A Retrospective Study of the Pattern of Hysterosalpingographic Findings Among Females with Infertility: A Five-year Trend Analysis in South-central, Ghana

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Abstract

Objectives: We aimed to find out the pattern of Hysterosalpingographic findings and annual trends among Ghanaians over the study period.

Methods: We undertook a retrospective evaluation of all radiological reports of 2,324 women with infertility who underwent Hysterosalpingography during their infertility work-up at Cape Coast Teaching Hospital (CCTH) and met the inclusion criteria, between January 2018 and December 2022. The collected data were thoroughly examined. Inferential statistics were performed using the Chi-square goodness of fit test tool and two-tailed independent sampled student's t-test. Statistical significance was also set at $p \leq 0.05$.

Results: Patients with primary infertility constituted the majority with a mean age of 32.21±4.51 years whilst that of secondary infertility was 34.20 ± 5.33 years ($p<0.0001$). Primary infertility was predominantly among those ≤30 years and it decreased with increasing age ($p<0.0001$). Bilateral tubal blockage, the commonest finding, was seen in 41.60%

and 57.12% of primary and secondary infertility cases respectively. Hydrosalpinx was seen in 10.15%, fimbrial adhesions in 19.11%, Ashermann's syndrome in 0.17%, and bilateral beaded tubes/tubercular salpingitis in 0.22% of all infertility cases.

Conclusions: About 22.07% of infertility cases were radiologically unexplained. Nearly 45.87% and 18.76% of females with infertility had bilateral and unilateral tubal blockage respectively whilst 64.63% had at least one tube blocked. Generally, there was an increasing trend in the annual cases of infertility at an increasing rate as the years progressed.

Keywords: Hysterosalpingography, Hysterosalpingographic findings, Female infertility, Ghana

Introduction

One of the most common health conditions affecting young males and females is infertility, which is defined by the World Health Organization (WHO) as a disease of the male or female reproductive system defined by the failure to achieve a pregnancy after 12 months or more of regular unprotected sexual intercourse.[1] There are two forms of infertility: primary and secondary infertility. Primary infertility is the inability to conceive despite attempts at conception for more than one year, whereas secondary infertility is the inability to become pregnant following a previous successful conception.[1] The cause of this condition may be due to either female factors, male factors, both male and female factors, or unexplained. Historically, infections like gonorrhea and sexually transmitted illnesses were the leading causes of infertility.[2] But today, stress and lifestyle factors like smoking and addictions have been linked to lower fertility rates.[2]

Infertility problem has been reported to be increasing since 1998. According to the WHO, about 48 million couples and 186 million individuals experience fertility problems worldwide leading to associated medical, economic, and psychological implications resulting in stress, and trauma, particularly in Africa where there is a strong emphasis on child-bearing.[3] The incidence of this condition varies across regions of the world and is estimated to affect 8–12% of couples worldwide. Females tend to have a higher prevalence and effects of infertility conditions than males. Literature has reported that about 11% of women of reproductive age experience fertility problems as compared to about 9% of men. It has also been reported that even though fertility declines with age in both men and women, the effects of age are much greater in women.[4,5]

According to literature, the global age-standardized prevalence rate of female infertility increased by 14.96% from 1366.85 per 100,000 in 1990 to 1571.35 per 100,000 in 2017. It has also been disclosed that an episode of infertility affects about 25% of women at some point in their reproductive lives. The prevalence is high among people in Sub-Saharan Africa, South Asia, North Africa/Middle East, Central Asia, and Central Europe.[6,7] Infertility in women can result from a variety of conditions that affect the ovaries, uterus, fallopian tubes, and endocrine system among others. However, oxidative stress has been recognized as one of the main mediators of female infertility by causing various reproductive pathologies in females such as polycystic ovary syndrome (PCOS), endometriosis, and unexplained infertility.[7]

Fertility tests may take a number of forms. These include ovulation testing, hysterosalpingography (HSG), ovarian reserve testing, other hormone testing, and imaging tests such as pelvic ultrasound, sonohysterography, and hysteroscopy. Depending on the situation, the test might include laparoscopy (to identify the existence of irregularities or blockages of the fallopian tubes, scarring, endometriosis, and problems with the ovaries and uterus), and genetic testing (to find out if the genes have changed in any way that could be affecting one's infertility). However, in most cases, hysterosalpingography is the first-line diagnostic technique used to diagnose tubal and intrauterine problems that may result in infertility.[8]

Hysterosalpingography is a non-invasive, and simple procedure that enables visualization of the uterine cavity contour and lesions, revealing or ruling out anomalies such as various intrauterine malformations.[9] It is a procedure that uses X-rays to reveal the interior structure of the uterus and determine whether the fallopian tubes are blocked or patent. In spite of potential issues such as nausea, fever, pelvic infection, pelvic cramps/pain, lymphogranuloma formation, vaso-vagal symptoms, radiation exposure, and a high rate of false positives, HSG is still one of the most widely utilized imaging modalities for assessing female infertility in the majority of nations like Ghana, Nigeria, the United Kingdom, and, the United States.[9,10]

Some studies in other jurisdictions have assessed the HSG findings of female partners of infertile couples and found that fibroids, tubal blockages, capacious uterine cavities, and hydrosalpinx are the common abnormal HSG findings.[10-12] We aimed to find out the pattern of hysterosalpingographic findings and annual trends among Ghanaians over the study period, which would help practitioners in their decision-making with the following specific objectives;

- To ascertain the sociodemographics, and proportions of primary and secondary infertility in our setting.
- To determine the pattern of HSG findings of female partners of couples with infertility.
- To find out the possible association between HSG findings and the age distribution, type of infertility, and the year of examination.
- To ascertain the yearly distribution of HSG findings over a 5-year period.

