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Association Between BMI and Leptin Levels in Women with Primary Infertility: A Cross-Sectional Study

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ABSTRACT

Background & Objective: Primary infertility affects a significant proportion of couples and is often attributed to female factors. Obesity, which is associated with increased levels of the hormone leptin, is a known risk factor for female infertility. The present study was conducted with aim to investigate the association between BMI and leptin levels in females with primary infertility.

Materials & Methods: This cross-sectional study was performed on 100 women with primary infertility at Al-Nuaman Hospital and Al-Salama private hospital from September 2022 to March 2023. The participants were divided into four groups: Group 1 (normal weight, fertile), Group 2 (overweight infertile), Group 3 (obese infertile), and Group 4 (severely obese infertile) women, each consisting of 25 participants, categorized based on their BMI: normal BMI (18.5–24.9 kg/m²), overweight BMI (25–29.9 kg/m²), obesity BMI (≥30 kg/m²), and severely obese BMI (35-40 kg/m²). The mean leptin levels were compared between the four groups using ANOVA, and the association between BMI and leptin levels was assessed using Pearson's correlation coefficient.

Results: There was a highly significant correlation between primary infertility and the parameters (BMI and leptin) (P<0.001) and showed a positive correlation between leptin and BMI.

Conclusion: It was shown that females with primary infertile and a high BMI have elevated serum leptin levels. This underscores the importance of weight management in addressing primary female infertility.

Keywords: Body Mass Index, Leptin, Primary Infertility, Female Infertility

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Introduction

Primary infertility is a prevalent reproductive issue that affects approximately 10-15% of couples worldwide **(1-4)**. In women, obesity is a recognized risk factor for infertility as it can lead to hormonal imbalances and ovulatory dysfunction **(5-7)**. Leptin is a hormone produced by adipose tissue that regulates energy balance and appetite **(8, 9)**. It also plays a critical role in the regulation of reproductive function, including the modulation of gonadotropin-releasing hormone (GnRH) secretion, which is essential for normal ovulation **(10)**. Leptin levels are known to be elevated in obesity, reflecting increased adipose tissue mass **(11-13)**. The heightened leptin levels in obesity may contribute to the development of ovulatory dysfunction, which is a common cause of female infertility **(14, 15)**. Several studies have explored the association between BMI and leptin levels in women with infertility. Some studies have reported a positive correlation between BMI and leptin levels in infertile women **(16-18)**. Moreover, most of these studies have focused on women with polycystic ovary syndrome (PCOS), a common cause of infertility in women with obesity **(19-23)**. Therefore, the relationship between BMI and leptin levels in primary infertile women with obesity remains unclear. To address this knowledge gap, the present study was conducted with aim to investigate the association between BMI and leptin levels in females with primary infertility.

Methods

This cross-sectional study was conducted at Al-Nuaman Hospital and Al-Salama Private Hospital from September 2022 to March 2023. We enrolled a total of 100 female participants aged 18-30 years and measured their BMI and serum leptin levels. Ethical approval for this study was granted by the Ethics Committee of the College of Medicine, Al-Iraqia University, Baghdad, Iraq (Approval Number: FM/SA/107), in accordance

with the ethical principles outlined in the Declaration of Helsinki. Prior to their inclusion in the study, all participants provided written informed consent. Participants were categorized into four groups: Group 1 (normal weight, fertile), Group 2 (overweight infertile), Group 3 (obese infertile), and Group 4 (severely obese infertile) women (n=25 in each group). The categorization was based on their BMI: normal BMI (18.5–24.9 kg/m²), overweight BMI (25–29.9 kg/m²), Obesity BMI (≥30 kg/m²), and severely obese BMI (35-40 kg/m²) **(23)**.

Five milliliters of venous blood were collected from all participants. The blood was drawn into gel tubes and left to coagulate on a bench for 20 min. Subsequently, it was centrifuged at 3000 rpm for 10 min. The obtained serum was stored in a refrigerator at 20°C for later analysis.

