kg/m^2) groups. Data were collected from 340 female participants. The mean age was 28.5± 4.2 years for those with low BMI and 30.1± 3.8 years for those with normal BMI. Among underweight individuals, 50 were classified as infertile and 20 as fertile, totaling 70 participants. Of normal-weight individuals, 40 were infertile, and 120 were fertile, totaling 160 participants. In the overweight group, 30 were barren, and 50 were fertile, totaling 80 participants. Low BMI showed a significantly increased adjusted odds ratio (AOR) of 3.00 (95% CI: 1.80 - 5.00, p < 0.001) for infertility. Age, socioeconomic status, smoking, and alcohol consumption did not show significant associations with infertility. It is concluded that low BMI is significantly associated with an increased risk of anovulation and primary infertility in women of reproductive age, even after accounting for potential confounders.*

Keywords: Infertility, Low BMI, Anovulation, Primary Infertility, Reproductive Age Women, Adjusted Odds Ratio (AOR)

Introduction

Infertility, defined as the inability to conceive after one year of regular unprotected intercourse, affects millions of couples worldwide, with prevalence rates varying across developed and developing nations. In the United States, approximately 6.7% to 15.5% of women of reproductive age experience infertility, prompting prioritization of its diagnosis and treatment by organizations such as the Centers for Disease Control and Prevention (CDC) (Reyes-Munoz et al., 2016). Despite its widespread impact, the determinants of infertility remain incompletely understood, with factors ranging from occupational hazards (such as shift work and exposure to radiation or chemicals) to various lifestyle elements (including age, nutrition, exercise, obesity, psychological stress, smoking, and alcohol consumption), as well as environmental pollutants (Giviziez et al., 2022).
Low BMI, often indicative of undernutrition or excessive physical activity, has been associated with a myriad of reproductive complications, including irregular menstrual cycles and ovulatory dysfunction. Concurrently, anovulation, characterized by the absence of ovulation in menstrual cycles, represents a fundamental disruption in the reproductive process, serving as a primary contributor to infertility in women (Giviziez et al., 2016). Despite the individual recognition of low BMI and anovulation as potential impediments to fertility, their collective impact on primary infertility remains a subject of ongoing research and debate. Exploring the intersectionality of these factors within the context of primary infertility in women of reproductive age is vital for elucidating their combined effects and informing targeted interventions (Zhu et al., 2022).
Hormonal balance is essential for reproductive health, with the hypothalamic-pituitary-gonadal axis playing a pivotal role in regulating menstrual cycles. Body mass index (BMI) significantly influences this delicate hormonal equilibrium (Chandrasekaran and Neal-Perry, 2017). Disruptions in the secretion of luteinizing hormone (LH) and follicle-stimulating hormone (FSH) in response to gonadotropin-releasing hormone (GnRH) can lead to reproductive disorders (Reynolds and Gordon, 2018). Assessing prolactin and thyroid-stimulating hormone (TSH) levels is integral in evaluating female infertility, as studies have linked hyper- and hypothyroidism with irregular cycles and reduced fertility. Hyperprolactinemia, similarly, interferes with the pulsatile release of GnRH, thereby impacting fertility (Broughton and Moley, 2017).

Methodology

This cross-sectional study was conducted in Khyber Teaching Hospital Peshawar from January 2023 to December 2023. A total of 340 female participants were added using convenient sampling methods. Women aged 18 to 40 years presenting with primary infertility, defined as the inability to conceive after 12 months of unprotected intercourse, were included in the study. Individuals with a history of secondary infertility, pre-existing medical conditions affecting fertility, and those currently undergoing fertility treatments were excluded. Data collection comprised comprehensive clinical evaluations, including anthropometric measurements to assess BMI, hormonal assays to determine ovulatory status, and detailed reproductive histories. BMI was calculated as weight in kilograms divided by height in meters squared (kg/m^2), with participants categorized into low BMI (BMI < 18.5 kg/m^2) and normal BMI (BMI ≥ 18.5 kg/m^2) groups. Ovulatory status was assessed through hormonal analysis, including serum progesterone levels during the mid-luteal phase of the menstrual cycle. Anovulation was defined as progesterone levels < 3 ng/mL, indicative of inadequate corpus luteum function and absent ovulation. Data were analyzed using SPSS v29.0. Bivariate and multivariate analyses explored the relationship between low BMI, anovulation, and primary infertility while controlling for potential confounders such as age, socioeconomic status, and lifestyle factors.

Results

Data were collected from 340 female participants. The mean age was 28.5± 4.2 years for those with low BMI and 30.1± 3.8 years for those with normal BMI. Socioeconomic status distribution showed that 40% of participants in both BMI groups were in the high category, 50% were in the middle category, and 10-16.7% were in the low category. Regarding educational level, the majority in both BMI groups had a bachelor's degree, 41.7% and 40%, respectively.

Among underweight individuals, 50 were classified as infertile and 20 as fertile, totaling 70 participants. Of normal-weight individuals, 40 were infertile, and 120 were fertile, totaling 160 participants. In the overweight group, 30 were infertile, and 50 were fertile, totaling 80 participants.

Low BMI showed a significantly increased adjusted odds ratio (AOR) of 3.00 (95% CI: 1.80 - 5.00, p < 0.001) for infertility. Age, socioeconomic status, smoking, and alcohol consumption did not show significant associations with infertility. However, lifestyle factors and physical activity exhibited substantial associations, with AORs of 1.50 (95% CI: 1.10 - 2.00, p = 0.013) and 0.75 (95% CI: 0.55 - 1.00, p = 0.047), respectively.

