

Pathological Findings from Laparoscopy and Hysteroscopy Procedural Assessments of the Pelvic Environment and the Uterine Cavity among Infertile Black Women in a Sub-Sahara African Country - Nigeria

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Received: July 05, 2019; Published: August 19, 2019

Abstract

Background: Infertility is a global problem among men and women. Laparoscopic and hysteroscopic examinations of the pelvic and uterine environment assist in better management of the infertile women. A complete infertility checkup in both the male and the female, including seminal fluid analysis in the male and hormonal assessment in the female should be carried out.

Setting: Nordica Fertility Centers, Nigeria.

Interventions: Laparoscopy and Hysteroscopy.

Main Outcome Measures: Patients' flow for each intervention, pelvic and intra-uterine pathologies.

Results: The medical records of 3,044 patients were analyzed. Patients inflow for gynecology and infertility management was 227 (7.5%) in 2003 rising to 646 (19.0%) in 2014. Means (\pm sd) of age (in years), BMI (in Kg/m²) and years trying to conceive of these patients were 36.9 (6.2), 27.8 (5.1) and 6.5 (5.0) respectively. Of the 123 (4.0%) women who had laparoscopic examination, 100 (72.9%) had abnormal findings, the most common of which was pelvic adhesions (40, 40.0%). Of the 736 (24.2%) women who had hysteroscopic examinations of the uterine cavity 535 (72.7%) had abnormal results, the most common pathology detected being intra-uterine adhesions (210, 39.2%). Majority of the pelvic (pelvic adhesions, myoma, ovarian cysts and endometriosis) and intra-uterine (intrauterine adhesions, myomas and cervical adhesions) pathologies were observed mostly in women aged 35 - 44 years and mostly among overweight women. The proportions of obese women with intra-uterine adhesions (62, 29.0%), submucous fibroid (40, 32.0%) and endometrial polyps (45, 37.5%) were higher than those who had normal BMI.

Conclusion: Women aged 35 - 44 years and those overweight were more prone to pelvic (adhesions, myoma, endometriosis) and intra-uterine (intrauterine adhesions, endometrial polyps, fibroid, cervical adhesions) pathologies than other groups of women. Gynecologists should consider, among other things, pelvic and intra-uterine endoscopic examinations especially for obese and overweight women and those aged 35 - 44 who present with infertility.

Keywords: Laparoscopy; Hysteroscopy; Pelvis; Uterus; Black Africans; Nigeria

Introduction

Few years ago, in Nigeria, almost all surgical operations involving the pelvis, especially in women with infertility, were conducted as "open surgical procedures" with resultant blood loss above 100 ml, and predisposition to wound infection, wound dehiscence and some mortality. Infertility can be defined as the failure to achieve a pregnancy within 1 year of regular unprotected intercourse [1,2] or, more precisely a lesser capacity to conceive than the mean capacity of the general population [3]. Notwithstanding the intrinsic complications

of estimating the prevalence of infertility [4], it was generally accepted that 25% of women are affected by this problem at one point or the other in their reproductive life [5]. About 30 years ago, approximately 20% of couples visited health facilities because of difficulty conceiving, and half of those couples (10%) required specialist care [6,7].