Statistical Analysis

Data were entered into the latest version of SPSS (Statistical Package for the Social Sciences) by the researcher. Descriptive statistics are presented in the form of "mean ± standard error." Group comparisons were made using the ANOVA method, and Pearson's correlation was employed to examine the association between the two variables. In all statistical analyses, P≤0.05 was considered statistically significant.

Results

The mean of parameters (BMI and Leptin), based on the collected data, are presented in Table 1. The results indicated that BMI and Leptin in the infertile patient groups showed a significant increase when compared to the normal fertile group (p=0.0001).

Table 1. BMI and leptin in the four study groups

Parameters	Mean±SD				P value
	G1 NO=25	G2 NO=25	G3 NO=25	G4 NO=25	
BMI (kg/m²)	20.91±0.24	27.81±0.26	30.71±0.27	35±0.15	0.0001
Leptin (ng/mL)	9.1±0.46	11.90±0.61	14.18±0.41	0.33±16.90	0.0001

*** G1: Fertile female with normal BMI, G2: Infertile with overweight, G3: Infertile with obesity, G4: Infertile with very obesity.**

The relationship between the parameters was analyzed using Pearson correlation analysis and the results are collectively presented in Table 2 and Figure 1. The results demonstrated a highly significant positive correlation between BMI and leptin.

Table 2. Correlations between variables in infertile groups

Parameters		BMI	Leptin
BMI	r	1	0.611*
	P-value		0.0001
Leptin	r	0.611**	1
	P-value	0.0001	

*** Correlation is significant at the 0.01 level, r=Pearson correlation coefficient**

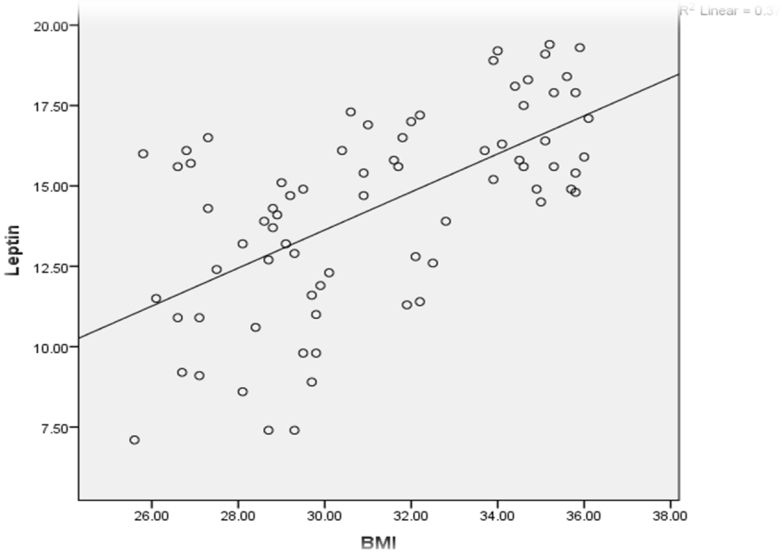


Figure 1. Positive Correlation between leptin level and BMI with fertility state

Discussion

The purpose of the present study was to investigate the association between BMI and leptin levels in women with primary infertility. The results showed that primary infertile females with a high BMI had significantly higher serum leptin levels compared to those with a normal BMI. Moreover, a positive correlation was found between BMI and serum leptin levels, indicating that the higher the BMI, the higher the levels of leptin. Some previous studies reported similar results and showed a positive association between BMI and leptin levels in women with infertility **(24, 25)**. Leptin is primarily produced by adipose tissue, and its levels are known to increase with adiposity **(26)**. Thus, the higher levels of leptin in women with a high BMI may reflect increased adipose tissue mass. Elevated leptin levels in obesity may contribute to the development of ovulatory dysfunction, which is a common cause of female infertility **(27, 28)**. Leptin has been shown to modulate the secretion of GnRH, which is essential for normal ovulation **(29-31)**. In women with obesity, elevated leptin levels may disrupt the GnRH pulse generator, resulting in ovulatory dysfunction and infertility **(32)**. Abdullah, et al. **(17)** showed a significant positive correlation between BMI and serum leptin levels in women with unexplained infertility **(17)**. Kargasheh, et al. **(18)** reported that a higher BMI was associated with higher serum leptin levels in women with a history of infertility **(18)**. The overall consensus is that obesity is linked to elevated leptin levels, which may contribute to ovulatory dysfunction and female infertility. The mechanisms underlying this association are complex and involve multiple pathways, including the modulation of GnRH secretion **(28-33)**, inflammation, and insulin resistance **(34, 35)**.

