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Comparison of the Relevance of Hysterosalpingography and Ultrasonography in the Management of Infertility Among Women of Reproductive Age In Rivers State, Nigeria

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ABSTRACT

Studies have shown that women of childbearing age in sub-Saharan Africa who desire to have children are facing higher rates of secondary infertility compared to the global average. This study aims to evaluate the significance of hysterosalpingography (HSG) and ultrasonography (US) in the treatment of infertility among women of reproductive age in Rivers State, Nigeria, by examining the findings from HSG and US regarding the myometrium, endometrium, ovaries, and fallopian tubes of the participants. The study used a Mindray ultrasound machines, with transducers (probes) operating at frequencies of 3.5MHz-7MHz and 5-12MHz (3C5A and L13-3), along with ultrasound gel. Data analysis was conducted using Microsoft Excel version 16 and SPSS (Statistical Package for the Social Sciences) version 22.

The findings related to the endometrium indicate a moderate level of agreement between US and HSG. The discrepancies primarily occurred in instances where US identified focal intracavitary lesions that were not clearly visible on HSG, or where HSG indicated an irregular cavity contour without a corresponding discrete correlate on US. Additionally, myometrium findings demonstrated a fair to moderate level of agreement.

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US was found to be superior in identifying leiomyomas and features indicative of adenomyosis, while HSG only revealed abnormalities indirectly when the uterine cavity was distorted. The ovarian findings showed a poor level of agreement between US and HSG. US, particularly transvaginal ultrasound, effectively visualized ovarian morphology and detected functional cysts or masses, whereas HSG had minimal diagnostic value for ovarian pathology. There was a significant level of agreement between both imaging modalities in assessing fallopian tube patency or blockage, with HSG remaining the gold standard for evaluating tubal patency. In summary, US offered a more comprehensive evaluation of the endometrium, myometrium, and ovaries, while HSG proved to be the most effective for assessing fallopian tube patency. The complementary functions of these imaging methods underscore the importance of their incorporation in fertility assessments.

***Keywords*:** Hysterosalpingography (HSG), Ultrasonography (US), Endometrium, Myometrium, Ovaries, Fallopian Tube

1. INTRODUCTION

Infertility is defined as failure to conceive after 12 months of unprotected intercourse. This affects about 180 million people worldwide and up to one in six couples [1]. Rates vary widely, reaching particularly high levels in developing regions, including sub-Saharan Africa, where strong cultural expectations around childbearing often lead to stigma and emotional distress, especially for women [2-4].

In Nigeria, the prevalence of primary infertility is 5 % and secondary infertility is 8 % [5], with female factors such as tubal blockage, uterine abnormalities, and ovarian dysfunction contributing significantly [6]. Studies reveal a high prevalence of secondary infertility and abnormalities such as tubal occlusion and fibroids among women undergoing hysterosalpingography (HSG) in Nigeria [7-9].

Women are frequently blamed for marital infertility in many African societies, leading to social marginalization. This underscores the need for accurate, accessible diagnostic methods [10, 11].

Imaging plays a central role in evaluating female infertility. HSG has long been used to assess uterine and tubal conditions, but it involves radiation, discomfort, and limitations in evaluating the ovaries and myometrium. Ultrasonography, including transvaginal scans, saline infusion sonohysterography (SIS), and hysterosalpingogram-contrast sonography, offers a less invasive, radiation-free alternative with comparable diagnostic accuracy and better patient comfort [12-14].

Although MRI and endoscopic procedures provide superior diagnostic detail, they are often inaccessible or too costly in many African settings [15]. Thus, HSG and US remain the most practical options. International guidelines from international guidelines from the European

Society of Human Reproduction and Embryology (ESHRE) and the the American Society for Reproductive Medicine (ASRM) recognize both HSG and hysterosalpingo-contrast sonography **(**HyCoSy) as effective first-line methods for assessing tubal patency, with studies showing similar outcomes [16].

Despite this, reliance on US and HSG persists in resource-limited areas like Rivers State, highlighting the need for local comparative studies that evaluate the full range of reproductive structures, not just tubal patency, to guide optimal infertility management. Specific objectives would compare the findings from HSG and sonography of the myometrium, endometrium, ovaries, and fallopian tubes of the subjects in River State, Nigeria.