Methods

We undertook a retrospective review of all radiological reports of 2,324 women with infertility who underwent HSG during their infertility work-up at the Department of Radiology, Cape Coast Teaching Hospital (CCTH), and met the inclusion criteria between January 2018 and December 2022. The CCTH is one of Ghana's top research institutions and the main public health facility in the Central Region of Ghana. It also serves as a training ground for residents in a range of medical specialties. The Department of Radiology receives patients from all over the country for radiological services hence, the patients included in this study came from the referring facilities.

All the hysterosalpingography examinations were performed and reported by three radiologists with over ten years of experience in fluoroscopic examinations including HSG. The images were acquired with a Shimadzu Flexavision Digital fluoroscopy system manufactured by Shimadzu Corporation (Kyoto, Japan) made in 2012. The HSG was done in the proliferative phase of the menstrual cycle (when there is no menstrual flow) and between day six to day eleven of the cycle. A negative urine pregnancy test was required. Patients were placed in the lithotomy position after administration of a rectal Diclofenac suppository (100mg) and about 60 to 80 mg of Buscopan (Hyoscine Butylbromide) tablets 30 to 50 minutes prior to the examination to help relieve pain and to reduce the likelihood of tubal spasms which is the protocol in our center. A control image of the pelvis was taken before the instrumentation of the cervix. Under sterile conditions, a vaginal speculum was passed in order to assess the external cervical os which was cannulated with the appropriate cervical cannula after which 10 to 30 mls of contrast medium (Iopamirol) was administered under fluoroscopic guidance after expelling air bubbles. The images were acquired on complete filling of the uterine cavity for the assessment of uterine and cervical abnormalities, visualization of the tubes, and free intraperitoneal spillage of the contrast medium for the assessment of tubal abnormalities. A normal HSG was reported when both tubes were visualized, normal in caliber and with free spillage of contrast medium into the peritoneum and a normal outline of the uterine cavity and cervical canal. An abnormal HSG was reported when there was evidence of unilateral or bilateral tubal obstruction, and/or dilatation, and/or uterine or cervical abnormality.

The Lightwave Health Information Management System (LHIMS), which holds all comprehensive electronic health data of patients, is where we obtained the records of all the patients who underwent HSG. The ages and imaging characteristics of the patients were gathered from the reports that were obtained. The type of infertility for each patient was also obtained using the gravidity and parity stated in the comprehensive report vis a vis the medical history. Uterine abnormalities (acquired or congenital) in this study comprised; irregular uterine outline, filling defects in the uterine cavity, Ashermann's syndrome, elongated uterine cavity, arcuate uterus, and bicornuate uterus whilst cervical abnormalities consisted of elongated cervical canal, irregular cervical outline, edematous cervix, and patulous cervix; tubal abnormalities considered were beaded tube(s) indicative of tubercular salpingitis, salpingitis isthmica nodosa (bilateral or unilateral), hydrosalpinx(es) (bilateral or unilateral), terminal tubal contrast collection suggestive of fimbrial adhesion(s) and tubal blockages comprising bilateral tubal blockage, left or right tubal blockage, which is seen as non-spillage of contrast medium at the affected side(s). From the records, we classified all the patients into two main categories (primary and secondary). With the help of patients' unique electronic identification numbers, a detailed review of the medical records was done to avoid duplication of participants. Within the years under study, a total of 2,337 patients underwent HSG examination out of which 13 patients were excluded because of incomplete reports. All the remaining 2,324 female patients who met the inclusion criteria were consecutively retrieved for analyses.

Inclusion Criteria

- Women who underwent HSG within the study period with complete medical records.
- Availability of comprehensive HSG reports.

Exclusion Criteria

• Women who underwent HSG whose detailed medical records could not be obtained.

• Women who underwent HSG whose comprehensive HSG reports could not be obtained.

The collected data (age, type of infertility, and HSG findings) were organized, arranged, coded, analyzed, and presented in the appropriate tables, and charts using GNU PSPP (Category: Math, Science & Education) pspp version 1.2.0-3 and LibreOffice Calc's (version 1:6.1.5-3+deb10u6) developed by the Free Software Foundation and The Document Foundation respectively. The association between the HSG findings and patient age, year of HSG examination, and type of infertility was examined using the Chi-square goodness of fit test tool. After the assumption for normality check had been satisfied, a two-tailed independent sampled students t-test was also employed to determine whether the mean ages of patients with primary and secondary infertility were statistically the same in our setting. Statistical significance was also set at $p \leq 0.05$, for this study. We categorized the ages of the patients as follows: ≤30 years, 31-35 years, 36-40 years, and >40 years.

The Ethical Review Committee of CCTH provided the study with an ethical clearance number CCTHERC/EC/2018/30. Although informed consent was not required because this was a retrospective study, anonymity and confidentiality were ensured. The 1975 Helsinki Declaration was followed.