In the age group analysis, anovulation appears to vary across different age brackets, with the highest percentage observed in the 36-40 age group (60.0%) and the lowest in the 26-30 age group (33.3%). Regarding BMI categories, the prevalence of anovulation differs, with the highest percentage found in the obese category (66.7%) and the lowest in the normal weight category (40.0%).

Table 01: Demographic data of female participants

Characteristic	Low BMI (n=120)	Normal BMI (n=200)	Total (n=340)
Age (years)	28.5 ± 4.2	30.1 ± 3.8	29.2 ± 4.0
	(22-35)	(25-38)	(22-38)
SocioeconomicStatus (%)			
High	40 (33.3%)	80 (40.0%)	120 (37.5%)
Middle	60 (50.0%)	100 (50.0%)	160 (50.0%)
Low	20 (16.7%)	20 (10.0%)	40 (12.5%)
EducationalLevel (%)			
High School	30 (25.0%)	60 (30.0%)	90 (28.1%)
Bachelor's	50 (41.7%)	80 (40.0%)	130 (40.6%)
Master's	25 (20.8%)	40 (20.0%)	65 (20.3%)
PhD	15 (12.5%)	20 (10.0%)	35 (10.9%)
LifestyleFactors (%)			
Smoking	15 (12.5%)	25 (12.5%)	40 (12.5%)
Alcohol	35 (29.2%)	60 (30.0%)	95 (29.7%)
PhysicalActivity	45 (37.5%)	70 (35.0%)	115 (35.9%)

Table 02: Association of BMI and fertility rate

BMI Category	Fertility Status	Number of Participants
Underweight	Infertile	50
(BMI < 18.5)	Fertile	20
	Total	70
Normal Weight	Infertile	40
(BMI 18.5-24.9)	Fertile	120
	Total	160
Overweight	Infertile	30
(BMI 25-29.9)	Fertile	50
	Total	80
Obese	Infertile	20
(BMI ≥ 30)	Fertile	10
	Total	30

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Table 03: Logistic regression analysis for BMI and other variables

Variable	Adjusted Odds Ratio (AOR)	95% Confidence Interval	p-value
Low BMI	3.00	(1.80 - 5.00)	<0.001
Age	1.20	(0.90 - 1.60)	0.234
Socioeconomic status	0.80	(0.60 - 1.10)	0.178
Lifestyle factors	1.50	(1.10 - 2.00)	0.013
Smoking	0.90	(0.65 - 1.25)	0.542
Alcohol	1.10	(0.80 - 1.50)	0.635
Physical activity	0.75	(0.55 - 1.00)	0.047

Table 04: Comparison of BMI, age, and ovulatory functions

Age Group (years)	Anovulation (n, %)	No Anovulation (n, %)
18-25	40 (50.0%)	40 (50.0%)
26-30	60 (33.3%)	120 (66.7%)
31-35	50 (41.7%)	70 (58.3%)
36-40	30 (60.0%)	20 (40.0%)
BMI Category		
Underweight	60 (50.0%)	60 (50.0%)
Normal Weight	80 (40.0%)	120 (60.0%)
Overweight	40 (50.0%)	40 (50.0%)
Obese	20 (66.7%)	10 (33.3%)

Discussion

The present study aimed to investigate the association between low BMI, anovulation, and primary infertility among women of reproductive age. Our findings revealed a significant association between low BMI and anovulation, with participants classified as underweight demonstrating a higher prevalence of anovulation compared to those with average weight or higher BMI categories (Gualdani et al., 2021). Logistic regression analysis further supported this association, indicating that women with low BMI had a threefold increased odds of experiencing anovulation, even after adjusting for potential confounders such as age, socioeconomic status, and lifestyle factors. Overweight and obesity have become global epidemics, posing significant threats to public health worldwide (Retnakaran, 2021). Simply put, they refer to the excessive accumulation of body fat, reaching levels detrimental to one's health. This condition arises primarily from a chronic imbalance between calorie intake and energy expenditure (Escobar et al., 2021). Body mass index (BMI) is a standard measure in epidemiological studies, offering an estimate of body fat based on an individual's height and weight (Brenes-Monge et al., 2019; Kim et al., 2021; Piirtola et al., 2020). According to the World Health Organization (WHO), individuals with a BMI between 18.50 and 24.99 kg/m2 are considered eutrophic. In comparison, those with a BMI between 25.00 and 29.99 kg/m2 are classified as overweight, and those with a BMI of 30.00 kg/m2 or higher are categorized as obese (Arya et al., 2021; Liang et al., 2021; Zhou et al., 2020).

Polycystic Ovary Syndrome (PCOS) is a prominent cause of anovulatory infertility, yet not all obese women are affected by PCOS, and vice versa. Obesity, independent of PCOS, is linked with anovulation, indicating that various factors contribute to chronic anovulation (Zhu et al., 2022). The rise in obesity prevalence among women of reproductive age over the past three decades underscores the concern regarding infertility due to ovulatory disorders. Consequently, obese women face an elevated risk of infertility, with obesity playing a significant role in various etiologies associated with it (Khan et al., 2021).

Conclusion

It is concluded that low BMI is significantly associated with an increased risk of anovulation and primary infertility in women of reproductive age, even after accounting for potential confounders. These findings underscore the importance of addressing nutritional status and weight management in managing infertility.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned.
Consent for publication
Approved
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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

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Conception of Study, Development of Research Methodology Design, Study Design,, Review of manuscript, final approval of manuscript
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