With the introduction of laparoscope, a thin fiber optic telescope which is inserted into the abdomen, through a small incision in the navel (belly button), surgeons have been able to have a good view of the organs to be operated on or the exact location of the pathology that needs to be corrected or removed. Furthermore, especially in gynecological surgery, if abnormalities are detected during laparoscopy, additional instruments can be placed into the abdomen through tiny incisions at the pubic hair line on the right or on the left side [8]. Women presenting with primary or secondary infertility are often examined to exclude tubal occlusion or pelvic factors through indirect tests, such as hysterosalpingography (HSG), sono-hystero-salpingography or hystero-salpingo-sonography (SH), and/or laparoscopy (Lps) [9]. The value of laparoscopic procedure in the management of infertility is still under debate. Tsuji., *et al.* [10] believe that patients with unexplained infertility, who had undergone standard infertility screening tests such as timing therapy that coordinates the time of ovulation and coitus, controlled ovarian hyperstimulation, or intrauterine insemination, should have diagnostic laparoscopy performed, especially if the treatment is unsuccessful. Naz., *et al.* [11] concluded that diagnostic laparoscopy is a valuable technique for complete assessment of female infertility and making treatment decisions according to the cause. However, Fatum and co-workers [12] were asking if diagnostic laparoscopy should be performed after normal hysterosalpingography in treating infertility suspected to be of unknown origin. Fatum., *et al.* [12] argued that when a diagnosis of unexplained infertility has been established after all standard clinical investigations yielded normal results and tubal patency has been confirmed by hysterosalpingography (HSG), then laparoscopy is suggested as a mandatory step to preclude the existence of peri-tubal adhesions and endometriosis as causes of infertility [12]. According to Bosteels., *et al.* [13], it is not always clear, if and when exactly in the fertility work-up a diagnostic laparoscopy should be offered. Nevertheless, Ajayi., *et al.* [14] reported a relatively low complication rate and short mean duration of hospital stay when laparoscopic procedures are carried out.

While laparoscopy general gives information on the pelvic environment during infertility work-up, hysteroscopy specifically examines the intra-uterine milieu for abnormalities that may be the causative factor for infertility. Abnormal intra-uterine findings are observed in approximately 50% of women with reproductive failure [15]. Studies have showed that the assessment of intrauterine structures can be accomplished by a variety of techniques such as ultrasonography (USG), sonohysterography (SHG), hysterosalpingography (HSG) and hysteroscopy [16-19]. Hysteroscopy has been established as a gold standard procedure for exploring and assessing the uterine cavity, making it a valuable diagnostic and therapeutic tool in the evaluation of intra-uterine abnormality - congenital or acquired - and management of infertility [20]. It is considered superior to HSG being increasingly used in the straight and uninterrupted visualization of the uterine cavity [21]. Hysteroscopy can be used to evaluate the extent and location of intra-uterine adhesions (IUA) as well as provide a means of treatment [22]. Of course, a complete infertility checkup in both the male and the female, including seminal fluid analysis in the male and hormonal assessment in the female should be initiated. In about 15% of couple seeking treatment for infertility, intrauterine abnormalities have been observed to be responsible for inability of the woman to get pregnant. Brown., *et al.* [23] reported that abnormal uterine findings occurred in 34% to 62% of infertile women. In this paper, we present assessment of laparoscopic and hysteroscopic findings among infertile women who consulted at Nordica Fertility Center in Nigeria between 2003 and 2014. The purpose is to examine patient flow pattern for these procedures, the proportion that had laparoscopic evaluation of the pelvis, the proportion that underwent hysteroscopic examination of the uterine cavity and the main pelvic and intra-uterine pathologies discovered using these two procedures among infertile Black African women.

Materials and Methods

Between 2003 and 2014, 3176 women consulted mainly for management of infertility at Nordica Fertility Center. Of these number of patients, medical records and anthropometric data were completed for 3,044 (95.8%), while the remaining 132 (4.2%) were excluded from the study because of incompleteness of data.

A retrospective observational study in which a detailed review of records of 3044 consecutive infertile women who had laparoscopic examinations and hysteroscopic assessments of the intrauterine cavity between 2003 and 2014 was conducted. The setting was Nordica Fertility center, Lagos Nigeria a leading assisted conception and endoscopy center. The study methodology has been reported elsewhere [14, 39]. Briefly, patients' records were retrieved. The pre-operative work up included a detailed history and examination, blood work and a vaginal ultrasound. All procedures were performed under general anesthesia.