2. MATERIALS AND METHODS

2.1. Methods

A prospective cross-sectional study design was adopted in this study to evaluate the correlation of pelvic US and hysterosalpingography examination findings in the management of infertility among women of reproductive age.
This study was carried out at the radiology units of Orange Medical Diagnostics and Olive Tree Diagnostic Services, Portharcourt. Orange Medical Diagnostics and OliveTree Diagnostics Services are privately owned radiodiagnostics and laboratory referral centers that are duly registered with State Ministry of Health, Radiographers Registration Board of Nigeria (RRBN) and Nigerian Nuclear Regulatory Authority (NNRA).
The target population for this study are all women of reproductive age with clinical history of infertility who were referred to Orange Dignostics and Olive Tree Diagnostic Services in Portharcourt Rivers State, for hysterosalpingography and pelvic US examinations between April 2025 and September 2025.
A purposive sampling technique was use to select 100 subjects. This method has been employed because only women of reproductive age who are referred for USS/HSG examination due to infertility issues will be chosen.

Inclusion Criteria in this Study

- Subjects with regular menstrual flow that were referred for HSG examination due to infertility to the selected study centers during the period of this study.
- Subjects that consented to the study.
- Subjects without history of any known cause of infertility.

Exclusion Criteria for the Study:

- Subjects who are not within the reproductive age group.
- Subjects with irregular menstruation.
- Subjects who might not consent to the study.

An ethical approval letter for this study was obtained from the Human Research and Ethical Committee of the Rivers State Hospitals Management Board (RSHMB) Portharcourt. The purpose of this study was adequately explained to the intended participants, and their consent was sought and obtained using written informed consent form. The nature of participation was entirely voluntary. All information that was obtained were treated with high level of confidentiality and used for the purpose of this study only.

2.2. Material

The pelvis US examination findings was obtained using the following instruments:

- Mindray ultrasound machines (Model Nos: Consona N6 2024 and DC-N32 2018)
- Transducer (probe) with 3.5MHz-7MHz and 5-12MHz (3C5A and L13-3)
- Ultrasound gel

The pelvic US scan/examination was performed on each subject using the methods described by Kondagari et al. [17] and Karena and Mehta [18] using both transabdominal and transvaginal techniques.

Before the transabdominal US scan, the subjects was asked to drink water to get full bladder, which acts as acoustic window and also pushes the uterus to its normal position, ensuring proper visualization of other pelvic structures. The individual was positioned comfortably in a supine posture and examined while having a full bladder.

The transvaginal scan was carried out with an empty bladder to allow for better visualization of the uterus. The subjects was comfortably positioned supine in lithotomy position, with pillow under the buttocks or feet rested in stirrups of the bed to allow for better positioning and visualization of pelvic organs [17].
The general technique included the measurement of the uterine length from the fundus to the external cervical os in the mid-sagittal plane, uterine depth, and the endometrial thickness measured from the same plane, but perpendicaular to the uterine length. The uterine width was measured in the coronal plane of the uterus, and the cervix was measured in the mid-sagittal plane and transverse plane [17]. Presence/no of follicles with measurement of the sizes.

For the HSG investigation: The patient was positioned in the lithotomy position on the X-ray table. After explaining the procedure and obtaining consent, the genital area was cleaned and draped under aseptic conditions. A speculum was placed into the vagina to allow for visualization of the cervix, and the anterior lip of the cervix was held with a tenaculum to stabilize it. A cannula or HSG catheter was then inserted into the cervical canal, and the speculum was carefully removed. Under fluoroscopic guidance, a radiopaque contrast medium was slowly injected through the cannula into the uterine cavity. As the contrast filled the uterus, the uterine contour was observed, and images were taken.

Further injection allowed the contrast to flow into the fallopian tubes, and additional radiographs were obtained to demonstrate tubal patency or any obstruction. If the contrast spilled freely into the peritoneal cavity, it indicated patent fallopian tubes.