Results

Over the 5-year period, the number of women referred for HSG who were 30 years or less was high in 2022 (27.05%, $p<0.0001$) and low in 2018 (13.18%, $p<0.0001$). A similar trend was seen in those who were 31-35 years old [**Table 1**]. For the patients who were more than forty (40) years, the number of women referred for HSG was highest in 2021 (33.88%) and least in 2019 (6.61%). Patients who presented with primary infertility constituted the majority with an increasing pattern in cases as the years went by except in 2022, however, there was a fluctuating trend in the cases of patients who presented with secondary infertility as the years progressed. These changes were statistically significant ($p<0.0001$). The mean age of patients with primary infertility was 32.21±4.51 years whilst that of secondary infertility was 34.20 ± 5.33 years ($p<0.0001$). Unremarkable or normal HSG was seen in 22.07% of the patients [Table 1].

Table 1: Distribution of the Ages, HSG Findings, and Infertility Type among Patients over a 5-year period and Age Range, Mean Age, and Examination of Mean Age Difference of Patients with Primary and Secondary Infertility.

Age (in years)	**Year**					**Total (%)**	**P-value**
	2018 (%)	**2019 (%)**	**2020 (%)**	**2021 (%)**	**2022 (%)**		
≤30	116 (13.18)	165 (18.75)	163 (18.52)	198 (22.50)	238 (27.05)	880 (100.00)	<0.0001*
31-35	122 (14.90)	131 (16.00)	158 (19.29)	192 (23.44)	216 (26.37)	819 (100.00)	
36-40	78 (15.48)	72 (14.29)	72 (14.29)	90 (17.86)	192 (38.10)	504 (100.00)	
>40	21 (17.36)	8 (6.61)	33 (27.27)	41 (33.88)	18 (14.88)	121 (100.00)	
Total	337 (14.50)	376 (16.18)	426 (18.33)	521 (22.42)	664 (28.57)	2324 (100.00)	
Infertility Type							
Primary	266 (15.79)	308 (18.28)	326 (19.35)	440 (26.11)	345 (20.47)	1685 (100.00)	<0.0001*
Secondary	71 (11.11)	68 (10.64)	100 (15.65)	81 (12.68)	319 (49.92)	639 (100.00)	
General Findings							
Normal	72 (14.04)	60 (11.70)	72 (14.04)	135 (26.32)	174 (33.92)	513 (100.00)	<0.0001*
Abnormal	265 (14.63)	316 (17.45)	354 (19.55)	386 (21.31)	490 (27.06)	1811 (100.00)	
Age (Overall)	**Minimum**		**Maximum**		**Mean (SD)**		**SE**
	21 years		48 years		32.76 (4.83)		0.10
	Mean (SD) years		**Mean Diff (CI)**		**t-score**		**P-value**
Primary	32.21 (4.51)		-1.99 (-2.42 – -1.56)		-9.02		<0.0001*
Secondary	34.20 (5.33)						

**Statistically Significant; SD=Standard Deviation; SE=Standard Error; Diff=Difference*.

Primary infertility cases were comparatively higher than secondary infertility in all age categories with an inverse relationship with age. Thus, it decreased with increasing age [**Figure 1]**. Unlike primary infertility (which is more common in the younger age group), secondary infertility was mostly seen in the 36-40 years age category [**Figure 1]**.