Equipment: Standard laparoscopic equipment was used in a laparoscopic theatre in the endoscopy arm of Nordica Fertility Centre, Lagos. Images were displayed on a high definition screen and a 3D-chip camera was used. Hysteroscopy was performed using a rigid 30° 5-mm hysteroscope.

Procedure: Laparoscopy with multiple-port access was the main procedure performed; diagnosis, retrieval of sample for histological diagnosis and appropriate surgical intervention were done as required. Hysteroscopy was performed to evaluate and treat the presence of intrauterine abnormalities. A detailed explanation of the procedure was given by the operating surgeon, and all women signed an informed consent before undergoing the procedure. The informed consent form also related to data being used for training and research purposes. Stage-by-stage findings at laparoscopy or hysteroscopy were recorded by hand in the case note of each patient.

Surgeons' experience: Surgeons experienced in laparoscopy and hysteroscopy performed the procedures. Gynecological endoscopy was their main practice.

Inclusion criteria: All consenting women with indications for laparoscopy or hysteroscopy and who met patient selection criteria were included.

Exclusion criteria: Pregnancy, history of acute pelvic inflammatory disease, pelvic cancer, other conditions rendering patient unfit for laparoscopy or hysteroscopy, lack of consent.

Patients consent: Each participant in the study was contacted and all gave approval for their data to be used in the research. In return, participants were assured of the confidentiality of their data and that the research will not use names of the subjects and that after three years, the data will be destroyed.

Ethics committee approval and Informed consent: All patients were counseled on the processes of laparoscopy and hysteroscopy. Informed consent for the process, and for using results for training and research was obtained from subjects of the study. Anonymity of individual patients was maintained by coding. The study was approved by the local Ethics Committee.

Definitions: For the purpose of this paper, age (years) was categorized into < 25, 25 - 34, 35 - 44 and \geq 45 and Body Mass Index (BMI kg/m²) was stratified into underweight (< 18.5), normal (18.5 - 24.9), overweight (25.0 - 29.9) and obese (\geq 30.0). Variables were accordingly coded for ease of statistical analysis.

Statistical analysis

Data of each patient was coded for anonymity, ease of reference, avoidance of bias and fed into a lap-top computer, cleaned and cross-checked for errors. Analysis of the cleaned data was done using STATA 13 (StataCorp, Texas 77845 USA) statistical software. The data were analyzed descriptively obtaining frequencies and percentages, and inferentially using chi-square test to determine associations, where appropriate. Student's t-test was used to compare means of two categorical variables and Chi-square was used to test association and a P-value < 0.05 was regarded as statistically significant. Confidence Interval (CI) in this study refers to a range of values for specific variable constructed so that this range has a specified probability of including the true value of that variable.

Results

The overall means (\pm sd) of age (in years), BMI (in Kg/m²) and years trying to conceive of these patients were 36.9 (6.2), 27.8 (5.1) and 6.5 (5.0) respectively. Beginning from 2003 till 2014, at a yearly interval, 227 (7.5%), 181 (6.0%), 492 (16.2%), 722 (23.7%), 776 (25.5%) and 646 (19.0%) were seen by experts in gynecology and fertility management (Table 1 and Figure 1). Of these 3,044 women, only 123 (4.0%) performed laparoscopic examination compared to 740 (24.0%) that had hysteroscopic assessment. In general, those who performed laparoscopic assessment of the pelvis were significantly younger (mean (\pm sd) age = 35.7 (5.1); $t = -2.53$, P -value = 0.006), marginally lighter (mean (\pm sd) BMI = 27.1 (4.7); $t = -1.61$, P -value = 0.05) and have been trying to conceive (ttc) for a marginally shorter period of time (mean (\pm sd) ttc = 5.8 (4.7); $t = -1.61$, P -value = 0.05) than those who did not perform laparoscopy. Conversely, those who had hysteroscopic assessment of the uterus were significantly older (mean age = 38.6 \pm 6.0; $t = 9.00$, P -value = 0.000001), not significantly heavier (mean BMI = 28.0 \pm 5.2; $t = 1.38$, P -value = 0.084) but have been trying to conceive for a significantly longer period of time (mean ttc = 7.5 \pm 5.3; $t = 5.91$, P -value = 0.000001).