After sufficient images were captured, the cannula was withdrawn, and the patient was cleaned and allowed to rest. The images were later reviewed and interpreted to assess the uterine cavity and tubal patency.

The HSG images was interpreted to give detailed conditions of the uterine cavity and the tubes, based on the following:

- Capacity of the cavity (Small, Normal, and Capacious),
- Smoothness of the cavity (smooth or irregular)
- Presence or absence of filling defect,
- Tubal status (patent or occluded).

The HSG investigation was reported by a radiologist based on the above-stated parameters.
The findings from the radiological reports was documented and captured using a spreadsheet for analysis.

2.2.1. Data Analysis

Data obtained from both US scan findings and HSG examination findings were processed and analyzed using Excel Microsoft version 16 and SPSS version 22. Descriptive statistical tools such as mean, standard deviation, percentage, and frequency were used for data analysis. Cohen's kappa and a comparison table for different reproductive organs. The level of statistical significance of p-value < 0.05 was used.

3. RESULTS

The bar chart illustrates the distribution of patients across different age groups. Age groups were distributed as follows: 18–24 years (6.0%), 25–29 years (20.0%), 30–34 years (28.0%), 35–39 years (24.0%), 40–44 years (17.0%), and 45–50 years (5.0%). The distribution peaks between 30–39 years (52.0% combined), followed by 25–29 years (20.0%) and 40–44 years (17.0%). The data show that most patients fall within the 30–44 year age range, indicating that reproductive-age women are more represented in this study population. This aligns with the clinical focus on infertility assessments, which are more common within these age brackets (Figure 1)

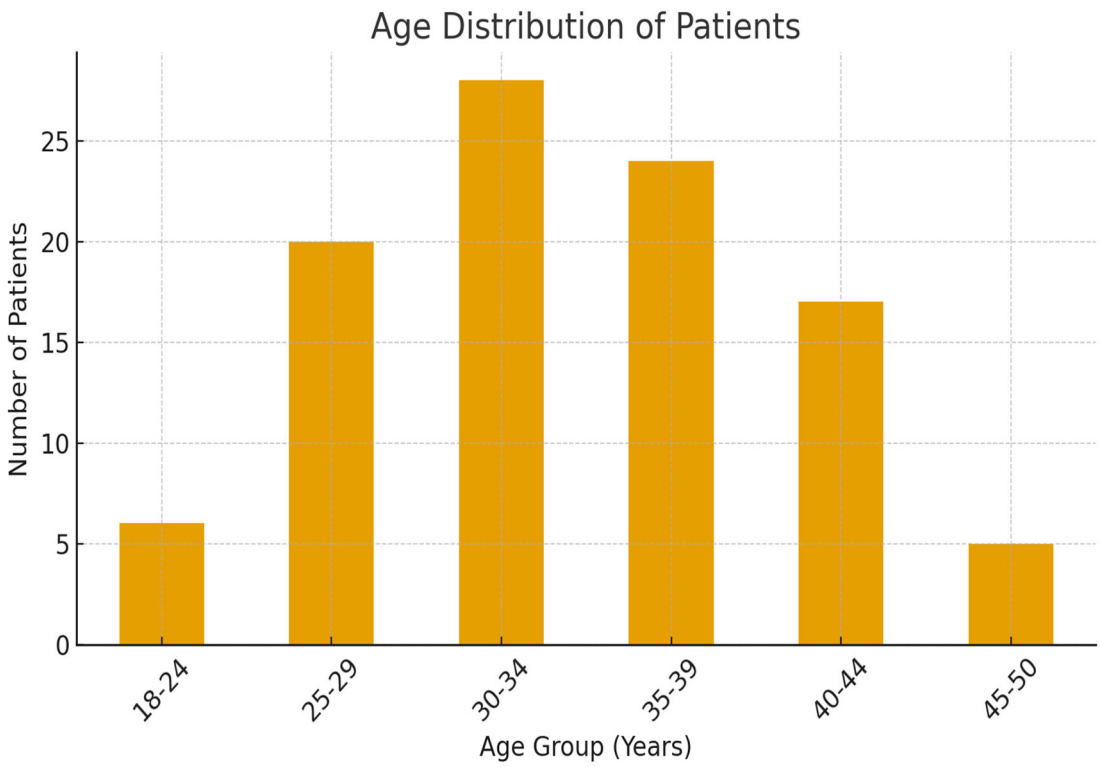

Figure 1. Age Distribution of Patients.

