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Predictors of abnormal findings in infertile women undergoing hysterosalpingography in Bayelsa State, South-South Nigeria

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Abstract
Background: Despite the development of other diagnostic tools such as hysteroscopy, laparoscopy, and magnetic resonance imaging, hysterosalpingography remains the most commonly used diagnostic modality for evaluating tubal patency in infertile women.
Objective: To determine the predictive factors for abnormal findings in infertile women undergoing hysterosalpingography.
Materials and Methods: This prospective, descriptive, cross-sectional study, was conducted at the Infertility Clinics and Radiology Departments of the Federal Medical Centre, Yenagoa, and Niger Delta University Teaching Hospital, Okolobiri, both in Bayelsa State, Nigeria, between January 2021 and July 2021. Hysterosalpingography was done for 350 eligible women, after obtaining written informed consents from them. Data were analysed using Statistical Product and Service Solutions for Windows® version 25. Results were presented in frequencies and percentages for categorical variables, and mean and standard deviation for continuous variables. Student's t-test was used to compare sample means, and Chi-square, for associations. Bivariate and multivariate logistic regression analyses were used to determine the relationship between variables and abnormal hysterosalpingography findings. P-value <0.05 was considered statistically significant.
Results: Secondary level of education (OR–5.97; p=0.007), secondary infertility (5.27; p=0.001), duration of marriage (6–10 years: OR–4.36; p=0.001), duration of infertility (6-10 years: 6.94; p=0.001) and induced abortion (OR–11.73; p=0.001) were significantly associated with abnormal hysterosalpingography findings.
Conclusion: Our study established that the predictors of abnormal findings on hysterosalpingography were secondary level of education, secondary infertility, duration of marriage, duration of infertility and induced abortion.

Keywords: Hysterosalpingography, Infertility, Abnormal, Findings, Predictive

1. Introduction
Tubal pathology is the major cause of secondary infertility, and is implicated in about 40% of all cases of infertility [1]. Despite the development of other diagnostic tools such as hysteroscopy, laparoscopy, and magnetic resonance imaging (MRI), hysterosalpingography (HSG) remains the most commonly used diagnostic modality for evaluating tubal patency in infertile women [2]. The demographic and clinical characteristics of infertile women undergoing HSG may play a role in predicting abnormal findings on HSG.
Onyangunga and Moodley found that tubal abnormalities on HSG occurred significantly more in HIV-infected infertile women compared to uninfected women [3]. Bello documented that women with secondary infertility had significantly more tubal pathologies on HSG than women with primary infertility [4]. This may not be unrelated to the effects of post-abortion and puerperal sepsis, as well as sexually transmitted infections. This finding was corroborated by Ukweh *et al*., who also revealed that older women (>34 years) had more tubal abnormalities on HSG compared to younger women (≤34 years), a reflection of the high rate of infertility seen in association with advancing age [5]. In addition, from the findings of the study by Ukweh *et al*., women who had had more than one induced abortion had more tubal pathologies compared to those who had no or only one induced abortion. The association between induced abortion and abnormal tubal findings on HSG may be attributed to the fact that, especially in our environment, the majority of induced abortions are unsafe, given our restrictive abortion laws, which limits access to safe abortion services [4, 5].

Furthermore, nulliparous women have been found to be significantly more likely to have abnormal HSG findings than parous women; so also, women with a history of pelvic inflammatory disease (PID) compared to those without a previous PID [5]. Torres-Sánchez *et al*., found a significant association between a history of PID and early age at sexual debut and increased risk of tubal infertility [6]. Long duration of infertility, previous ectopic pregnancy, previous gynaecological and abdominal surgery, and previous PID were associated with a significantly higher risk of tubal abnormality on HSG in the study by Farhi *et al*. [7] Previous gynaecological and abdominal surgery predispose to tubal infertility owing to postoperative infection, scarring and adhesion formation. This study sought to determine the predictors of abnormal findings in infertile women undergoing HSG in Bayelsa State, South-South Nigeria.