Variable		All (n = 3,044)	2003-4 (n = 227)	2005-6 (n = 181)	2007-8 (n = 492)	2009-10 (n = 722)	2011-2 (n = 776)	2013-4 (n = 646)
For all women in the study								
Age (Yrs.)	Mean	36.9 (6.2)	35.6 (5.5)	36.1 (5.6)	36.7 (6.0)	36.9 (6.3)	36.8 (6.4)	37.5 (6.4)
BMI (Kg/m ²)	\pm sd	27.8 (5.1)	28.1 (4.5)	27.9 (5.1)	28.2 (4.9)	27.2 (5.0)	27.2 (4.9)	28.5 (5.4)
Trying to conceive (Yrs.)		6.5 (5.0)	6.3 (4.5)	6.1 (4.7)	6.2 (4.8)	6.7 (5.0)	6.5 (5.2)	6.6 (5.0)
Hysteroscopy								
Performed hysteroscopy	Yes	740 (24.0)	8 (3.5)	14 (7.7)	70 (14.2)	148 (20.5)	249 (32.1)	251 (38.8)
	No	2304 (76.0)	219 (96.5)	167 (92.3)	422 (85.8)	574 (79.5)	527 (67.9)	395 (61.2)
Performed hysteroscopy (a)								
Age (Yrs.)	Mean	38.6 (6.0)	37.9 (3.9)	38.1 (4.9)	38.4 (5.5)	39.1 (5.5)	38.6 (6.5)	38.4 (6.1)
BMI (Kg/m ²)	\pm sd	28.0 (5.2)	28.6 (4.3)	29.8 (4.6)	28.0 (5.7)	27.3 (4.4)	27.5 (5.0)	28.6 (5.6)
Trying to conceive (ttc) (Yrs.)		7.5 (5.3)	4.9 (2.7)	6.8 (5.3)	7.7 (5.6)	8.3 (5.4)	7.6 (5.6)	7.0 (4.7)
Did not perform hysteroscopy (b)								
Age (Yrs.)	Mean	36.3 (6.2)	35.5 (5.5)	35.9 (5.6)	36.4 (6.1)	36.3 (6.3)	35.9 (6.1)	36.8 (6.6)
BMI (Kg/m ²)	\pm sd	27.7 (5.0)	28.1 (4.5)	27.8 (5.1)	28.2 (4.8)	27.2 (5.2)	27.1 (4.8)	28.4 (5.2)
Trying to conceive (ttc) (Yrs.)		6.2 (4.9)	6.4 (4.5)	6.0 (4.7)	6.0 (4.6)	6.2 (4.9)	6.0 (4.9)	6.4 (5.3)
Statistical analysis for the two groups (a and b)								
Age (Yrs.)	t-statistics	9.00 (0.000001)	1.68 (0.066)	1.59 (0.065)	2.77 (0.003)	5.35 (0.000001)	5.51 (0.000001)	3.15 (0.0009)
BMI (Kg/m ²)	P-value	1.38 (0.084)	0.32 (0.378)	1.55 (0.071)	-0.28 (0.391)	0.24 (0.406)	1.05 (0.146)	0.45 (0.325)
Trying to conceive (ttc) (Yrs.)		5.91 (0.000001)	-1.50 (0.085)	0.55 (0.296)	2.41 (0.009)	4.30 (0.000001)	3.86 (0.0001)	1.50 (0.066)
Laparoscopy								
Performed laparoscopy	Yes	123 (4.0)	15 (6.6)	11 (6.1)	25 (5.1)	25 (3.5)	32 (4.1)	15 (2.3)
	No	2921 (96.0)	212 (93.4)	170 (93.9)	467 (94.9)	697 (96.5)	744 (95.9)	631 (97.7)