3.1. Comparative Analysis of Endometrial Findings on US and HSG

Findings from the study showed a statistically significant association between the two modalities. A Chi-square test of independence was performed to examine the association between endometrial findings on US and HSG. The test yielded $\chi^2 = 69.86$, df = 9, $p < 0.001$. This indicates a statistically significant association between the two modalities. The significant Chi-square result suggests that endometrial findings on US are not independent of those on HSG. In other words, abnormalities detected by one modality tend to correspond to abnormalities observed on the other. The multi-category agreement between US and HSG was quantified by a Cohen's kappa (-0.118), indicating poor agreement beyond chance.
(Table 1).

Table 1. Cross-tabulation of Findings (Multi-category).

Endometrium (HSG) vs Endometrium (US)	Filling defect	Irregular cavity	Normal	Synechiae	Total
Normal	2	6	48	1	57
Polyp	9	3	5	1	18
Synechiae	1	0	3	7	11
Thickened	2	3	8	1	14
Total	14	12	64	10	100

When findings were collapsed to normal versus abnormal, McNemar's test ($p = 0.2295$), suggests no statistically significant difference (Table 2).

Table 2. Binary Analysis (Normal vs Abnormal) and McNemar's Test.

US Abnormal/HSG Abnormal	Normal	Abnormal	Total
Normal	48	9	57
Abnormal	16	27	43
Total	64	36	100

3.2. Comparative Analysis of Myometrial Findings on US and HSG

A multi-category contingency table summarized myometrial findings on US versus HSG. To test paired differences in detecting any abnormality, findings were collapsed to Normal vs Abnormal and compared with an exact McNemar's test (Table 3).

Table 3. Contingency Table (Multi-category).

US/HSG	Contour deformity (suspected fibriod)	Normal	Subtle contour irregularity	Total
Adenomyosis	0	10	1	11
Fibroids	33	9	0	42
Normal	2	45	0	47
Total	35	64	1	100

Agreement: 45.0%; Cohen's kappa (nominal): -0.323

The observed agreement between US and HSG for myometrial findings yielded Cohen's kappa of -0.323, indicating poor agreement beyond chance. The McNemar test on normal vs. abnormal classifications returned p=0.0002, suggesting a significant difference in detection tendencies between modalities (Table 4).

Table 4. Binary Analysis (Normal vs. Abnormal) and McNemar's Test.

US Abnormal/HSG Abnormal	Normal	Abnormal	Total
Normal	45	2	47
Abnormal	19	34	53
Total	64	36	100

3.3. Comparative Analysis of Ovarian Findings on US and HSG

A contingency table was used to summarize ovarian findings on US versus HSG. Agreement was assessed using Cohen's kappa (nominal). To compare detection of abnormalities, findings were collapsed into normal vs. abnormal categories and analyzed with an exact

McNemar's test. The agreement between US and HSG for ovarian findings yielded Cohen's kappa of 0.000, indicating poor agreement beyond chance (Table 5).

Table 5. Contingency Table (Multi-category).

US\ HSG	Not assessed	Total
Endometrioma	6	6
Functional cyst	16	16
Normal	51	51
PCOM features	27	27
Total	100	100

Percent exact agreement: 0.0%; Cohen's kappa (nominal): 0.000

McNemar's test on Normal vs. Abnormal classifications returned p=0.0000, suggesting a significant difference in detection rates (Table 6).

Table 6. Binary Analysis (Normal vs. Abnormal) and McNemar's Test.

