Original Article

The diagnostic value of transvaginal ultrasonography in female infertility: A cross-sectional analysis

Vidhina Gupta, Harsh Kumar, Simran Gupta, Pramod Kumar

Department of Radiodiagnosis, Rohilkhand Medical College and Hospital, Bareilly, Uttar Pradesh, India

Corresponding Author:
Dr. Vidhina Gupta, Rohilkhand Medical College and Hospital, Bareilly, Uttar Pradesh, India.
E-mail: randomvidhz@gmail.com

Received: 15-03-2024
Accepted: 14-04-2024

How to cite this article:
Gupta V, Kumar H, Gupta S, Kumar P. The diagnostic value of transvaginal ultrasonography in female infertility: A cross-sectional analysis. Int J Adv Integ Med Sci 2024;9(1):22-28.

Source of Support: Nil,
Conflicts of Interest: None declared.

Background: Female infertility affects 40% of couples, with ovulatory dysfunction and tubal factor infertility being the leading causes. Transvaginal sonography (TVS) is a safe, non-invasive, and cost-effective diagnostic tool for evaluating female infertility. **Objectives:** The objectives of the study are to assess the role of TVS in evaluating female infertility and identify common reproductive health issues in infertile women. **Materials and Methods:** This cross-sectional study included 80 women with infertility complaints who underwent TVS at Rohilkhand Medical College and Hospital, Bareilly, from November 2022 to October 2023. **Results:** The study found a high prevalence of infertility in women aged 20–25 years (35%). Secondary infertility (58.75%) was more common than primary infertility (41.25%). The ovaries (43.63%) and uterus (38.18%) were the most commonly affected organs. Common diagnostic findings included fibroids/adenomyosis (15%), ovarian cysts (10%), polycystic ovarian morphology (8.75%), and pelvic inflammatory disease (7.5%). **Conclusion:** TVS is a valuable diagnostic tool for evaluating female infertility, revealing a range of underlying reproductive health issues. The study highlights the importance of early diagnosis and treatment of female infertility.

KEY WORDS: Female infertility, ovulatory dysfunction, reproductive health, transvaginal sonography, tubal factor infertility

INTRODUCTION

Transvaginal sonography (TVS) is a relatively recent inclusion among the diagnostic methodologies accessible for examining the female pelvis. The instrument in question is an affordable, efficient, secure, and dependable solution for addressing diagnostic challenges in women experiencing gynecological symptoms.[1,2] Infertility affects 8–12% of couples worldwide,[3] accounting for 50% of gynecology clinic visits.[4] Females contribute to 40% of cases, with an additional 20% due to combined factors. Main causes include ovulatory dysfunction (30%) and tubal factor infertility (25%).[5] Infertility has significant emotional, physical, and financial impacts on families. A thorough assessment is crucial to identify potential anatomical issues requiring intervention.[6,7] Ultrasonography (US) is a crucial tool in evaluating female infertility, a complex and multifactorial issue. US is a safe, non-invasive, and cost-effective first-line investigation that helps gynecologists identify causes of infertility and guide treatment.[8] Ultrasonographic limitations include limited field of view, subjective errors, interference by obesity or by gaseous bowel loops, suboptimal visualization of fallopian tubes and broad ligament, failure to delineate small ovaries, and inability to obtain images in the surgical plane.[6]

So far, there is a lack of evidence about any detrimental biological consequences associated with transvaginal US on patients, oocytes, or ultrasound operators, as stated by the

Access this article online	
Website: www.ijaims.in	**Quick Response code**

American Institute of Ultrasonography in Medicine.[9] The preferred diagnostic method for assessing female infertility as an initial investigative measure is currently transvaginal US. It is recommended that clinicians incorporate this technique into their clinical practice, in conjunction with pelvic examination, while examining patients in the consulting chamber.[10]

The incidence of infertility and the need to undergo assisted reproductive techniques to conceive has been increasing in the recent times due to lifestyle changes, late marriages, and late family planning. With the advancement in assisted reproductive techniques, better and early diagnosis of the cause of female infertility can help patients access their options which can ultimately result in better reproductive outcomes. Furthermore, knowing about the common factors of female infertility prevalent in our region can help our doctors in better understanding and better treatment of those causes. Due to the modality's subject-dependent nature, there is always scope for betterment of technique and in improving the diagnostic precision which may fill in the lacuna that is currently present in diagnosing female infertility. Thus, the motive of this study to assess the role of TVS in evaluating female infertility and identify common reproductive health issues in infertile women.