		Performed laparoscopy (c)						
Age (Yrs.)	Mean	35.7 (5.1)	37.2 (5.7)	38.6 (5.4)	34.5 (4.3)	35.1 (4.8)	35.3 (5.8)	35.9 (4.1)
BMI (Kg/m ²)	(± sd)	27.1 (4.7)	29.2 (4.5)	28.4 (4.6)	27.7 (4.4)	27.2 (4.2)	25.8 (4.1)	27.9 (6.1)
Trying to conceive (Yrs.)		5.8 (4.7)	7.0 (5.3)	9.4 (6.5)	6.9 (5.0)	4.0 (3.0)	4.9 (3.9)	5.8 (4.4)
		Did not perform laparoscopy (d)						
Age (Yrs.)	Mean	36.9 (6.3)	35.5 (5.5)	35.9 (5.7)	36.8 (6.1)	37.0 (6.3)	36.8 (6.4)	37.5 (6.5)
BMI (Kg/m ²)	(± sd)	27.8 (5.1)	28.1 (4.5)	27.9 (5.1)	28.2 (5.0)	27.2 (5.0)	27.3 (4.9)	28.5 (5.4)
Trying to conceive (Yrs.)		6.5 (5.0)	6.3 (4.4)	5.8 (4.5)	6.2 (4.8)	6.8 (5.1)	6.6 (5.2)	6.6 (5.1)
		Statistical analysis for the two groups (c and d)						
Age (Yrs.)	t-statistics	-2.53 (0.006)	1.12 (0.140)	1.60 (0.068)	-2.54 (0.008)	-1.92 (0.033)	-1.43 (0.081)	-1.61 (0.062)
BMI (Kg/m ²)	(P-value)	-1.61 (0.05)	0.91 (0.187)	0.35 (0.367)	-0.55 (0.294)	0.00 (1.000)	-2.01 (0.026)	-0.41 (0.342)
Trying to conceive (Yrs.)		-1.61 (0.054)	0.50 (0.312)	1.81 (0.049)	0.68 (0.250)	-4.44 (0.0001)	-2.38 (0.011)	-0.76 (0.229)

Table 1: Socio-demographic characteristics of women who consulted at Nordica Fertility Center between 2003 and 2014.

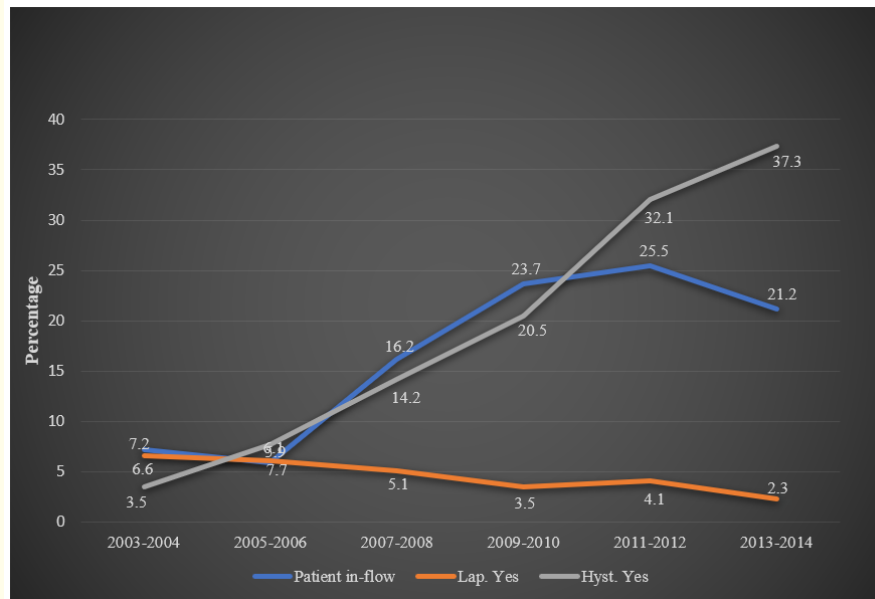


Figure 1: Percent distribution of patients' in-flow and proportion of those that performed Laparoscopy (Lap.) and hysteroscopy (Hyst.) between 2003 and 2014.