The present study has several strengths, including a relatively large sample size and the inclusion of only primary infertile females, which eliminates the confounding effects of previous infertility treatments. However, our study also has some limitations. Firstly, we did not assess other potential mediators of the association between obesity and infertility, such as insulin resistance or inflammation. Secondly, our study was cross-sectional, which does not allow for causal inferences to be made. Thus, further longitudinal studies are needed to confirm the relationship between BMI and leptin levels in females with primary infertility.

Conclusion

AS evidenced by the results of the present study, there was a significant increase in leptin levels with increasing BMI among female primary infertility patients. Additionally, a robust positive correlation was found between BMI and leptin. In conclusion, our study provides evidence of a positive association between BMI and leptin levels in primary infertile females. These findings underscore the significance of weight management in addressing primary female infertility. Further research is warranted to explore the role of leptin in the pathogenesis of female infertility and its potential as a therapeutic target.

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Conflict of Interest

The authors declared no conflicts of interest.

Authors' Contribution

Each author participated in data analysis, drafting, and revising of the manuscript, and consented to assume responsibility for all aspects of this project.

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References

1. Abdo NM, Ahmad H, Loney T, Zarmakoupis PN, Aslam I, Irfan S, et al. Characterization of Fertility Clinic Attendees in the Abu Dhabi Emirate, United Arab Emirates: A Cross-Sectional Study. Int J Environ Res Public Health. 2023;20(3):1692. [PMID] [PMCID] [DOI:10.3390/ijerph20031692]

2. Sadecki E, Weaver A, Zhao Y, Stewart EA, Ainsworth AJ. Fertility trends and comparisons in a historical cohort of US women with primary infertility. Reprod Health. 2022;19(1):13. [DOI:10.1186/s12978-021-01313-6] [PMID] [PMCID]

3. Maharlouei N, Morshed Behbahani B, Doryanizadeh L, Kazemi M. Prevalence and Pattern of Infertility in Iran: A Systematic Review and Meta-Analysis Study. Women's Health Bulletin. 2021;8(2):63-71.

4. Hussam F, Abdulhameed Khudair S, K. Alkhafaje W, S. Alnassar Y, M. Kaoud R, Najm Abed A, et al. A Cross-Sectional Study Regarding Infertility Among Women in Iraq. J Obstet Gynecol Cancer Res. 2022;8(1):47-52. [DOI:10.30699/jogcr.8.1.47]

5. Westerman R, Kuhnt A-K. Metabolic risk factors and fertility disorders: A narrative review of the female perspective. Reprod Biomed Soc Online. 2022;14:66-74. [PMID] [PMCID] [DOI:10.1016/j.rbms.2021.09.002]

6. Marinelli S, Napoletano G, Straccamore M, Basile G. Female obesity and infertility: outcomes and regulatory guidance. Acta Biomed. 2022;93(4):e2022278.

7. Salma U, Alanazi MF, Alshaikh ABA, Alruwail WMA, Alzamil THZ, Alruwaili SSB, et al. Risk Factors of Infertility in a Woman: A Case-Control Study. Malays J Public Health Med. 2022;22(2): 103-9.