US Abnormal/HSG Abnormal	Normal	Total
Normal	51	51
Abnormal	49	49
Total	100	100

McNemar's test (exact): statistic=0, p-value=0.0000

3.4. Comparative Analysis of Fallopian Tube Findings on US and HSG

Contingency tables were constructed to compare fallopian tube findings on US versus HSG. Agreement was quantified using Cohen's kappa. For binary analysis, tubes were classified as Normal/Patent vs. Abnormal/Blocked and assessed with McNemar's test. The agreement between US and HSG for fallopian tube findings yielded Cohen's kappa of 0.122, indicating poor agreement beyond chance (Table 7).

Table 7. Contingency Table (Multi-category).

US \ HSG	Bilateral block	Hydrosalpinx (Unilateral)	Patent bilateral	Spasm suspected	Unilateral block (Left)	Unilateral block (Right)	Total
Hydrosalpinx (Bilateral)	8	0	2	0	0	0	10
Hydrosalpinx (Unilateral)	0	3	4	0	3	4	14
Normal-appearing	0	0	10	2	0	0	12
Not visualized/Not assessed	9	0	43	1	6	5	64
Total	17	3	59	3	9	9	100

McNemar's test for Patent vs. Blocked categories returned p=0.0000, suggesting a significant difference in detection rates (Table 8).

Table 8. Binary Analysis (Patent vs. Abnormal/Blocked) and McNemar's Test.

US Abnormal/HSG Abnormal	Normal	Abnormal	Total
Abnormal	59	41	100
Total	59	41	100

4. DISCUSSION

Most patients assessed fall within the 30–39 age range, which represents just over half of the sample, while fewer women are seen below 25 or above 44 years. This pattern reflects the typical age at which fertility issues and gynaecological conditions prompting US or HSG evaluations are most common. The trend aligns with findings from similar studies, which show that referrals for infertility and pelvic imaging rise in the late twenties, peak in the thirties, and decline in the forties, with younger and older women less frequently seeking or being referred for such evaluations.

Comparison of Endometrial Findings on US and HSG

The findings show that US and HSG offer complementary strengths in assessing endometrial pathology. US effectively detects polyps and endometrial thickening, while HSG is more sensitive to cavity contour abnormalities, synechiae, and filling defects. Using both modalities together enhances diagnostic accuracy, especially in infertility investigations. This aligns with by Okonkwo et al. [19] who determined and compare the diagnostic accuracy of TVS and HSG in detecting uterine cavity pathology using HSG as a gold standard.

US and HSG interrogate different aspects of the uterine cavity: US (especially transvaginal) directly visualizes endometrial echotexture and focal lesions (e.g., polyps, submucosal fibroids), whereas HSG outlines the cavity indirectly via contrast and is primarily optimized for tubal patency. The observed level of agreement reflects these complementary strengths. Discordant cases typically arise when US identifies small intracavitary lesions not well profiled on HSG (appearing as subtle or absent filling defects), or when HSG suggests irregular cavity contour without a discrete lesion on US (e.g., due to transient spasm, mucus, or technical factors) [19].

Clinically, these results underscore the importance of a multimodal approach to endometrial assessment in women with infertility. US serves as a first-line, non-invasive tool, while HSG provides additional anatomical information about intrauterine abnormalities that may not be well visualized on sonography. The integration of findings from both modalities may reduce misdiagnosis, guide treatment planning, and improve reproductive outcomes. A moderate agreement supports the use of US as the first-line modality for endometrial assessment, with HSG reserved for concurrent evaluation of tubal status. In patients with suspected intracavitary lesions or unexplained bleeding/infertility, adjunctive techniques such as saline-infusion sonohysterography (SIS) or hysteroscopy may be warranted to reconcile discrepancies and guide management [20].

Prior work consistently reports that transvaginal US (and especially SIS) outperforms HSG for detecting polyps and submucosal fibroids, whereas HSG is superior for assessing tubal patency. Studies also note that HSG can over- or under-estimate cavity abnormalities due to artefacts (e.g., air bubbles, suboptimal distension). The present findings are therefore broadly concordant with the literature: US better characterizes intracavitary morphology; HSG contributes cavity outline and tubal information. Where our results diverge (e.g., HSG-only abnormalities), technical and physiological factors—as well as lesion size and location—likely explain the differences. Kappa estimates depend on category prevalence; rare categories can deflate agreement. Binary collapsing for McNemar's test may obscure category-specific differences (e.g., polyp vs. fibroid) [21].