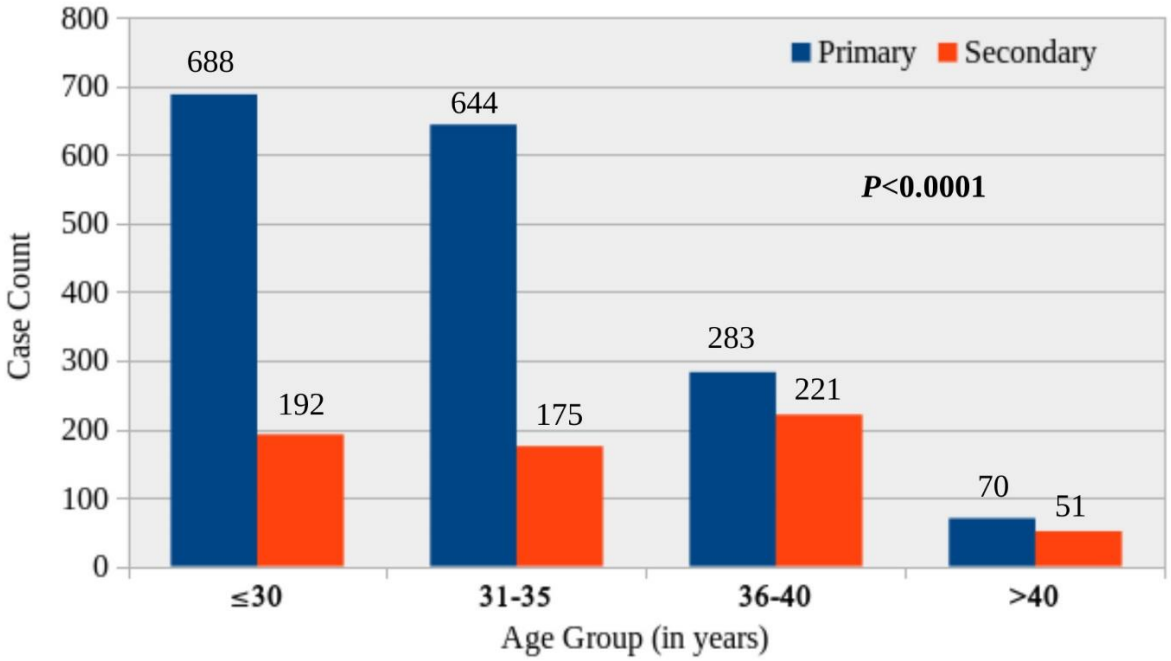

Figure 1: Pattern of Primary and Secondary Infertility Cases among Age Groups

Bilateral tubal blockage (26.35%) was the most common abnormal HSG finding among female patients with infertility followed by elongated cervical canal (11.22%) and irregular uterine outline (7.19%). The least recorded findings were Ashermann's syndrome, bilateral beaded tubes/tubercular salpingitis, and bicornuate uterus. Apart from left hydrosalpinx, all the HSG findings were more prevalent in primary infertility. All the cases of right tubal blockage, right fimbrial adhesions, edematous cervix, patulous cervix [Figure 2], arcuate uterus, bicornuate uterus, Ashermann's syndrome, and bilateral beaded tubes/tubercular salpingitis were in those with primary infertility as shown in Table 2. Hydrosalpinx was recorded in 7.66% and 16.75% of primary and secondary infertility respectively, and was predominantly on the left side. Fimbrial adhesions were also seen in 21.24% and 12.83% of primary and secondary infertility respectively and were common on the right side [Table 2].

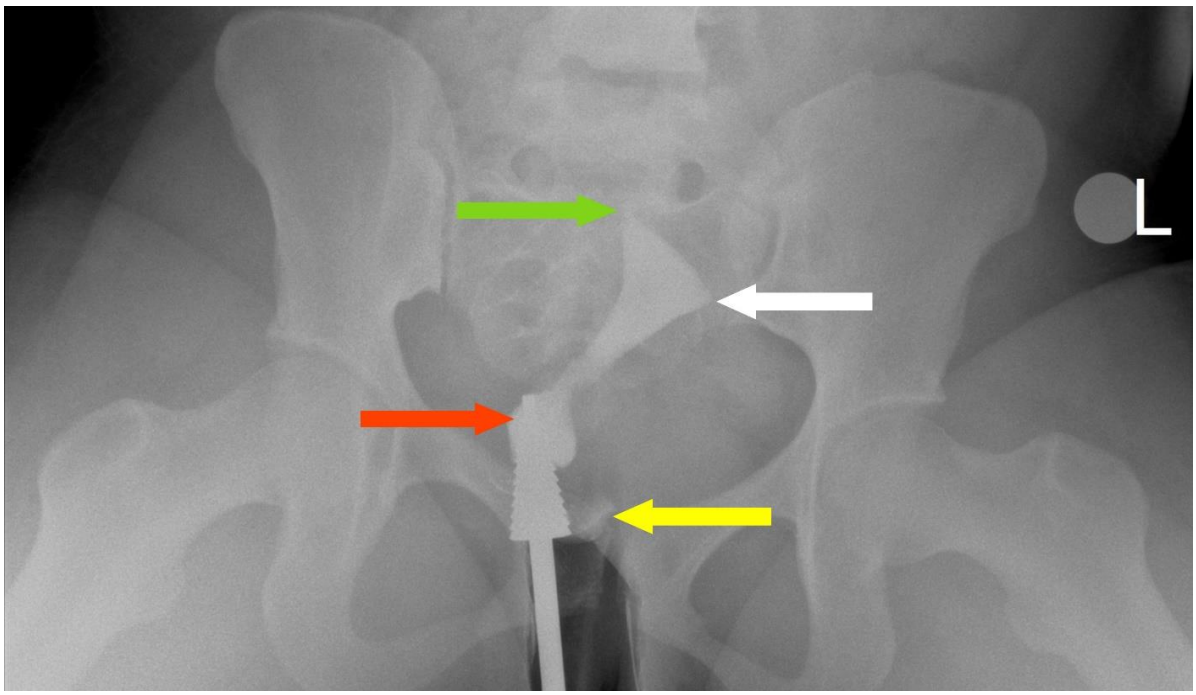

Figure 2: A frontal radiograph of a hysterosalpingography showing pooling of contrast medium around the cervical canula suggestive of a patulous cervix as indicated by the red arrow, back flow of contrast (yellow arrow), right tubal blockage (green arrow), and left tubal blockage (white arrow).

Table 2: Distribution of Hysterosalpingographic Findings among Infertility Type.

Hysterosalpingography Findings	**Infertility Type**		**Total**	***P*-value**
	Primary (%)	**Secondary (%)**		
Tubal Findings				
Bilateral Tubal Blockage	701 (65.76)	365 (34.24)	1066	<0.0001*
Right Tubal Blockage	275 (100.00)	0 (0.00)	275	<0.0001*
Left Tubal Blockage	157 (97.52)	4 (2.48)	161	<0.0001*
Bilateral Hydrosalpinxes	78 (72.90)	29 (27.10)	107	0.926
Left Hydrosalpinx	51 (39.53)	78 (60.47)	129	<0.0001*
Right Fimbrial Adhesions	172 (100.00)	0 (0.00)	172	<0.0001*
Left Fimbrial Adhesions	190 (69.85)	82 (30.15)	272	0.297
Bilateral Beaded tubes/Tubercular Salpingitis	5 (100.0)	0 (0.00)	5	0.168
Bilateral Tubal Patency	446 (63.53)	256 (36.47)	702	<0.0001*
Uterine Findings				
Elongated Uterine Cavity	39 (76.47)	12 (23.53)	51	0.521
Irregular Uterine Outline	229 (78.69)	62 (21.31)	291	0.011*
Filling Defect/Fibroid	98 (61.25)	62 (38.75)	160	0.001*
Arcuate Uterus	16 (100.0)	0 (0.00)	16	0.013*
Bicornuate Uterus	7 (100.0)	0 (0.00)	7	0.103
Ashermann’s syndrome	4 (100.0)	0 (0.00)	4	0.218
Cervical Findings				