MATERIALS AND METHODS

This cross-sectional study was conducted at the department of radio-diagnosis, Rohilkhand Medical College and Hospital, Bareilly, from November 01, 2022, to October 31, 2023. The study included a sample of 80 patients, calculated using the formula 4pq/L2, with a prevalence (p) of 4%, allowable error (L) of 5%, and a resulting sample size of 61.44, rounded up to 80 for convenience.

The study included women within the reproductive age group who presented with complaints of infertility and were referred to the radiology department of Rohilkhand Medical College and Hospital, Bareilly, for transvaginal US from the department of obstetrics and gynecology. Previously diagnosed cases of infertility requiring follow-up with radiological investigations were also included. However, unmarried females, those with huge abdomino-pelvic masses, and individuals who refused to participate in the study were excluded. The study utilized real-time ultrasound scanners, specifically the Samsung HS 70 and Samsung HS 40, equipped with a 7.5–12 MHz transvaginal probe, to scan the patients.

The patient was first explained the procedure and an informed consent was taken. Patient was then asked to void urine before commencing the examination and told to lie on the couch in supine position with legs flexed at the knee. Detailed menstrual, obstetric, and medical histories of each patient were taken before the procedure. For performing the transvaginal ultrasound (TVUS), we prepared the intraluminal transducer probe by applying standard coupling gel followed by a condom which was again lubricated with coupling gel before inserting into the vagina. In case of retroverted uterus, the transducer probe was gently introduced into the posterior fornix of vagina but in case of anteverted uterus, it was introduced into anterior fornix of vagina. Now, the complete pelvis was evaluated to diagnose any possible.

Data were entered in the Statistical Package for the Social Sciences licensed version 23.0. Descriptive study was done by calculating proportions, means, and standard deviation. Appropriate statistical tests were applied. $P < 0.05$ was considered significant.

RESULTS

The study examined the distribution of infertility across different age groups among 80 women, presenting the findings in Table 1. The data revealed that the highest percentage of infertility was observed in the youngest age group, 20–25 years, accounting for 35% of the cases. The prevalence of infertility gradually decreased with increasing age: 28.75% of the participants were aged 26–30 years, followed by 21.25% in the 31–35 age group, 10% in the 36–40 age group, and the lowest prevalence was found in the 41–45 age group at 5%. The mean age of the participants was 28.40 years with a standard deviation of 6.54, indicating a concentration of infertility cases in the younger segments of the study population.

The types of infertility were also analyzed, with secondary infertility (58.75%) being more common than primary infertility (41.25%) [Table 2]. The organs involved in infertility were identified, with the ovaries (43.63%) and uterus (38.18%) being the most commonly affected [Table 3]. Ovarian volume was also assessed, with 72.5% of women having normal volumes, 23.75% having high volumes potentially indicative of polycystic ovarian syndrome (PCOS), and 3.75% having low volumes potentially indicative of ovarian insufficiency. The study also examined follicle number, uterus size, endometrial thickness, fluid in the pouch of Douglas (POD), and diagnostic findings, revealing a range of underlying reproductive health issues [Tables 4 and 5]. Among 80 infertile females, diagnostic findings revealed a range of reproductive health issues [Table 6]. Key findings included 33.75% with normal results, 15% with fibroids/adenomyosis, 10% with ovarian cysts, 8.75% with polycystic ovarian morphology, 7.5% with pelvic inflammatory disease (PID), and smaller percentages with endometriosis/