2. Materials and Methods

This prospective, descriptive, cross-sectional study was conducted over a seven-month period, from January to July 2021, at the Infertility Clinics and Radiology Departments of the Federal Medical Centre, Yenagoa, and Niger Delta University Teaching Hospital, Okolobiri, both in Bayelsa State, Nigeria. These hospitals are the two tertiary hospitals in Bayelsa State, and they provide training, research and tertiary healthcare services to the population in Bayelsa State, as well as the neighbouring Rivers and Delta States, in South-South Nigeria. All women that present to the infertility clinics of the study centres for evaluation of infertility are referred to the radiology departments, for hysterosalpingography, as part of their investigations.

The sample size for this study was calculated using the formula:

$n = z^2pq/d^2$ [8]

Where:
n = minimum sample size
z = normal standard deviation set at 95% confidence limit = 1.96
p = prevalence of infertility which was 32% (0.32) from a previous study in South-South Nigeria [9].
q = 1-p (complementary probability).
d = margin of error = 5% = 0.05
Calculation:
$n = (1.96)^2 \times 0.32 \times 0.68 / (0.05)^2$
$n = 3.8416 \times 0.32 \times 0.68 / 0.0025$
$n = 0.8359 / 0.0025$
$n = 334.37$

After giving room for attrition of 5%, n was adjusted to 350.

Therefore, 350 women being evaluated for infertility were selected for this study from the gynaecological clinics. These women were recruited consecutively until the sample size was complete. Hysterosalpingography was performed for these women in the radiology departments of both study centres.

Infertile women referred for hysterosalpingography, who gave consent, and completely filled the consent/questionnaire form, were included in the study. Exclusion criteria included abnormal uterine/vaginal bleeding before the procedure, on-going menstruation, discharge on inspection of the cervix, cervical stenosis/cervical pathology, evidence of pelvic inflammatory disease, previous history of contrast hypersensitivity, and all patients that declined consent or incompletely filled the consent form and questionnaire.

The objective of the study, the procedure and the likely benefits to the patients were explained to them. Written informed consents were obtained from the women that met the inclusion criteria. Their age, level of education, occupation, parity, body mass index and other patients' information were obtained and documented. Afterwards, they were referred to the Radiology Department for hysterosalpingography.

2.1 Procedure

All the hysterosalpingography investigative modalities were performed at the Radiology Unit of both hospitals, on outpatient basis. The procedure was performed during the proliferative phase of the menstrual cycle, between days 7–10. Lead apron, for body protection, and eye shield, were worn by the radiologist performing the procedure. Prior to the procedure, the patient was asked to abstain from unprotected sexual intercourse from the beginning of her menses until after the procedure, to exclude the risk of pregnancy, which is an absolute contraindication to the procedure. Allergy to contrast media was also excluded.

The patient was placed in lithotomy position on the x-ray table, and a warmed bivalve speculum was introduced to visualize the cervix. The vagina and cervix were cleaned with chlorhexidine solution, following which the cervix was grasped at 12 o'clock position with a tenaculum, and gentle traction applied. A self-retaining cannula was then introduced into the cervical canal, and about 10–20 ml of Urographin, a radio-opaque, water-soluble radiologic contrast media was introduced through the cannula into the uterus, after removing the speculum. Before introducing the contrast, a scout x-ray film was obtained.

The patient was placed supine after contrast media administration, and filling of the uterine cavity and fallopian tubes, and spillage of the dye into the peritoneal cavity was observed under fluoroscopy, with serial x-ray images taken during filling of the uterine cavity, filling of the fallopian tubes, as well as during contrast spillage into the peritoneal cavity. On completion of the procedure, the instruments were removed in turns, the patient was cleaned and repositioned, and asked to put her clothes on. The hysterosalpingography films were reported by Consultant Radiologists, and the study findings were explained to study participants.

2.2 Data analysis

Data were entered into a pre-designed proforma, and were analysed using Statistical Product and Service Solutions for Windows® version 25 (SPSS Inc.; Chicago, USA). Results were presented in frequencies and percentages for categorical variables, and mean and standard deviation for continuous variables. Student's t-test was used to compare sample means, and Chi-square, for associations. Bivariate and multivariate logistic regression analyses were used to determine the relationship between variables and abnormal hysterosalpingography findings. P-value < 0.05 was considered statistically significant.