Elongated Cervical Canal	298 (65.64)	156 (34.36)	454	<0.0001*
Irregular Cervical Outline	22 (84.62)	4 (15.38)	26	0.164
Edematous Cervix	135 (100.0)	0 (0.00)	135	<0.0001*
Patulous Cervix	12 (100.0)	0 (0.00)	12	0.032*

**Statistically Significant*

Irregular uterine outline, bilateral tubal blockage [Figure 2], left tubal blockage, elongated cervical canal, elongated uterine cavity, irregular cervical outline, and edematous cervix were significantly associated with young age (≤30 years) constituting 40.55%, 40.15%, 34.78%, 35.90%, 64.71%, 53.85%, and 56.30% respectively. On the other hand, filling defects/fibroids (47.50%, p<0.0001), bicornuate uterus (100.00%, p<0.0001), and bilateral beaded tubes/tubercular salpingitis (100.00%, p<0.0001) were mostly associated with 36-40 years age class whilst right tubal blockage (50.18%), bilateral hydrosalpinxes (35.51%) [Figure 3], left hydrosalpinx (41.09%), right fimbrial adhesions (53.49%), left fimbrial adhesions (41.18%), patulous cervix (100.00%), arcuate uterus (75.00%), and Ashermann's syndrome (75.00%) were frequently seen among the 31-35 years age category [Table 3].

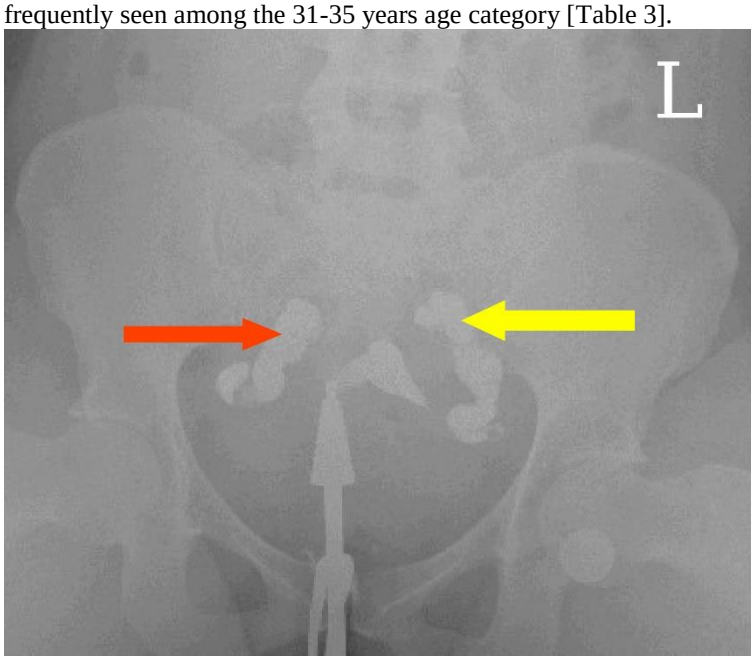

Figure 3: A hysterosalpingography showing bilateral tubal dilatation with no spillage of contrast medium bilaterally into the peritoneal cavity as depicted by the left and right arrows suggestive of bilateral hydrosalpinxes.

Table 3: Prevalence of Hysterosalpingographic Findings among Age Group.

Hysterosalpingography Findings	**Age Group (in years)**				***P*-value**
	≤ 30 (%)	**31-35 (%)**	**36-40 (%)**	**➢ 40 (%)**	
Tubal Findings					
Bilateral Tubal Blockage	428 (40.15)	341 (31.99)	232 (21.76)	65 (6.10)	0.009*
Right Tubal Blockage	98 (35.64)	138 (50.18)	39 (14.18)	0 (0.00)	<0.0001*
Left Tubal Blockage	56 (34.78)	38 (23.60)	47 (29.19)	20 (12.42)	<0.0001*
Bilateral Hydrosalpinxes	23 (21.50)	38 (35.51)	14 (13.08)	32 (29.91)	<0.0001*
Left Hydrosalpinx	15 (11.63)	53 (41.09)	50 (38.76)	11 (8.53)	<0.0001*
Right Fimbrial Adhesions	69 (40.12)	92 (53.49)	4 (2.33)	7 (4.07)	<0.0001*
Left Fimbrial Adhesions	72 (26.47)	112 (41.18)	84 (30.88)	4 (1.47)	<0.0001*

Bilateral Beaded tubes/Tubercular Salpingitis	0 (0.00)	0 (0.00)	5 (100.00)	0 (0.00)	<0.0001*
Bilateral Tubal Patency	264 (37.61)	250 (35.61)	174 (24.79)	14 (1.99)	<0.0001*
Uterine Findings					
Elongated Uterine Cavity	33 (64.71)	18 (35.29)	0 (0.00)	0 (0.00)	<0.0001*
Irregular Uterine Outline	118 (40.55)	68 (23.37)	95 (32.65)	10 (3.44)	<0.0001*
Filling Defect/Fibroid	42 (26.25)	32 (20.00)	76 (47.50)	10 (6.25)	<0.0001*
Arcuate Uterus	0 (0.00)	12 (75.00)	4 (25.00)	0 (0.00)	0.003*
Bicornuate Uterus	0 (0.00)	0 (0.00)	7 (100.00)	0 (0.00)	<0.0001*
Ashermann's syndrome	1 (25.00)	3 (75.00)	0 (0.00)	0 (0.00)	0.384
Cervical Findings					
Elongated Cervical Canal	163 (35.90)	121 (26.65)	149 (32.82)	21 (4.63)	<0.0001*
Irregular Cervical Outline	14 (53.85)	7 (26.92)	5 (19.23)	0 (0.00)	0.292
Edematous Cervix	76 (56.30)	40 (29.63)	19 (14.07)	0 (0.00)	<0.0001*
Patulous Cervix	*0 (0.00)*	*12 (100.00)*	*0 (0.00)*	*0 (0.00)*	*<0.0001**