8. Picó C, Palou M, Pomar CA, Rodríguez AM, Palou A. Leptin as a key regulator of the adipose organ. Rev Endocr Metab Disord. 2022;23(1):13-30. [DOI:10.1007/s11154-021-09687-5] [PMID] [PMCID]

9. Al-Hussaniy HA, Alburghaif AH, Naji MA. Leptin hormone and its effectiveness in reproduction, metabolism, immunity, diabetes, hopes and ambitions. J Med Life. 2021;14(5): 600-5. [DOI:10.25122/jml-2021-0153] [PMID] [PMCID]

10. Childs GV, Odle AK, MacNicol MC, MacNicol AM. The Importance of Leptin to Reproduction. Endocrinology. 2021;162(2):bqaa204. [PMID] [DOI:10.1210/endocr/bqaa204] [PMCID]

11. Perakakis N, Farr OM, Mantzoros CS. Leptin in Leanness and Obesity: JACC State-of-the-Art Review. J Am Coll Cardiol. 2021;77(6):745-60. [DOI:10.1016/j.jacc.2020.11.069] [PMID] [PMCID]

12. Izquierdo AG, Crujeiras AB, Casanueva FF, Carreira MC. Leptin, Obesity, and Leptin Resistance: Where Are We 25 Years Later? Nutrients. 2019;11(11):2704. [DOI:10.3390/nu11112704] [PMID] [PMCID]

13. Obradovic M, Sudar-Milovanovic E, Soskic S, Essack M, Arya S, Stewart AJ, et al. Leptin and Obesity: Role and Clinical Implication. Front Endocrinol. 2021;12:585887. [PMCID] [DOI:10.3389/fendo.2021.585887] [PMID]

14. Abella V, Scotece M, Conde J, Pino J, Gonzalez-Gay MA, Gomez-Reino JJ, et al. Leptin in the interplay of inflammation, metabolism and immune system disorders. Nat Rev Rheumatol. 2017;13(2):100-9. [DOI:10.1038/nrrheum.2016.209] [PMID]

15. Al Maskari MY, Alnaqdy AA. Correlation between Serum Leptin Levels, Body Mass Index and Obesity in Omanis. Sultan Qaboos Univ Med J. 2006;6(2):27-31.

16. Baig M, Azhar A, Rehman R, Syed H, Tariq S, Gazzaz ZJ. Relationship of Serum Leptin and Reproductive Hormones in Unexplained Infertile and Fertile Females. Cureus. 2019;11(12):e6524. [DOI:10.7759/cureus.6524]

17. Abdullah AA, Ahmed M, Oladokun A. Leptin levels in women with unexplained infertility: A systematic review and meta-analysis. World J Meta-Anal. 2022;10(1):37-45. [DOI:10.13105/wjma.v10.i1.37]

18. Kargasheh FB, Ansaripour S, Borumandnia N, Moradi N, Zandieh Z, Maleki M, et al. Association of leptin G2548A and leptin receptor Q223R polymorphisms and their serum levels with infertility and recurrent pregnancy loss in Iranian women with polycystic ovary syndrome. PLoS One. 2021;16(8):e0255920. [PMCID] [DOI:10.1371/journal.pone.0255920] [PMID]

19. Zuhair Abdul-Majeed Alkhwaja S, Jabir Edan B, Raad Muhi Z. Role of Serum Leptin Levels in Women with Primary Subfertility. Arch Razi Inst. 2022;77(5):1699-707.

20. Jalilian N, Haghnazari L, Rasolinia S. Leptin and body mass index in polycystic ovary syndrome. Indian J Endocrinol Metab. 2016;20(3):324-8. [DOI:10.4103/2230-8210.180005] [PMID] [PMCID]

21. Chakrabarti J. Serum leptin level in women with polycystic ovary syndrome: correlation with adiposity, insulin, and circulating testosterone. Ann Med Health Sci Res. 2013;3(2):191-6. [DOI:10.4103/2141-9248.113660] [PMID] [PMCID]

22. Hassan IT, Hussein EA, Abu Ragheef MA, Haddad RA, Khalil NS. Follicular and serum testosterone as a predictor of assisted reproductive technology outcomes in infertile polycystic ovarian syndrome patients. Eur Asian J Bio Sci. 2020;14(2):7315-9.