3. Results

3.1 Sociodemographic characteristics

Three hundred and fifty women participated in the study. The mean age of the women was 35.8 ± 4.56 years, and the modal age-group was 36–40 years (156, 44.6%). Majority (249, 71.1%) of the women had completed tertiary education, and were civil servants (156, 44.6%). About one-half (174, 49.7%) of the women were overweight. Slightly more than one-half (187, 53.4%) were married for 1–5 years, while 16 (4.6%) of the women, were married for longer than 15 years. Two hundred and forty-two (69.1%) women had no living child (Table 1).

3.2 Gynaecological features

One hundred and thirty-nine (39.7%), 99 (28.3%) and 84 (24.0%)

women, were nulliparous, multiparous and primiparous, respectively. About 4 in 5 (273, 78%) women were being evaluated for secondary infertility, as shown in Table 2. Table 2 also shows that the most common gynaecological history among the women was history of induced abortion (215, 61.4%). Others included dysmenorrhoea (175, 50.0%), chronic pelvic pain (97, 27.7%) and pelvic inflammatory disease (84, 24.0%).

3.3 Hysterosalpingography findings

There were abnormal hysterosalpingography findings in 271 (77.4%) women. The findings included tubal pathologies in 263 (75.1%) women, and uterine pathologies in 94 (26.9%) women. The most common uterine pathology was uterine fibroid (74, 21.1%), while tubal blockage was the most common tubal pathology, affecting 251, 71.7%, of the women (Figure 1). Both fallopian tubes were blocked in 109, 31.1% women, the left tube, in 79, 22.6% women, and the right tube, in 63, 18.0%, of the women (Figure 1). Hydrosalpinx (20, 5.7%) and peri-tubal adhesions (12, 3.4%) more commonly involved the right tube (Figure 1). Figures 2 – 7 shows findings on HSG.

Table 1: Sociodemographic characteristics

Characteristics	Frequency, N = 350	Percentage (%)
Age group (years)		
25-30	43	12.3
31-35	111	31.7
36-40	156	44.6
> 40	40	11.4
Mean age ± SD in years	35.8 ± 4.56	
Educational level		
Primary	12	3.4
Secondary	89	25.4
Tertiary	249	71.1
Occupation		
Civil servant	156	44.6
Professional	36	10.3
Trader	122	34.9
Unemployed	36	10.3
Body mass index		
Normal	79	22.6
Overweight	174	49.7
Class I obesity	85	24.3
Class II obesity	12	3.4
Class III obesity	0	0
Duration of marriage (years)		
1-5	187	53.4
6-10	123	35.1
11-15	24	6.9
> 15	16	4.6
Number of children		
None	242	69.1
1-2	88	25.1
> 3	20	5.7
Residential location		
Bayelsa State	313	89.4
Outside Bayelsa State	37	10.6

Table 2: Gynaecological features

Characteristics	Frequency, N = 350	Percentage (%)
Parity		
Nulliparity	139	39.7
Primiparity	84	24.0
Multiparity	99	28.3
Grand-multiparity	28	8.0
Type of infertility		
Primary	77	22.0
Secondary	273	78.0
Duration of infertility (years)		
< 5	246	70.3
6-10	88	25.1
11-15	16	4.6
Gynaecological history		
Dysmenorrhoea	175	50.0
Chronic pelvic pain	97	27.7
Pelvic inflammatory disease	84	24.0
Spontaneous abortion	36	10.3

Induced abortion	215	61.4
Abnormal hysterosalpingography findings		
	271	77.4
Tubal pathology	263	75.1
Uterine pathology	94	26.9
Fibroids	74	21.1
Intrauterine adhesions	12	3.4
Bicornuate uterus	4	1.1
Adenomyosis	4	1.1