**Statistically Significant*

Figure 4 is a line graph that shows the trend of the yearly cases of infertility over the study period. Generally, it shows an increasing trend at an increasing rate as the years progressed which is depicted by the slopes of the lines.

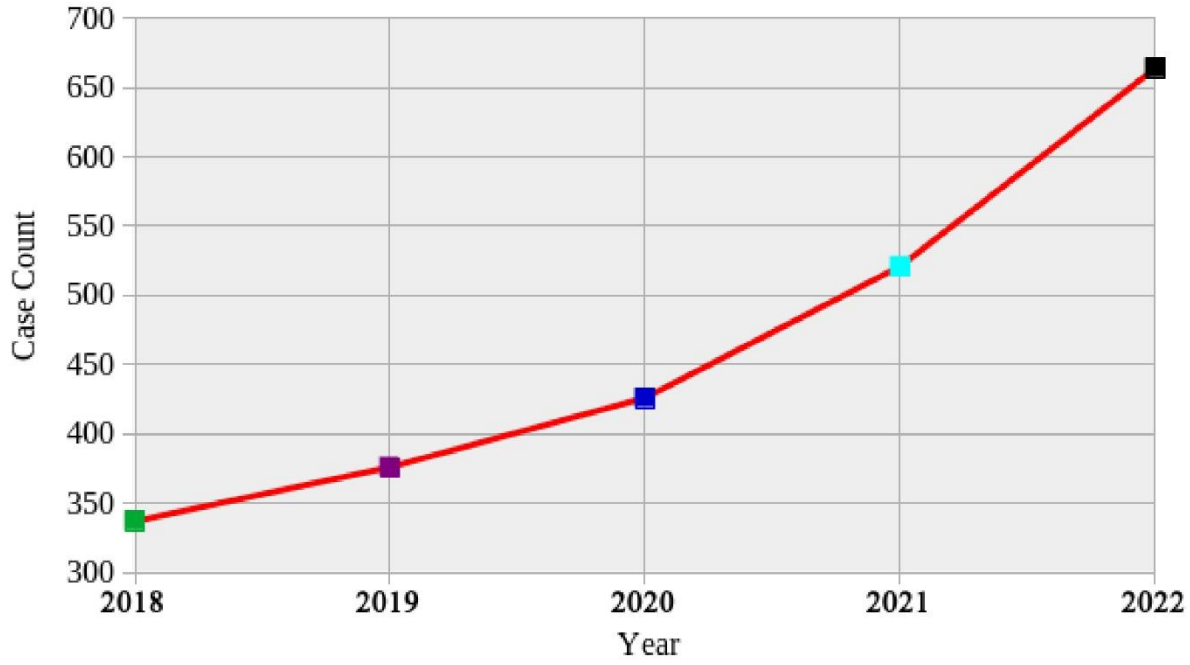

Figure 4: Trend Analyses of the Prevalence of Infertility Cases over the Years

Most of the irregular uterine outline (29.90%), bilateral tubal blockage (23.64%), irregular cervical outline (38.46%), edematous cervix (37.04%), and bilateral beaded tubes/tubercular salpingitis findings were recorded in 2021 whilst right tubal blockage (44.00%), left tubal blockage (54.04%), elongated uterine cavity (33.33%), bilateral tubal patency (27.21%) [Figure 5] were more common in 2022. All the bicornuate uterus, Ashermann's syndrome, and bilateral beaded tubes/tubercular salpingitis features were seen in 2018, 2019, and 2021 respectively. Details are shown in Table 4.

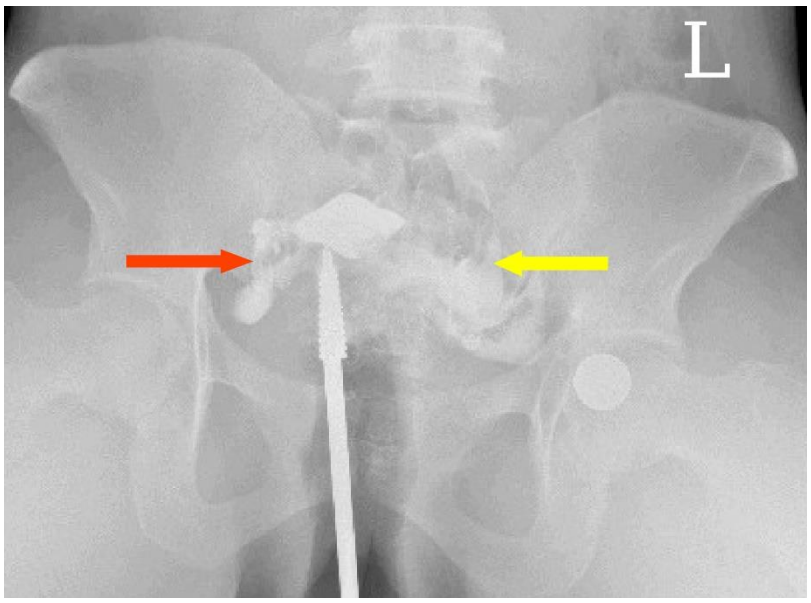

Figure 5: A frontal radiograph of a hysterosalpingography showing free intraperitonial spillage bilaterally (right spillage-red arrow, left spillage arrow-yellow arrow) suggestive of bilateral tubal patency.