23. Ali IT, Haddad NIA, Hussein EA. Assessment of monocyte chemo-attractant protein-1 (MCP-1) and other biochemical parameters in Iraqi pregnant women. Iraqi J Sci. 2022;63(10):4152-62. [DOI:10.24996/ijs.2022.63.10.2]

24. Weir CB, Jan A. BMI Classification Percentile And Cut Off Points. Treasure Island: StatPearls Publishing; 2024.

25. Kumari P, Jaiswar SP, Shankhwar P, Deo S, Ahmad K, Iqbal B, et al. Leptin as a Predictive Marker in Unexplained Infertility in North Indian Population. J Clin Diagn Res. 2017;11(3):Qc28-Qc31. [DOI:10.7860/JCDR/2017/22444.9567] [PMID] [PMCID]

26. Dayer D, Nikbakht R, Kadkhodai Elyaderani M. Comparison of leptin concentrations between infertile women with polycystic ovary syndrome and fertile women. Iran J Reprod Med. 2013; 11(12):1033-4.

27. Martínez-Sánchez N. There and Back Again: Leptin Actions in White Adipose Tissue. Int J Mol Sci. 2020;21(17):6039. [DOI:10.3390/ijms21176039] [PMID] [PMCID]

28. Jéquier E. Leptin signaling, adiposity, and energy balance. Ann N Y Acad Sci. 2002;967:379-88. [DOI:10.1111/j.1749-6632.2002.tb04293.x] [PMID]

29. Shyam Pyari J, Apala P. Leptin and Female Reproductive Health. In: Hassan MH, editor. Weight Management. Rijeka: IntechOpen; 2021. p. Ch. 3.

30. Pérez-Pérez A, Sánchez-Jiménez F, Maymó J, Dueñas JL, Varone C, Sánchez-Margalet V. Role of leptin in female reproduction. Clin Chem Lab Med. 2015;53(1):15-28. [PMID] [DOI:10.1515/cclm-2014-0387]

31. Sharma Y, Galvão AM. Maternal obesity and ovarian failure: is leptin the culprit? Anim Reprod. 2023;19(4):e20230007. [PMCID] [DOI:10.1590/1984-3143-ar2023-0007] [PMID]

32. Quennell JH, Mulligan AC, Tups A, Liu X, Phipps SJ, Kemp CJ, et al. Leptin indirectly regulates gonadotropin-releasing hormone neuronal function. Endocrinology. 2009;150(6): 2805-12. [DOI:10.1210/en.2008-1693] [PMID] [PMCID]

33. Kelesidis T, Kelesidis I, Chou S, Mantzoros CS. Narrative review: the role of leptin in human physiology: emerging clinical applications. Ann Intern Med. 2010;152(2):93-100. [DOI:10.7326/0003-4819-152-2-201001190-00008] [PMID] [PMCID]

34. Daghestani MH, Daghestani M, Daghistani M, El-Mazny A, Bjørklund G, Chirumbolo S, et al. A study of ghrelin and leptin levels and their relationship to metabolic profiles in obese and lean Saudi women with polycystic ovary syndrome (PCOS). Lipids Health Dis. 2018; 17(1):195. [DOI:10.1186/s12944-018-0839-9] [PMID] [PMCID]

35. Liu S, Hong L, Lian R, Xiao S, Li Y, Diao L, et al. Transcriptomic Analysis Reveals Endometrial Dynamics in Normoweight and Overweight/Obese Polycystic Ovary Syndrome Women. Front Genet. 2022;13:874487. [PMID] [DOI:10.3389/fgene.2022.874487] [PMCID]

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