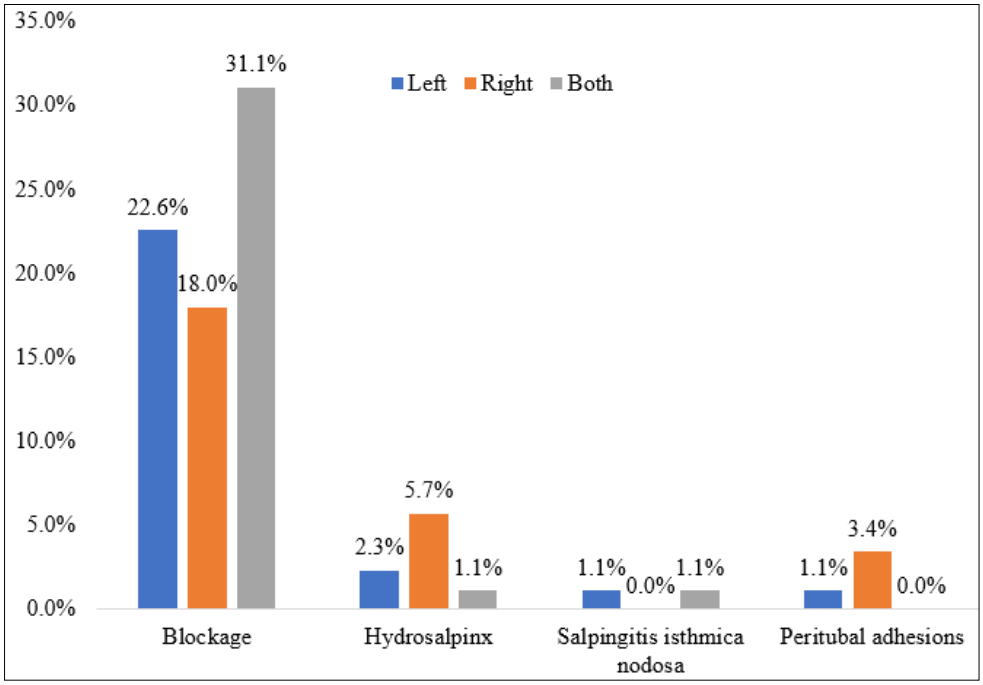

Fig 1: Tubal findings on hysterosalpingography

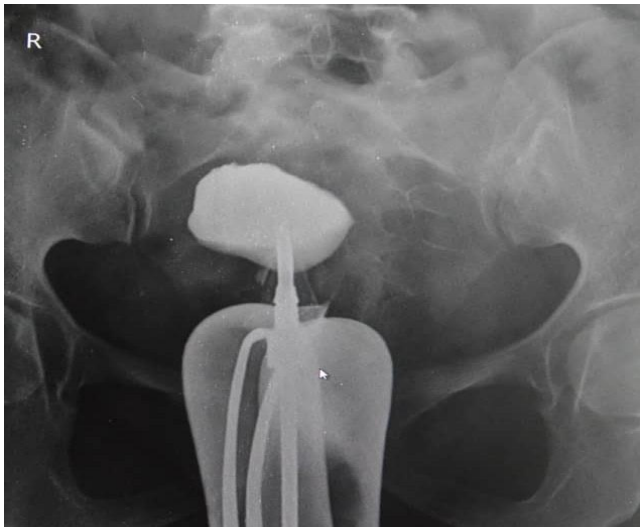

Fig 2: Tubes are not outlined, with no peritoneal contrast spill, suggestive of bilateral tubal occlusion

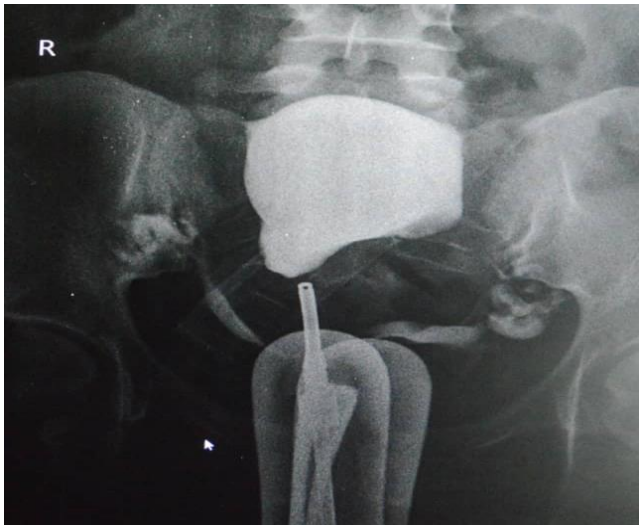

Fig 3: Capacious uterine cavity with bulging outline suggestive of uterine fibroids. Bilateral tubal patency

Fig 4: Capacious uterine cavity. Right tubal patency with free peritoneal spillage. Left tubal occlusion