Table 4: Annual Trend of the Hysterosalpingographic Findings.

Hysterosalpingography Findings	**Year**					***P*-value**
	2018(%)	**2019(%)**	**2020(%)**	**2021(%)**	**2022(%)**	
Tubal Findings;						
Bilateral Tubal Blockage	158 (14.82)	188 (17.64)	220 (20.64)	252 (23.64)	248 (23.26)	<0.0001*
Right Tubal Blockage	21(7.64)	48(17.45)	34(12.36)	51(18.55)	121(44.00)	<0.0001*
Left Tubal Blockage	22(13.66)	8(4.97)	13(8.07)	31(19.25)	87(54.04)	<0.0001*
Bilateral Hydrosalpinxes	7(6.54)	20(18.69)	33(30.84)	30(28.04)	17(15.89)	<0.0001*
Left Hydrosalpinx	28(21.71)	28(21.71)	36(27.91)	20(15.50)	17(13.18)	<0.0001*
Right Fimbrial Adhesions	43(25.00)	32(18.60)	43(25.00)	20(11.63)	34(19.77)	<0.0001*
Left Fimbrial Adhesions	35(12.87)	72(26.47)	52(19.12)	45(16.54)	68(25.00)	<0.0001*
Beaded tubes/Tubercular Salpingitis	0(0.00)	0(0.00)	0(0.00)	5(100.00)	0(0.00)	0.002*
Bilateral Tubal Patency	107 (15.24)	108 (15.38)	124 (17.66)	172 (24.50)	191 (27.21)	0.460
Uterine Findings						
Elongated Uterine Cavity	8(15.69)	12(23.53)	9(17.65)	5(9.80)	17(33.33)	0.205
Irregular Uterine Outline	35(12.03)	80(27.49)	71(24.40)	87(29.90)	18(6.19)	<0.0001*
Filling Defect/Fibroid	28(17.50)	36(22.50)	41(25.62)	37(23.13)	18(11.25)	<0.0001*
Arcuate Uterus	8(50.00)	0(0.00)	8(50.00)	0(0.00)	0(0.00)	<0.0001*
Bicornuate Uterus	7(100.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)	<0.0001*
Ashermann's syndrome	0(0.00)	4(100.00)	0(0.00)	0(0.00)	0(0.00)	<0.0001*
Cervical Findings						
Elongated Cervical Canal	64(14.10)	120(26.43)	111(24.45)	107(23.57)	52(11.45)	<0.0001*
Irregular Cervical Outline	7(26.92)	4(15.38)	5(19.23)	10(38.46)	0(0.00)	0.010*
Oedematous Cervix	7(5.19)	44(32.59)	34(25.19)	50(37.04)	0(0.00)	<0.0001*

Patulous Cervix	8(66.67)	4(33.33)	0(0.00)	0(0.00)	0(0.00)	<0.0001*

**Statistically Significant*

Discussion

The investigation of female infertility frequently involves the radiological procedure known as hysterosalpingography (HSG). According to literature, the most prevalent type of female infertility worldwide is secondary infertility which is contrary to what was found in this current study.[13] A huge majority of the female patients in this study had primary infertility (72.50%), mostly resulting from bilateral tubal blockage (accounting for 41.60%). Bilateral tubal blockage [Figure 2] also accounted for 57.12% and 45.87% of secondary infertility and all infertility cases respectively in this current study [Table 2]. A study by Ambildhuke et al., reported bilateral tubal obstruction as being responsible for 30%-40% of female infertility which is similar to our finding.[14] In another study by Kiridi et al., bilateral tubal blockage also constituted the majority, however, only a few of their participants had primary infertility (22.0%), which is in contrast with our findings.[15]

In a study by Okafor et al., in Nnewi, Nigeria, the majority of the patients had primary infertility (44.8%) which is similar to our findings.[16] In this present study, primary infertility was more common in the younger age group (≤ 30 years) with a decreasing pattern as the ages progressed. On the other hand, secondary infertility was frequently seen in the 36-40 years age group and showed a fluctuating pattern with increasing age [Figure 1]. This study by Okafor et al., also reported high cases of primary infertility in the younger age group (< 30 years) with a similar pattern as ours, whilst secondary infertility was common in the older age group (35-39 years).[16] In Sudan, Toufig et al., reported a similar pattern for primary infertility, but secondary infertility increased with increasing age, which is contrary to ours.[17] A study by Maheshwari et al., considering the effects of female age on the diagnostic categories of infertility found that the causes of infertility in older women differ from those in younger women.[18]

Females with primary infertility (mean age=32.21±4.51 years, p<0.0001) were significantly younger than those with secondary infertility (mean age=34.20 ± 5.33 years, p<0.0001) also corroborated by Toufig et al., and Benksim et al. [Table 1].[17,19] All the patients with right tubal blockage, right fimbrial adhesions, and edematous cervix among others in this study had primary infertility [Table 2], and only a few patients (0.17-0.69%) had these abnormal findings. Makwe et al., and Botwe et al., reported similar results.[10,20]