Table 1: Describing the percentage of infertile females based on age group

Age	*n*	%
20–25	28	35
26–30	23	28.75
31–35	17	21.25
36–40	8	10
41–45	4	5
Mean±SD	28.40±6.54	
Total	80	100.0

Table 2: Describing the percentage of infertile females based on type of infertility

Type of fertility	*n*	%
Primary	33	41.25
Secondary	47	58.75
Total	80	100.0

Table 3: Describing the percentage of infertile females based on organ involved

TVS finding	*n*	%
Uterus	21	38.18
Ovaries	24	43.63
Fallopian tubes	4	07.27
Cervix	2	03.63
Peri-uterine/peri-adnexal	4	07.27
Total	55	100.0

TVS: Transvaginal sonography

Table 4: Describing the percentage of infertile females based on various parameters

Parameters	*n*	%
Ovarian volume		
Normal	58	72.5
High	19	23.75
Low	03	3.75
Number of follicles		
Normal	71	88.75
Increased	06	7.5
Decreased	03	3.75
Uterus size		
Normal	62	77.5
Bulky	17	21.25
Absent	01	1.25
Fluid in POD		
Present	18	22.5
Absent	62	77.5

POD: Pouch of Douglas

Table 5: Describing the mean endometrial thickness among infertile females

Endometrial thickness	Mean/*n*	SD/%
Measured value	5.81	2.89
Indistinct	12	15.0
Absent	01	1.25

Table 6: Describing the percentage of infertile females based on diagnosis

Diagnosis	*n*	%
Normal findings	27	33.75
Fibroid/adenomyosis	12	15
Endometrial polyp	2	2.5
Congenital uterine anomaly	1	1.25
Cervicitis	4	5
PID	6	7.5
Tubo-ovarian mass	2	2.5
PCOM	7	8.75
Ovarian cyst	8	10
Endometriosis/endometrioma	4	5
Hematometra/pyometra	1	1.25
Low ovarian reserve	1	1.25
Endometrial hyperplasia	2	2.5
Hydrosalpinx	2	2.5
Cervical mass	1	1.25
Total	80	100.0

PCOM: Polycystic ovarian morphology, PID: Pelvic inflammatory disease

Table 7: Describing the percentage of infertile females based on type of fibroid

Type of fibroid	*n*	%
Submucosal	1	6.67
Intramural	3	20.00
Subserosal	2	13.33
Adenomyotic changes	9	60.00
Total	15	100.0

endometrioma, cervicitis, endometrial polyps, tubo-ovarian masses, and uterine anomalies [Table 6]. Fibroid-related diagnoses were also analyzed, with adenomyotic changes being the most common (60%) [Table 7]. Finally, the study compared reproductive health diagnoses between primary and secondary infertility, highlighting differences in the distribution of conditions [Table 8 and Figures 1-3].

DISCUSSION

This study used TVUS to investigate infertility in 80 reproductive-age women, examining the uterus, ovaries, fallopian tubes, and pelvis to identify underlying causes and improve diagnosis and management of female reproductive health disorders and found that infertility was most prevalent among women aged 20–25 years (35%), with a steady decline in cases with increasing age. The majority of infertility cases (65%) were found in women under 30 years old. The mean age of participants was 28.40 years, indicating a concentration of infertility cases in younger women. Infertility cases decreased significantly in women over 35 years old. It is evident from the literature that a female is most fertile within age 24 and diminishes after 30, with pregnancy occurring rarely after age 50.[11] However, as similar to findings of the present study, multiple researchers in their respective studies observed higher infertility rates due to varied etiological factors in the young reproductive-age women of about 20–25 years.[12-14]