Fig 5: Abnormally shaped moderately contracted uterine cavity, probably due to intrauterine adhesions. There is left hydrosalpinx and ipsilateral tubal occlusion. Right tubal patency

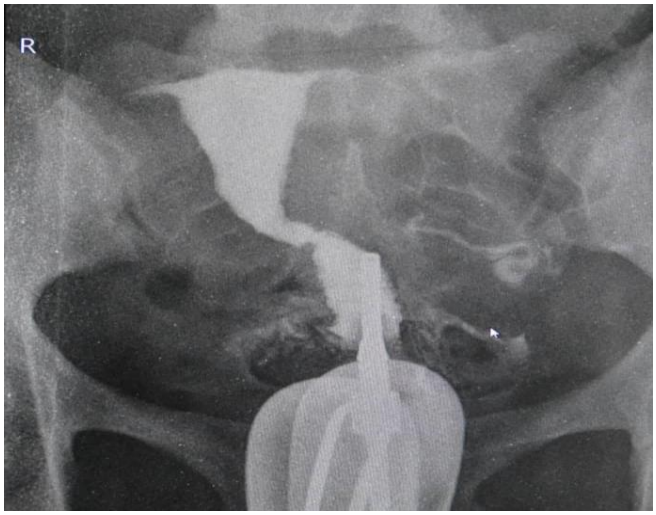

Fig 6: Only proximal aspect of the right fallopian tube is outlined without ipsilateral spillage suggestive of occlusion. The left is outlined with intraperitoneal smearing of contrast consistent with tubal patency

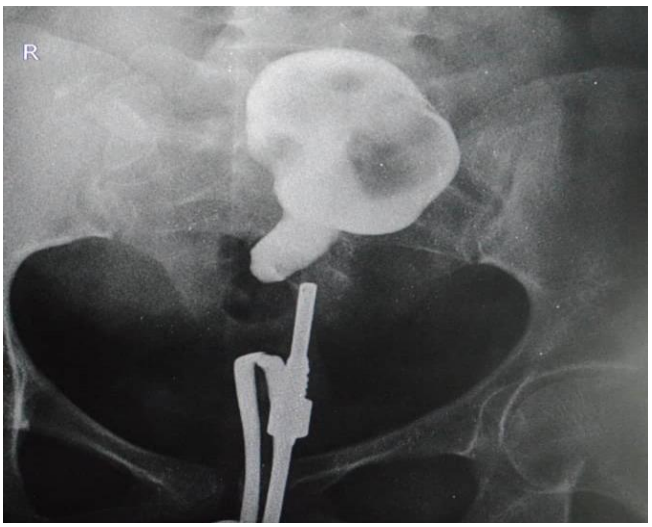

Fig 7: Enlarged uterus with rounded smooth filling defects, and no peritoneal spillage seen, in keeping with uterine fibroids with bilateral tubal occlusion

3.3 Relationship between sociodemographic characteristics and abnormal hysterosalpingography findings

Age (χ^2 = 16.45; p=0.001), educational level (χ^2 = 12.87; p =0.002), and occupation (χ^2 = 73.99; p=0.001), were sociodemographic characteristics that showed significant relationship with the occurrence of abnormal hysterosalpingography findings in the study population (Table 3). The odds of having an abnormal hysterosalpingography increased with advancing age. Women older than forty years were seven times more likely than those aged between 25-30 years (OR-7.13; p=0.001) to have abnormal hysterosalpingography findings. Women with secondary education were three times more likely than their counterparts with tertiary education (OR-3.73; p=0.001) to have an abnormal hysterosalpingography.

Table 3 further shows that while duration of marriage showed a significant relationship (χ^2 =31.11; p=0.001) with occurrence of abnormal hysterosalpingography findings, the number of living children a woman had, was not significantly related to abnormal hysterosalpingography findings (χ^2 = 4.43; p=0.112).