According to literature, myomas, intrauterine adhesions, polyps, and even gas bubbles (iatrogenic) may show up as filling defects on HSG. In this study, filling defect was recorded in 5.82% (98/1685) of patients with primary infertility, 9.70% (62/639) of secondary infertility cases, and 6.88% (160/2324) of all infertility cases. Udobi et al., had a comparatively higher proportion of filling defects (26.9%) recorded in all female patients with infertility.[21] The outline of the uterus was irregular in 12.52% of the patients whilst the cervical outline was irregular in 1.12%, and these were all more common in the younger age group (≤30 years). In Nigeria, Udobi et al., recorded comparatively higher proportions; 20.60% and 12.10% respectively.[21] Uterine abnormalities in general were seen in 22.76% of the patients, which could be multifactorial in causes, comprising genetic, acquired, and environmental factors.[22] A study has linked abnormality in gene expression to uterine anomalies. Genes, such as Pax, Wnt9b, Wnt4, Emx2, and Lim1 have been found to be involved in the development of Mullerian ducts during morphogenesis. Exposure to diethylstilbestrol and thalidomide during pregnancy may act as environmental factors that can trigger fetal malformations that could lead to the formation of a T-shaped uterus.[22,23] However, Albalushi et al. in Oman found a lower prevalence of uterine abnormalities among females with infertility as compared to ours (3% versus 22.76%).[24] The possible reason for their lower proportion is due to the inclusion of only congenital uterine abnormalities.

In general, cervical abnormalities were observed in 26.98% of infertility cases, however, literature has shown that cervical abnormalities (either acquired or congenital) account for approximately 10% of cases of female infertility.[25] The comparatively high prevalence of cervical abnormalities in women with infertility could be caused by uterine prolapse, chronic cervicitis, STI, or congenital. Studies have associated uterine prolapse with the elongation of the supravaginal part of the cervix whilst the vaginal part has been linked with chronic cervicitis which may make the cervix bulky from hypertrophy.[26,27]

We found hydrosalpinx (all cases of hydrosalpinxes) in 10.15%, fimbrial adhesions (all cases of fimbrial adhesions) in 19.11%, Ashermann's syndrome in 0.17%, and bilateral beaded tubes/tubercular salpingitis in 0.22% of all cases. Dreisler et al., reported the prevalence of Ashermann's syndrome in females with infertility ranging from 2.8% to 45.5%, whilst Smikle et al., found 1.5%.[28,29] The low proportion of Ashermann's syndrome found in our study may be encouraging taking into account the menstrual disturbances, recurrent pregnancy losses, or infertility it may present

with.[28,30] Ashermann's syndrome has been associated with secondary infertility.[30,31] The opposite was recorded in this current study. In a European survey on the treatment of hydrosalpinxes in infertile women, Nisolle et al., recorded a prevalence of hydrosalpinx in women with impaired fertility of 30% which is also higher than what we found. Adedigba et al., reported in Nigeria a rise in the incidence of hydrosalpinx on the right side probably due to the presence of the appendix.[32] This is in contrast with our finding as the majority were observed on the left side with decreasing patterns as the years progressed [Table 4]. About 22.07% of infertility cases were unremarkable on HSG and could be due to other factors like ovulation problems, poor sperm quality, or poor egg quality, which were not assessed in this current study.[2]

Generally, we observed an increasing trend in the annual cases of infertility at an increasing rate as the years progressed [Figure 2]. There was no clear pattern seen in the annual proportions of HSG findings apart from tubal blockage which appeared to be increasing with progressing years. A similar increasing trend in the annual prevalence of infertility was reported by Sun et al. They found that the prevalence rate of infertility grew by 0.29% for men and 0.37% for women globally thereby increasing the global burden aside from the stress, depression, and trauma it is associated with.[3,33] We therefore propose that healthcare decision-makers and professionals implement strategies in order to lessen the burden of infertility.

Conclusion

Patients with primary infertility constituted the majority of patients referred for HSG which showed an increasing pattern as the years went by whilst those with secondary infertility showed a fluctuating trend. Women with primary infertility referred for HSG were significantly younger than those with secondary infertility. Tubal blockage and cervical abnormalities were the most prevalent findings among females with infertility whilst Ashermann's syndrome and bilateral beaded tubes/tubercular salpingitis were the least. Generally, there was an increasing trend in the annual number of patients referred for HSG at an increasing rate as the years progressed. There was no clear pattern seen in the annual proportions of HSG findings apart from tubal blockage which appeared to be increasing with progressing years. These increases have the potential to increase the global burden in the prevalence of infertility, in addition to the stress, depression, and trauma it is associated with.

Limitations

The causal relationship for primary and secondary infertility could not be evaluated in this study which is a possible limitation. Those whose comprehensive HSG reports and medical records could not be obtained were excluded from the study and this may reduce the sample size. The characteristics of the study population are another drawback to the generalization of the findings.

Implication for Practice

About 22.07% of infertility cases were unremarkable on HSG, hence practitioners should explore other causal factors like ovulation problems, poor sperm quality, or poor egg quality and come out with the appropriate interventions. The increasing trend in the annual number of patients referred for HSG as the years progressed, should be an issue of public health concern to reduce the associated medical, economic, and psychological implications resulting in stress, and trauma, particularly in Africa where there is a strong emphasis on child-bearing.

Disclosure

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