These observations are consistent with evidence from Kaveh et al. [22] and Soares et al. [23] that transvaginal US (especially with saline-infusion sonohysterography, SIS) better delineates intracavitary lesions such as polyps and submucosal fibroids, whereas HSG primarily provides an outline of the cavity and assesses tubal patency.

Recent comparative work by Okonkwo et al. [19] using hysteroscopy as reference also reports higher abnormal-cavity rates than either TVS or HSG alone, underscoring the complementary roles of these modalities. Professional guidance similarly positions TVS/SIS for detailed endometrial evaluation and HSG for tubal assessment [24-26].

Comparison of Myometrial Findings on US and HSG

This study found a poor agreement between HSG and US in evaluating the myometrium, with US demonstrating greater diagnostic value for fibroids and myometrial abnormalities. US (particularly transvaginal US, TVS) directly visualizes the myometrium and is well suited to identifying leiomyomas (fibroids), mapping size and location, and evaluating features suggestive of adenomyosis. In contrast, HSG depicts the endometrial cavity outline indirectly and is not optimized for evaluating intramural myometrial pathology—abnormalities may only be inferred when they deform the cavity contour. Accordingly, the level of agreement observed here reflects the different diagnostic emphases of each modality. Discordant cases are expected when small intramural or subserosal fibroids (or diffuse adenomyosis) do not significantly indent the cavity on HSG, yet are apparent on US; conversely, subtle HSG contour irregularities may arise from transient factors (e.g., uterine spasm, mucus, suboptimal distension) without a discrete US correlate. TVS should remain the first-line imaging tool for suspected myometrial disease, with saline-infusion sonohysterography (SIS) or hysteroscopy used when intracavitary involvement is suspected. HSG is best reserved for tubal assessment in the infertility work-up rather than primary myometrial characterization. Where myometrial pathology is strongly suspected or characterization is equivocal, pelvic MRI provides superior tissue contrast for adenomyosis and complex leiomyoma mapping.

Guidance documents emphasize TVS (± SIS) as first-line for uterine structural abnormalities and discourage reliance on HSG for myometrial evaluation; HSG's principal role is tubal patency assessment.

Comparison of Ovarian Findings on US and HSG

The current study showed near-zero agreement in ovarian findings because HSG plays no role in ovarian imaging. This aligns with WHO reproductive imaging guidelines [1], which state that HSG is not recommended for ovarian evaluation, while US remains the gold standard for assessing ovarian morphology, follicular activity, cysts, and features of polycystic ovarian syndrome (PCOS). This finding is also consistent with Okeke et al. [27] who emphasized that HSG lacks soft-tissue resolution and therefore cannot evaluate ovarian structure.

Hysterosalpingography (HSG) is not primarily designed to evaluate the ovaries, as it images the uterine cavity and fallopian tubes via contrast radiography. Consequently, ovarian pathology is often not visualized or reported as "not assessed." US (particularly transvaginal US, TVUS), by contrast, provides direct visualization of ovarian morphology, enabling assessment of follicular development, cysts, and masses. The relatively low agreement observed here reflects these fundamental differences: discordant findings typically occur where US detects functional cysts or structural abnormalities, while HSG is non-contributory [22-23].

For infertility evaluation, US should remain the gold standard for ovarian assessment. HSG should not be relied upon for ovarian characterization, but rather for tubal patency and cavity outline. Patients suspected of ovarian pathology on clinical or laboratory grounds require targeted US (and sometimes MRI), not HSG.

Comparison of Fallopian Tube Findings on US and HSG

A key observation in this study is that HSG demonstrated superior diagnostic performance in evaluating tubal patency compared to US. Tubal blockage was more accurately identified by HSG. These findings agree with Mahendra and Sahana [28] where HSG remains effective for screening tubal patency. The present study did not employ HyCoSy/HyFoSy, which may explain US's lower tubal diagnostic yield here. HSG is widely regarded as the standard radiological method for evaluating fallopian tube patency, with the ability to visualize both tubal lumen and spill of contrast into the peritoneal cavity. The US, when used with adjuncts such as saline infusion sonohysterography or contrast sonohysterography (HyCoSy), can also evaluate tubal patency, but conventional US without contrast has limited capability in this regard. Accordingly, discrepancies in findings often reflect inherent modality differences: US may under-detect tubal pathology without contrast, while HSG may produce false positives from tubal spasm or false negatives from technical limitations.