Of the 123 (4.0%) women examined by laparoscopy procedure between 2003 - 2014, 100 (72.9%) had abnormal findings - especially in 2007/8 when, of the 25 women thus examined, 23 (92.0%) had abnormal findings. The most common pathology detected at laparoscopic examination was pelvic adhesion, observed in a total of 40 (40.0%) cases. This was followed by fibroid in 29 (29.0%) cases, ovarian cyst in 14 (14.0%) cases and endometriosis in 10 (10.0%) cases. Other pathologies detected in low frequencies were unilateral tubal blockage in 8 (8.0%) cases, salpingitis in 7 (7.0%) cases, bilateral tubal blockage in 6 (6.0%) cases and hydrosalpinx in 5 (5.0%) cases. Finding of tubal blockage was low because laparoscopy was not routinely combined with dye test. There were other pathologies of even lower frequencies as shown in table 2. Cumulatively, there were significant differences in the proportion of fibroid ($\chi^2 = 19.2$, P-value = 0.002), bilateral tubal blockage and foreign body ($\chi^2 = 13.81$, P-value = 0.02) detected at laparoscopy yearly. The proportions of pelvic adhesions (12, 57.1%) and ovarian cysts (6, 30.0%) detected at laparoscopy were higher in 2011/12 and 2009/2010 respectively, than any period, though no significant difference was noted.

Performed Laparoscopy	Category	All	%	2003/4	2005/6	2007/8	2009/10	2011/2	2013/4	χ^2	P-value
				(n = 227)	(n = 181)	(n = 492)	(n = 722)	(n = 776)	(n = 646)		
				Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)		
	Yes	123	4.0	15 (6.6)	11 (6.1)	25 (5.1)	25 (3.5)	32 (4.1)	15 (2.3)		
	No	2921	96.0	212 (93.4)	170 (93.9)	467 (94.9)	697 (96.5)	744 (95.9)	631 (97.7)		
If "Yes"	Normal	23	18.7	1 (6.7)	0 (0.0)	4 (16.0)	5 (20.0)	11 (34.4)	2 (13.3)	9.56	0.09
	Abnormal	100	81.3	14 (93.3)	11 (100.0)	21 (84.0)	20 (80.0)	21 (65.6)	13 (86.7)		
Pathology detected	Cervical polyp	1	1.0	0 (0.0)	0 (0.0)	1 (4.3)	0 (0.0)	0 (0.0)	0 (0.0)	3.80	0.58
	Ovarian cyst	14	14.0	0 (0.0)	0 (0.0)	4 (19.0)	6 (30.0)	2 (9.5)	2 (15.4)	9.14	0.10
	Ovarian drilling	1	1.0	0 (0.0)	0 (0.0)	1 (4.3)	0 (0.0)	0 (0.0)	0 (0.0)	3.80	0.58
	Dermoid cyst	1	1.0	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (7.1)	6.76	0.24
	PCOS	1	1.0	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (7.1)	6.76	0.24
	Fibroid	27	27.0	1 (7.1)	1 (9.1)	7 (33.3)	1 (5.0)	10 (47.6)	7 (53.8)	19.2	0.002
	Bilateral tubal blockage	6	6.0	4 (28.6)	1 (9.1)	0 (0.0)	1 (5.0)	0 (0.0)	0 (0.0)	16.37	0.006
	Unilateral tubal blockage	10	10.0	3 (21.4)	3 (27.3)	3 (14.3)	0 (0.0)	1 (4.8)	0 (0.0)	10.41	0.06
	Pelvic adhesion	40	40.0	2 (14.3)	4 (36.4)	8 (38.1)	11 (55.0)	12 (57.1)	3 (23.1)	9.95	0.08
	Hydrosalpinx	5	5.0	1 (7.1)	0 (0.0)	2 (9.5)	0 (0.0)	2 (9.5)	0 (0.0)	4.26	0.51
	Absent tubes	3	3.0	0 (0.0)	1 (9.1)	1 (4.3)	0 (0.0)	1 (4.8)	0 (0.0)	3.30	0.65
	Salpingitis	8	8.0	1 (7.1)	0 (0.0)	1 (4.3)	2 (10.0)	4 (19.0)	0 (0.0)	5.99	0.31
	Endometrioma	2	2.0	0 (0.0)	0 (0.0)	0 (0.0)	1 (5.0)	1 (4.8)	0 (0.0)	2.94	0.71
	Endometriosis	10	10.0	0 (0.0)	1 (9.1)	2 (9.5)	2 (10.0)	2 (9.5)	3 (23.1)	4.05	0.54
	Adenomyosis	1	1.0	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (7.1)	6.76	0.24
	Foreign body	4	4.0	3 (21.4)	0 (0.0)	0 (0.0)	0 (0.0)	1 (4.2)	0 (0.0)	13.81	0.02
Frozen pelvis	2	2.0	0 (0.0)	0 (0.0)	0 (0.0)	1 (5.0)	1 (4.2)	0 (0.0)	2.94	0.71	