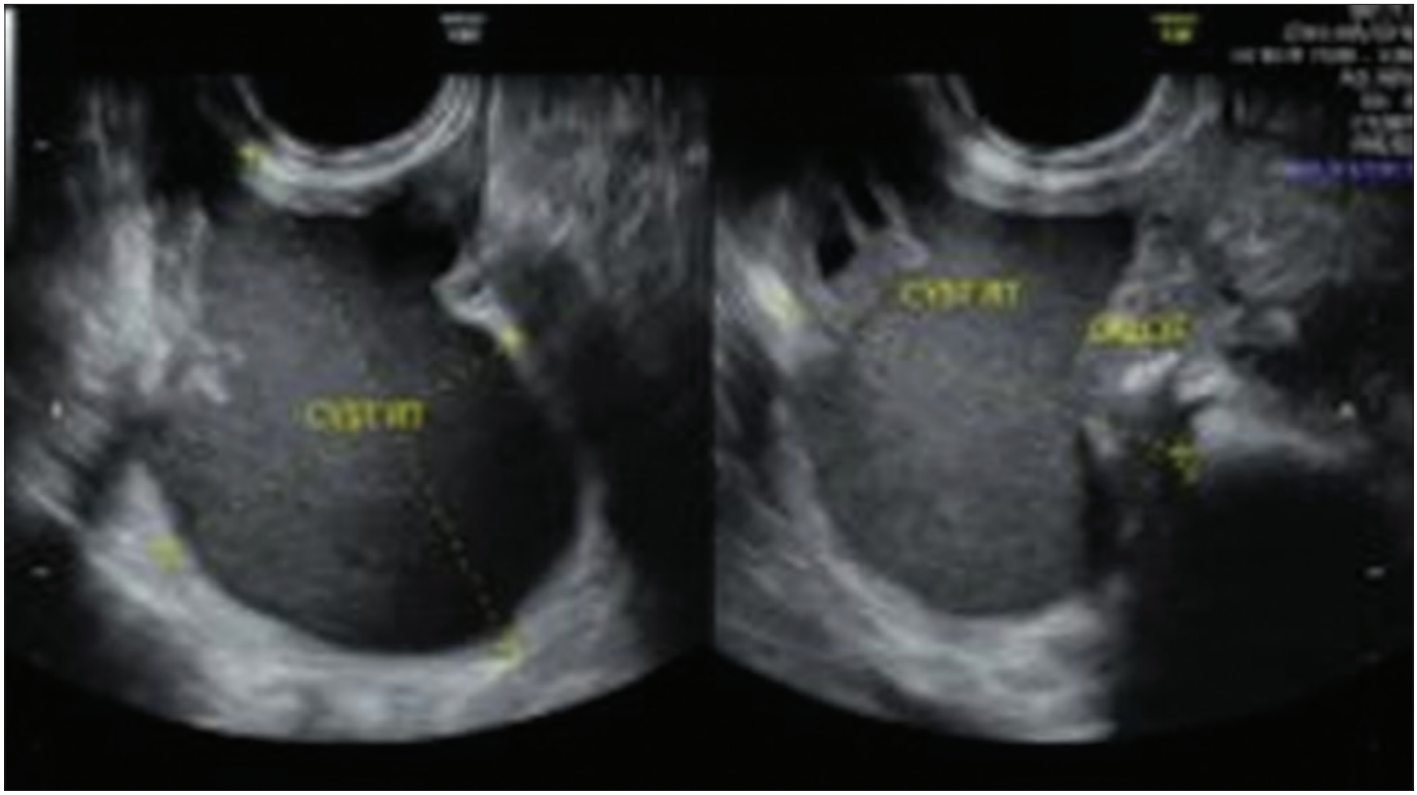

Figure 1: A well-defined unilocular cystic lesion with low-level echoes (ground glass appearance) in the adnexa suggesting endometrioma

Table 8: Describing the study groups as per primary and secondary infertility status