3.4 Relationship between gynaecological features and abnormal hysterosalpingography findings

The type (χ^2 = 10.753; p=0.001) and duration (χ^2 = 34.71; p=0.001) of infertility were significantly associated with the occurrence of abnormal hysterosalpingography findings among the women in the study population. Women with secondary infertility had an increased chance (OR–2.48; p=0.001) of having abnormal hysterosalpingography findings when compared to their counterparts with primary infertility. With increasing duration of infertility, the occurrence of abnormal hysterosalpingography findings increased. Sixty-nine-point five percent (171) of women with duration of infertility of less than five years had abnormal hysterosalpingography findings, and with duration of 6-10 years, this proportion increased to 95.5% (84). All (16) women with 11-15 years of infertility had an abnormal hysterosalpingography finding. Induced abortion (χ^2 = 41.51; p=0.001) and chronic pelvic pain (χ^2 = 7.99; p=0.006) were also significantly associated with abnormal findings on hysterosalpingography. Parity was not significantly (χ^2 = 4.03; p=0.258) associated with abnormal hysterosalpingography findings in this study. These findings are shown in Table 4.

Table 3: Relationship between sociodemographic characteristics and abnormal hysterosalpingography findings

Characteristics	Hysterosalpingography findings		X^2 (p-value)	Crude OR (95%CI)	P-value
	Abnormal	Normal			
Age group (years)					
25-30	24 (55.8)	19 (44.2)	16.45 (0.001)	1	
31-35	91 (82.0)	20 (18.0)		3.60 (1.67-7.79)	0.001
36-40	120 (76.9)	36 (23.1)		2.64 (1.30-5.35)	0.007
> 40	36 (90.0)	4 (10.0)		7.13 (2.16 - 23.55)	0.001
Educational level					
Primary	8 (66.7)	4 (33.3)	12.87 (0.002)	0.74 (0.22-2.53)	0.626
Secondary	81 (91.0)	8 (9.0)		3.73 (1.71-8.12)	0.001
Tertiary	182 (73.1)	67 (26.9)		1	
Occupation					
Civil servant	136 (87.2)	20 (12.8)	73.99 (0.001)	0.85 (0.27-2.66)	0.780
Professional	8 (22.2)	28 (77.8)		0.04 (0.01-0.13)	0.001
Trader	95 (77.9)	27 (22.1)		0.44 (0.14-1.35)	0.152
Unemployed	32 (88.9)	4 (11.1)		1	
Body mass index					
Normal	47 (59.5)	32 (40.5)	49.19 (0.001)	1	
Overweight	162 (93.1)	12 (6.9)		9.19 (4.39-19.24)	0.001
Class I obesity	54 (63.5)	31 (36.5)		1.19 (0.63-2.23)	0.598
Class II obesity	8 (66.7)	4 (33.3)		1.36 (0.38-4.91)	0.637
Duration of marriage (years)					
< 5	124 (66.3)	63 (33.7)	31.11[a] (0.001)	1	
6-10	111 (90.2)	12 (9.8)		4.70 (2.41-9.17)	0.001
11-15	20 (83.3)	4 (16.7)		2.54 (0.83-7.75)	0.101
> 16	16 (100.0)	0 (0.0)			
Number of children					
None	194 (80.2)	48 (19.8)	4.43 (0.112)	1	
1-2	61 (69.3)	27 (30.7)		0.56 (0.32-0.97)	0.039
> 3	16 (80.0)	4 (20.0)		0.99 (0.32-3.09)	0.986

*Statistically significant; [a]Fisher's exact was reported; Note-Category of variable in the shaded row was not included in the bivariate logistic regression analysis because the variable has no participants in that category.

Table 4: Relationship between gynaecological features and abnormal hysterosalpingography findings