Table 2: Abnormal laparoscopic findings (with multiple pathologies) among women who consulted at Nordica Fertility Center between 2003-2014.

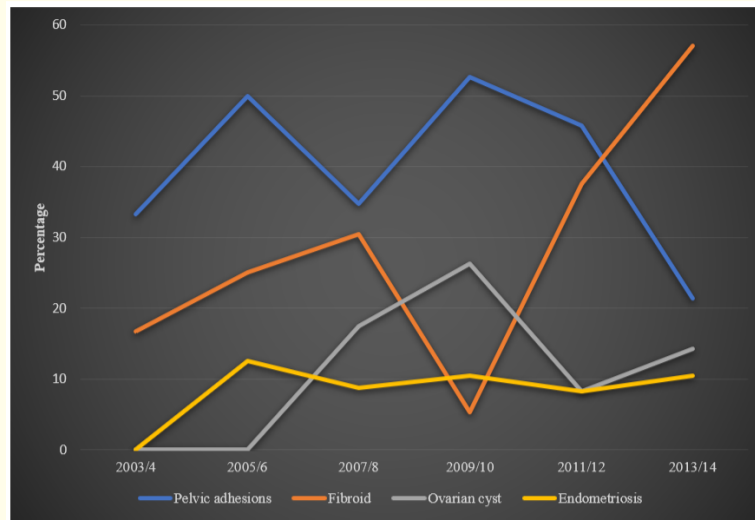


Figure 2: Yearly distribution of major pathologies discovered at laparoscopy.

A higher proportion of women (736, 24.2%) had hysteroscopic examinations of the uterine cavity (Table 3), than those who had laparoscopic investigation (123, 4.0%) for pelvic assessment. Of the 736 that underwent hysteroscopic examinations, 535 (72.7%) had abnormal results, especially in 2009/10 period when, out of 722 patients that consulted, 149 (20.6%) presented for hysteroscopy amongst whom 129 (86.6%) had one form of uterine abnormality or another. Overall, the most common pathologies detected at hysteroscopic assessments were intrauterine adhesions (218, 40.7%), fibroid (121, 22.6%) and endometrial polyps (118, 22.1%). Cervical adhesions (23, 4.3%), cervical polyps (13, 2.4%), cervical stenosis (10, 1.9%) and uterine septum (9, 1.7%) were observed to occur in low frequencies. Endometrial hyperplasia 5 (0.9%), adenomyosis (2, 0.4%), foreign body (2, 0.4%), uterus bicornuate (1, 0.2%) and necrotic uterine lesion (1, 0.2%) were pathologies that were observed in very low frequencies.