Diagnosis	Primary	%	Secondary	%
Normal findings	10	12.5	12	15.0
Fibroid/adenomyosis	5	6.3	9	11.3
Endometrial polyp	0	0.0	2	2.5
Congenital uterine anomaly	1	1.3	0	0.0
Cervicitis	2	2.5	4	5.0
PID	3	3.8	4	5.0
Tubo-ovarian mass	0	0.0	2	2.5
PCOM	5	6.3	1	1.3
Ovarian cyst	6	7.5	3	3.8
Endometriosis/endometrioma	1	1.3	3	3.8
Hematometra/pyometra	0	0.0	1	1.3
Low ovarian reserve	0	0.0	1	1.3
Endometrial hyperplasia	1	1.3	1	1.3
Hydrosalpinx	0	0.0	2	2.5
Cervical mass	0	0.0	1	1.3
Total	34	42.5	50	57.5

PCOM: Polycystic ovarian morphology, PID: Pelvic inflammatory disease

In this study, secondary infertility (58.75%) was more prevalent than primary infertility (41.25%). This aligns with the findings of Kolade-Yunusa *et al*.[7] but contrasts with findings by Hussain and Das[2] and Ferdows *et al*.[15] TVS results showed ovarian damage in 43.63% of cases, uterine damage in 38.18%, and less commonly, peri-uterine/peri-adnexal and fallopian tube damage (7.27%), and cervical involvement (3.63%). These findings support previous research by Hussain and Das,[2] Okeke *et al*.,[6] and Steinkeler *et al*.[16] which identified ovarian, tubal, and uterine issues as the main causes of infertility.

In a study of 80 infertile females, TVS results revealed that 72.5% had normal ovarian volumes, 23.75% had elevated volumes (potential PCOS), and 3.75% had low volumes (potential ovarian insufficiency), highlighting the importance of TVS in diagnosing ovarian-related infertility. These results may show significant overlap with normal ovarian ranges. In

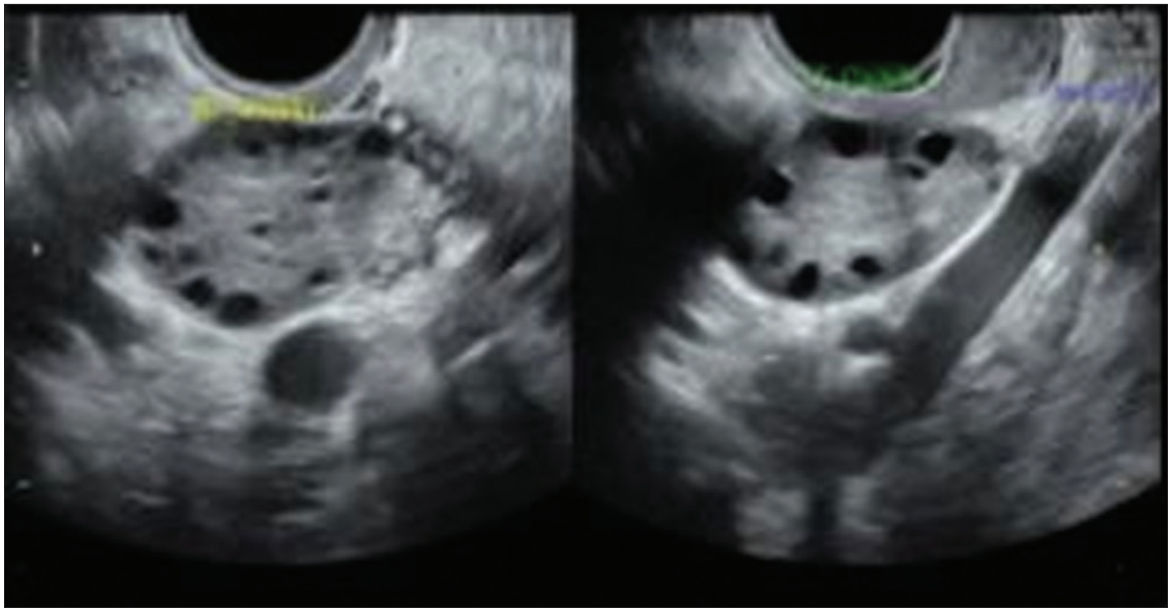

Figure 2: Bilateral bulky ovaries with multiple small peripherally arranged follicles and central echogenic stroma suggesting polycystic ovarian morphology