Characteristics	Hysterosalpingography findings		X^2 (p-value)	Crude OR (95%CI)	P-value
	Abnormal	Normal			
Parity					
Nulliparity	107 (77.0)	32 (23.0)	4.03 (0.258)	1.34 (0.54-3.32)	0.531
Primiparity	61 (72.6)	23 (27.4)		1.06 (0.41-2.74)	0.903
Multiparity	83 (83.8)	16 (16.2)		2.08 (0.78-5.52)	0.144
Grand-multiparity	20 (71.4)	8 (28.6)		1	
Type of infertility					
Primary	49 (63.6)	28 (36.4)	10.75 (0.001)	1	
Secondary	222 (81.3)	51 (18.7)		2.48 (1.43-4.33)	0.001
Duration of infertility (years)					
< 5	171 (69.5)	75 (30.5)	34.71[a] (0.001)	1	
6-10	84 (95.5)	4 (4.5)		9.21 (3.25-26.03)	0.001
11-15	16 (100.0)	0 (0.0)			
Dysmenorrhoea					
Yes	123 (70.3)	52 (29.7)	10.22 (0.001)	0.43 (0.26-0.72)	0.002
No	148 (84.6)	27 (15.4)		1	
Chronic pelvic pain					
Yes	85 (87.6)	12 (12.4)	7.99 (0.005)	2.55 (1.31-4.97)	0.006
No	186 (73.5)	67 (26.5)		1	
Pelvic inflammatory disease					
Yes	61 (72.6)	23 (27.4)	1.46 (0.226)	0.71 (0.40-1.24)	0.228
No	210 (78.9)	56 (21.1)		1	
Spontaneous abortion					
Yes	20 (55.6)	16 (44.4)	10.99 (0.001)	0.31 (0.15-0.64)	0.001
No	251 (79.9)	63 (20.1)		1	
Induced abortion					
Yes	191 (88.8)	24 (11.2)	41.51 (0.001)	5.47 (3.17-9.45)	0.001
No	80 (59.3)	55 (40.7)		1	

*Statistically significant; [a] Fisher's exact was reported; Note: Category of variable in the shaded row was not included in the bivariate logistic regression analysis because the variable has no participants in that category.

3.5 Predictors of abnormal hysterosalpingography findings

Table 5 shows the outcome of the multivariate logistic regression analysis that uncovered the predictive model for abnormal hysterosalpingography findings in this study. Secondary level of education (OR – 5.97; p=0.007) and secondary infertility (5.27; p=0.001) remained significant variables associated with the occurrence of abnormal hysterosalpingography findings. Other significant variables included the duration of marriage (6 – 10 years: OR – 4.36; p=0.001), duration of infertility (6 – 10 years: 6.94; p=0.001), and induced abortion (OR – 11.73; p=0.001).

Table 5: Predictors of abnormal hysterosalpingography findings

Characteristics	AOR	95%CI for AOR		P-value
		Min	Max	
Age group (25-30 years)				
31-35	1.09	0.73	1.64	0.084
36-40	1.58	0.14	2.67	0.291
> 40	2.48	0.64	6.10	0.491
Educational level (Tertiary)				
Primary	0.38	0.06	3.26	0.110
Secondary	5.97	2.99	11.47	0.007*
Occupation (Unemployed)				
Civil servant	0.24	0.10	5.68	0.374
Professional	0.13	0.07	1.80	0.349
Trader	0.24	0.19	16.04	0.440
Number of children (None)				
1-2	0.49	0.01	4.17	0.184
> 3	0.70	0.14	3.91	0.192
Type of infertility (Primary)				
Secondary	5.27	4.31	6.46	0.001*
Duration of marriage (< 5 years)				
6-10	4.36	1.93	30.79	0.001*
11-15	1.04	0.46	7.21	0.371
> 16				
Duration of infertility (< 5 years)				
6-10	6.94	1.16	14.15	0.001*
11-15				
Dysmenorrhoea (No)				
Yes	0.10	0.01	2.05	0.103
Chronic pelvic pain (No)				
Yes	5.601	0.92	33.98	0.411
Pelvic inflammatory disease (No)				
Yes	0.83	0.06	1.17	0.175
Spontaneous abortion (No)				
Yes	0.22	0.03	0.41	0.001*
Induced abortion (No)				
Yes	11.73	3.71	37.08	0.001*
Body mass index (Normal)				
Overweight	6.26	0.32	47.15	0.723
Class I obesity	1.81	0.67	10.13	0.482
Class II obesity	0.38	0.17	4.22	0.127

*Statistically significant; [a]Fisher's exact was reported; Note – Category of variable in the shaded row was not included in the bivariate logistic regression analysis because the variable has no participants in that category.

4. Discussion

Abnormal findings on hysterosalpingography can be classified as uterine and tubal. Uterine abnormalities include congenital abnormalities, polyps, fibroids, adenomyosis and intrauterine adhesions. Tubal abnormalities are tubal blockage, hydrosalpinx, salpingitis isthmica nodosum, polyps, and peritubal adhesions. Certain patient-related factors may predict the possible presence of one or more of these abnormalities in a woman being evaluated for infertility. This study sought to evaluate these predictive factors. Our study revealed that age, educational level, duration of marriage, type and duration of infertility, induced abortion and chronic pelvic pain significantly increased the chances of an abnormal finding on hysterosalpingography.