HSG remains highly valuable in the infertility work-up for tubal patency, though HyCoSy is emerging as a radiation-free alternative with comparable accuracy. The US should be the first-line modality for uterine and ovarian evaluation, supplemented with HyCoSy where tubal information is required. Discordant cases highlight the importance of confirmatory testing in equivocal results.

5. CONCLUSION

This study demonstrates that US and HSG have complementary strengths in infertility evaluation. US is more effective for characterizing endometrium, myometrium, and ovarian pathology**,** while HSG remains indispensable for tubal patency assessment**.** The observed discrepancies highlight the importance of multimodal imaging in infertility work-up to avoid misdiagnosis and ensure comprehensive evaluation. By strategically integrating both modalities, clinicians can provide more accurate, patient-centered infertility care, optimize diagnostic accuracy, and guide appropriate management pathways.

References

[1] World Health Organization (WHO). Infirtility. WHO Publication Geneva. Infertility. Geneva WHO. 2020

[2] Ekpor E, Brobbey SS, Kumah CY, Akyirem S. Experience of infertility-related stigma in Africa: a systematic review and mixed methods meta-synthesis. Int Health. 2025;17(6):903-913.

[3] Gedef GM, Taye EB, Mohammed OY, Abegaz MY, Asratie MH, Andualem F. Prevalence of infertility and its risk factors in Sub-Saharan Africa: a systematic review and meta-analysis. Contracept Reprod Med. 2025;10(1):73.

[4] Kassie AT, Zegeye AF, Bazezew AM, Mamo EY, Gebru DM, Tamir TT. Determinants of pressure to conceive among reproductive age women in Sub-Saharan Africa: A multilevel analysis of recent Demographic and Health Surveys in five countries. PLOS Glob Public Health. 2025; 5(2): e0004244.

[5] Esan DT, Nnamani KQ, Ogunkorode A, Muhammad F, Oluwagbemi OO, Ramos CG. Infertility affects the quality of life of Southwestern Nigerian women and their partners. Int. J. Afr. Nurs. Sci.2022;17: 100506

[6] Carson SA, Kallen AN. Diagnosis and Management of Infertility: A Review. JAMA. 326(2021):65-76.

[7] Adedigba JA, Idowu BM, Hermans SP, Ibitoye BO, Fawole OA. The relationship between hysterosalpingography findings and female infertility in a Nigerian population. Pol J Radiol. 2020;85:e188-e195.

[8] Jimah BB, Gorleku P, Baffour Appiah A. Hysterosalpingography Findings and Jimah Ratio of the Uterine Cavity in Women with Infertility in Central Region, Ghana. Radiol Res Pract. 2020;2020:6697653.

[9] Okafor CO, Okafor CI, Okpala OC, Umeh E. The pattern of hysterosalpingographic findings in women being investigated for infertility in Nnewi, Nigeria. Niger J Clin Pract. 2010;13(3):264-7.

[10] Ombelet W, Onofre J. IVF in Africa: what is it all about? Facts Views Vis Obgyn. 2019;11(1):65-76.

[11] Larsen U, Hollos M, Obono O, Whitehouse B. Suffering infertility: the impact of infertility on women's life experiences in two Nigerian communities. J Biosoc Sci. 2010;42(6):787-814.

[12] Schankath AC, Fasching N, Urech-Ruh C, Hohl MK, Kubik-Huch RA. Hysterosalpingography in the workup of female infertility: indications, technique and diagnostic findings. Insights Imaging. 2012;3(5):475-83.

[13] Toufig H, Benameur T, Twfieg ME, Omer H, El-Musharaf T. Evaluation of hysterosalpingographic findings among patients presenting with infertility. Saudi J Biol Sci. 2020;27(11):2876-2882.