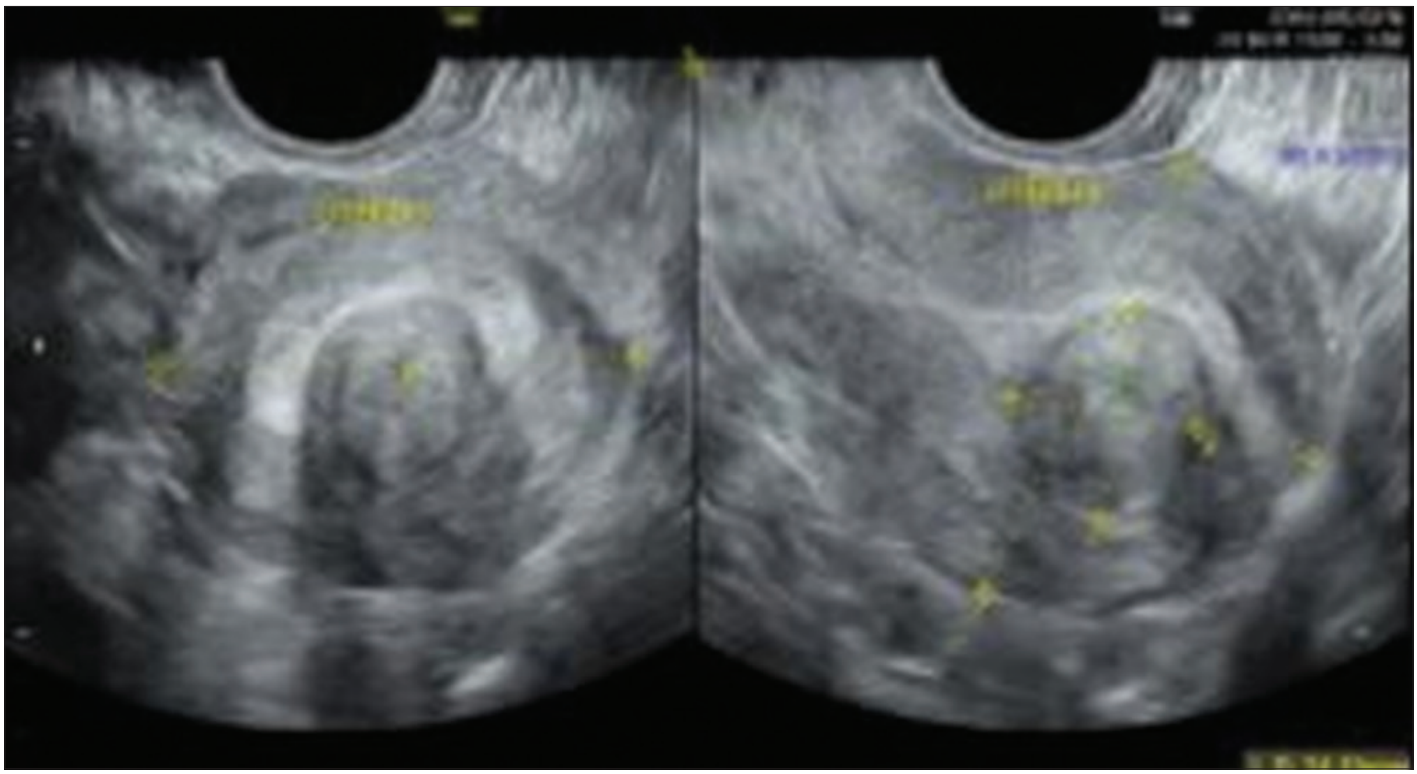

Figure 3: A well-defined heterogeneously hypoechoic lesion in the endometrial cavity suggesting submucosal fibroid

their study, Ferdows *et al*.[15] found that the most common TVS finding was PCOS, along with its varied presentations and ovarian volume.