The mean age of the women in this study was 35.8 ± 4.56 years, with the highest number of infertile women within the age range of 36-40 years. Other studies within and outside Nigeria have reported similar mean age and/or age range [10-16]. In our study, the chance of having an abnormal hysterosalpingography increased with increasing patients' age. This is consistent with the findings of previous studies [10, 14, 17, 18], but in contrast with the reports of some other authors, who reported that age showed no significant association with abnormal hysterosalpingography findings [19-21]. Ovarian reserve diminishes with increasing age; there is therefore, an increased risk of female infertility, and abnormal hysterosalpingography findings with increasing age.

Women with secondary education were three times more likely to have an abnormal hysterosalpingography compared to other women in this study. The reason for this finding is not very clear. However, the period of secondary education coincides with the age of sexual debut for the majority of young girls in our environment. Unsafe sexual practices, common in this age group, may result in unwanted pregnancy, and consequently, unsafe abortion, given our restrictive abortion laws. Unsafe abortion predisposes to pelvic inflammatory disease, which consequently leads to tubal or uterine factor infertility. In addition, the more educated a woman is, the more likely she is, to practice safe sex,

with positive health-seeking behaviour.

Duration of marriage, type and duration of infertility, showed significant relationship with the occurrence of abnormal findings on hysterosalpingography in this study. The duration of marriage and duration of infertility often positively correlate with the age of the woman, and increasing age is associated with a high rate of infertility, and consequently, abnormal findings on hysterosalpingography. With increasing duration of infertility therefore, the occurrence of abnormal hysterosalpingography findings increases. This corroborates the observation of a previous study in the study centres [17]. Factors contributing to the relationship between duration of marriage, type and duration of infertility, and abnormal hysterosalpingography findings, include post-abortion and puerperal sepsis, postoperative infections, sexually transmitted infections and pelvic inflammatory disease that may complicate induced abortions, as observed in a previous study [17]. In contrast, Toufig *et al*. reported that there was no relationship between type of infertility and abnormal hysterosalpingography findings [19].

In our study, induced abortion significantly increased the chances of an abnormal finding on hysterosalpingography. This is in consonance with the observations of Igoh *et al*., [14] and Egbe *et al*., [20] where induced abortion showed correlation with abnormal hysterosalpingography findings. This is explained by the fact that post-abortion sepsis and pelvic inflammatory disease can complicate induced abortion, especially if unsafe. In as much as multivariate logistic regression did not show a correlation between pelvic inflammatory disease and increased chances of abnormal hysterosalpingography findings in our study, the presence of chronic pelvic pain significantly increased the chances of abnormal hysterosalpingography findings. The women with a history of chronic pelvic pain in this study may have had pelvic inflammatory disease which did not present with the classic clinical features, as one of the major causes of chronic pelvic pain is pelvic inflammatory disease. Pelvic inflammatory disease has been documented by previous studies to be significantly related to tubal factor infertility [19, 22-25].

The strength of this study lies in the fact that it was a two-centre prospective, descriptive, cross-sectional study. Only two Consultant Radiologists performed the hysterosalpingography in this study, thereby reducing the risk of performance bias, and increasing the validity of the study findings. This study is limited by the fact that it is hospital-based. Larger scale, high powered studies are recommended.

5. Conclusion

Our study established that the predictors of abnormal findings on hysterosalpingography were secondary level of education, secondary infertility, duration of marriage, duration of infertility and induced abortion. Attempts to modify these features will help reduce abnormal findings on hysterosalpingography.

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Conflict of interest

The authors declare that there are no conflicts of interest.

Authors' contributions

EKK wrote the research protocol, carried out hysterosalpingography, reported hysterosalpingography films. And collected data. PCO conceptualised the research topic, collated data, wrote the methodology, results, discussion and the first draft of the manuscript. AEU wrote the introduction, and contributed to writing the methodology. IJA managed literature searches. JUU reported hysterosalpingography films. All the authors read and approved the final manuscript.

Ethical approval

The research work was examined and approved by the Research and Ethics Committees of the hospitals.

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