[14] Panchal, Sonal; Nagori, Chaitanya. Imaging techniques for assessment of tubal status. Journal of Human Reproductive Sciences. 2014; 7(1):2-12

[15] Ottun AT, Olumodeji AM, Ayanbode O, Ogunyemi AA, Jinadu FO, Adewunmi AA. Outcomes and complications of pre-assisted reproductive technology hysteroscopic evaluation and treatment: a cross-sectional study at a Nigerian teaching hospital. Contracept Reprod Med. 2025;10(1):37.

[16] Xydias EM, Emmanouil V, Koutini M, Ntanika A, Tsakos E, Prior M, Sarris I, Thanasas I, Daponte A, Ziogas AC. Comparison of HyFoSy, HyCoSy, and X-Ray Hysterosalpingography in the Assessment of Tubal Patency in Women with Infertility: A Systematic Review and Meta-Analysis. Med Sci (Basel). 2025;13(3):168.

[17] Kondagari L, Kahn J, Singh M. Sonography Gynecology, Infertility Assessment, Protocols, and Interpretation. StatPearls Publishing; 2025

[18] Karena ZV, Mehta AD. Sonography Female Pelvic Pathology Assessment, Protocols, and Interpretation. StatPearls Publishing, Treasure Island (FL). 2023

[19] Okonkwo IO, Eleje GU, Obiechina NJ, Ugboaja JO, Okafor CO, Mbachu II, Obiagwu HI, Okwuosa AO, Onwusulu DN, Okeke CF, Ofojebe CJ, Okafor CC, Ogabido CA, Olisa CL, Okafor CG. Diagnostic accuracy of transvaginal ultrasonography and hysterosalpingography in the detection of uterine cavity pathologies among infertile women. Acta Radiol Open. 2024;13(5):20584601241252335.

[20] Muhammad ID, Sabo US, Ibrahim SA, Labaran AD, Takai IU. Comparative Study Between Hysterosalpingo-Contrast Sonography and Hysterosalpingography in Evaluating Tubal Patency at Aminu Kano Teaching Hospital, Kano. Niger Med J. 2023;64(5):671-679.

[21] Phillips CH, Benson CB, Ginsburg ES. *et al.* Comparison of uterine and tubal pathology identified by transvaginal sonography, hysterosalpingography, and hysteroscopy in female patients with infertility. *Fertil Res and Pract* **1**, 20 (2015).

[22] Kaveh M, Sadegi K, Salarzaei M, Parooei F. Comparison of diagnostic accuracy of saline infusion sonohysterography, transvaginal sonography, and hysteroscopy in evaluating the endometrial polyps in women with abnormal uterine bleeding: a systematic review and meta-analysis. Wideochir Inne Tech Maloinwazyjne. 2020;15(3):403-415.

[23] Soares SR, Barbosa dos Reis MM, Camargos AF. Diagnostic accuracy of sonohysterography, transvaginal sonography, and hysterosalpingography in patients with uterine cavity diseases. Fertil Steril. 2000;73(2):406-11.

[24] ACOG Committee Opinion No. 734: The Role of Transvaginal Ultrasonography in Evaluating the Endometrium of Women With Postmenopausal Bleeding. Obstet Gynecol. 2018;131(5):e124-e129.

[25] The Use of Hysteroscopy for the Diagnosis and Treatment of Intrauterine Pathology: ACOG Committee Opinion, Number 800. Obstet Gynecol. 2020;135(3):e138-e148.

[26] Practice Committee of the American Society for Reproductive Medicine. Role of tubal surgery in the era of assisted reproductive technology: a committee opinion. *Fertil Steril*. 2021;115(5):1143-1150.

[27] Okeke TC, Agwuna KK, Eenyeaku CC and Ikeako LC. Application of ultrasonography in female infertility: a comprehensive review. International Journal of Reproductive Contraceptive and Obstetric Gynecology.2015; 4(5):1246-1256

[28] G M, M S. Comparative Analysis of Hysterosalpingography and Diagnostic Hysteroscopy Findings in Infertility Evaluation. Cureus. 2025 Apr 6;17(4):e81789.