A summary of the follicle number distribution among the 80 infertile female participants was evaluated in the study. 88.75% of the samples showed a normal number of follicles. A lower percentage (7.5%) had more follicles than normal, which might be related to diseases such as PCOS. On the other hand, just 3.75% of the subjects had fewer follicles, which would suggest a lower ovarian reserve. TVS is used to monitor the development of ovarian follicles.[6] The follicle count is one of the important indicators of determining ovarian biophysical profile.[15]

A study of 80 infertile females found variations in uterine size, with 77.5% having normal-sized uteruses, 21.25% having bulky uteruses (potential adenomyosis or fibroids), and 1.25% having absent uteruses. In addition, the study revealed significant

variations in endometrial thickness, with a mean of 5.81 mm and 15% of subjects having unclear endometrial layers, highlighting the importance of uterine evaluation in infertility diagnosis. US can effectively measure endometrial thickness and fluctuations, crucial for successful implantation, and pregnancy maintenance.[17,18] Endometrial thickness in premenopausal women varies throughout the menstrual cycle, ranging from 3–5 mm to 6–12 mm, while in postmenopausal women on hormone therapy, a thickness of up to 5 mm is considered normal. Abnormal thickness or irregularities can indicate adenomyosis. Endometrial thickness is a crucial factor in assisted reproductive methods, and monitoring and optimization are essential for successful infertility treatments and healthy pregnancies.[19]

Among 80 infertile females, 22.5% had fluid in the POD, potentially indicating endometriosis, ovarian cysts, or PID. The majority (77.5%) had no POD fluid, suggesting the absence of acute symptoms. POD fluid analysis is crucial for diagnosing and understanding infertility-related issues.[20,21]

Among 15 infertile women with fibroid-related issues, 60% had adenomyotic alterations, 20% had intramural fibroids, 13.33% had subserosal fibroids, and 6.67% had submucosal fibroids. Adenomyotic alterations, which affect fertility, were the most prevalent. This distribution highlights the significant impact of fibroid-related diagnoses on female infertility.[22] Adenomyosis is linked to infertility, most likely as a result of decreased uterine contractility, which is necessary for controlled sperm passage into the uterus. Furthermore, it has been discovered that adenomyosis is linked to decreased chances of both continued pregnancy and embryo implantation.[23]

Among 80 infertile females, 42.5% had primary infertility (never pregnant) and 57.5% had secondary infertility (trouble conceiving after one or more pregnancies). Secondary infertility cases had higher rates of normal results (15%) and fibroids/adenomyosis (11.3%), while primary infertility cases had higher rates of ovarian cysts (7.5%). These findings of the present study are in line with past research done by Kolade-Yunusa *et al*.[7] Remarkably, diseases including hydrosalpinx, tubo-ovarian masses, and endometrial polyps were only documented in secondary infertile women, suggesting possible problems following childbirth.

CONCLUSION

A study on infertility found that secondary infertility (difficulty conceiving after a previous pregnancy) was more common than primary infertility (difficulty conceiving without a previous pregnancy). The research highlighted that ovarian and uterine pathologies, such as abnormal ovarian volumes, fibroids, adenomyosis, and ovarian cysts, were prevalent among participants. However, a significant number of women showed normal anatomical findings, suggesting that infertility can be influenced by factors beyond detectable anatomical issues. The study also identified potential indicators of pelvic inflammatory conditions and endometrial receptivity issues. The findings emphasize the need for a comprehensive approach to fertility treatment, integrating advanced reproductive technologies and personalized medical strategies, and underscore the importance of understanding individual patient needs to improve fertility outcomes.

REFERENCES

1. Sokalska A, Timmerman D, Testa AC, Van Holsbeke C, Lissoni AA, Leone FPG, *et al*. Diagnostic accuracy of transvaginal ultrasound examination for assigning a specific diagnosis to adnexal masses. Ultrasound Obstet Gynecol 2009;34:462-70.
2. Hussain NB, Das RR. Transvaginal ultrasound findings among the women presenting with infertility. Chatt Maa Shi Hosp Med Coll J 2018;16:31-4.
3. Inhorn MC. Global infertility and the globalization of new reproductive technologies: Illustrations from Egypt. Soc Sci Med 2003;56:1837-51.
4. Oguntoyinbo AE, Aboyeji AP. Hysterosalpingography (HSG) findings: Of infertile patients in ilorin. Trop J Obstet Gynaecol 2012;29:118-25.
5. Kremer JA. Ultrasound and Infertility: Pathenon Publishing, Lancs, UK, 2000, Hardcover, 302 pp., $78.00; ISBN: 1-85070-620-4. Edited by S. Kupesic and D. de Ziegler. Eur J Obstet Gynecol Reprod Biol 2000;93:225.
6. Okeke TC, Agwuna KK, Ezenyeaku CC, Ikeako LC. Application of ultrasonography in female infertility: A comprehensive review. Int J Reprod Contracept Obstet Gynecol 2015;4:1246-56.
7. Kolade-Yunusa HO, Abdullahi HI, Salaam AJ. Evaluation of infertile women using transvaginal ultrasound in a tertiary health facility. Jos J Med 2019;13:12-20.
8. Rastogi R. Role of imaging in female infertility [Dr. K.M. Rai memorial oration award]. Indian J Radiol Imaging 2010;20:168-73.
9. Fowlkes JB, Bioeffects Committee of the American Institute of Ultrasound in Medicine. American Institute of Ultrasound in Medicine consensus report on potential bioeffects of diagnostic ultrasound: Executive summary. J Ultrasound Med 2008;27:503-15.
10. Bora R, Malhotra Bora N. Transvaginal sonography in infertility. Donald Sch J Ultrasound Obstet Gynecol 2013;7:462-74.
11. Mustafa M, Hadi J, Iiizam E, Sani A. Male and female infertility: Causes, and management. IOSR J Dent Med Sci 2019;18:27-32.
12. Homer HA, Li TC, Cooke ID. The septate uterus: A review of management and reproductive outcome. Fertil Steril 2000;73:1-14.
13. Giudice LC, Kao LC. Endometriosis. Lancet 2004;364:1789-99.
14. Wallach EE, Vlahos NF. Uterine myomas: An overview of development, clinical features, and management. Obstet Gynecol 2004;104:393-406.
15. Ferdows JA, Jahan I, Joty FS, Jahan R, Susan ZS, Ghani A. Role of transvaginal ultrasound in infertility: Experience at a tertiary care hospital in Dhaka city. J Sci Found 2018;15:41-7.
16. Steinkeler JA, Woodfield CA, Lazarus E, Hillstrom MM. Female infertility: A systematic approach to radiologic imaging

and diagnosis. Radiographics 2009;29:1353-70.
17. Bassil S. Changes in endometrial thickness, width, length and pattern in predicting pregnancy outcome during ovarian stimulation in *in vitro* fertilization. Ultrasound Obstet Gynecol 2001;18:258-63.
18. Fanchin R. Assessing uterine receptivity in 2001: Ultrasonographic glances at the new millennium. Ann N Y Acad Sci 2001;943:185-202.
19. Mogavero G, Sheth S, Hamper UM. Endovaginal sonography of the nongravid uterus. Radiographics 1993;13:969-81.
20. AIUM Practice parameter for the performance of an ultrasound examination of the female pelvis. J Ultrasound Med 2020;39:E17-23.
21. Guile SL, Mathai JK. Ovarian torsion. In: StatPearls. Treasure Island, FL: StatPearls Publishing; 2023. Available from: http://www.ncbi.nlm.nih.gov/books/NBK560675 [Last accessed on 2023 Sep 24].
22. Matalliotakis IM, Katsikis IK, Panidis DK. Adenomyosis: What is the impact on fertility? Curr Opin Obstet Gynecol 2005;17:261-4.
23. Kunz G, Beil D, Huppert P, Noe M, Kissler S, Leyendecker G. Adenomyosis in endometriosis--prevalence and impact on fertility. Evidence from magnetic resonance imaging. Hum Reprod 2005;20:2309-16.