Performed Hysteroscopy	Category	All	%	2003/4	2005/6	2007/8	2009/10	2011/2	2013/4
				(n = 227)	(n = 181)	(n = 492)	(n = 722)	(n = 776)	(n = 646)
				Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)
Yes	Yes	736	24.2	8 (3.5)	14 (7.7)	70 (14.2)	149 (20.6)	243 (32.1)	252 (38.8)
	No	2308	75.8	219 (96.5)	167 (92.3)	422 (85.8)	573 (79.4)	533 (67.9)	394 (61.2)
If "Yes"	Normal	201	27.3	2 (25.0)	5 (35.7)	22 (31.4)	20 (13.4)	83 (34.2)	69 (27.4)
	Abnormal	535	72.7	6 (75.0)	9 (64.3)	48 (68.5)	129 (86.6)	160 (65.8)	183 (72.6)
If "Abnormal"	Cervical polyps	13	2.4	0 (0.0)	0 (0.0)	2 (4.2)	1 (0.8)	1 (0.6)	9 (4.9)
	Cervical adhesion	23	4.3	0 (0.0)	0 (0.0)	2 (4.2)	2 (1.5)	9 (5.6)	10 (5.5)
	Cervical septum	2	0.4	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.8)	0 (0.0)	1 (0.5)
	Cervical stenosis	10	1.9	0 (0.0)	1 (11.1)	0 (0.0)	3 (2.3)	6 (3.8)	0 (0.0)
	Endometrial polyps	118	22.1	4 (66.7)	1 (11.1)	15 (31.2)	34 (2.4)	28 (17.5)	36 (19.7)
	Endometrial hyperplasia	5	0.9	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.5)	1 (0.6)	2 (1.1)
	Intrauterine adhesion	218	40.7	0 (0.0)	4 (44.4)	18 (37.5)	51 (39.5)	74 (46.2)	71 (38.8)
	Adenomyosis	2	0.4	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.1)
	Foreign body	2	0.4	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.2)	0 (0.0)
	Necrotic uterine lesion	1	0.2	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.6)	0 (0.0)
	Uterus bicornuate	1	0.2	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.8)	0 (0.0)	0 (0.0)
	Uterine Septum	9	1.7	0 (0.0)	1 (11.1)	0 (0.0)	7 (5.4)	1 (0.6)	0 (0.0)
	Fibroid	121	22.6	2 (33.3)	2 (22.2)	11 (22.9)	27 (20.9)	34 (21.3)	45 (24.6)
Fibrotic band	10	1.9	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (1.9)	7 (3.8)	

Table 3: Abnormal hysteroscopic findings (with multiple pathologies) among women who consulted at Nordica Fertility Center between 2003-2014.

When the women were disaggregated by age and by body mass index, no woman aged < 25 years and none with BMI < 18.5 had laparoscopic examination as indicated in figures 3a and 3b. Majority of the foremost pelvic pathologies were observed more among women aged 35 - 44 years and among those aged 25 - 34 years, indicating that critical age range for women to present with pelvic adhesions, myoma, ovarian cysts and endometriosis is between 25 - 44 years. For example, in figure 3a, pelvic adhesions (21, 52.5%) and myoma 14 (50.0%) were more common in infertile women aged 35 - 44 years than among those aged 25-34 years (19, 47.5% and 11, 39.3% respectively). However, ovarian cysts were more common in women aged 25 - 34 years (9, 64.3%) than among those aged 35 - 44 years (5, 35.7%). Endometriosis was found in equal proportion (5, 50.0% respectively) in the two age groups of 25 - 34 and 35 - 44 years. Other pathologies were more common (24, 77.4%) in those aged 35 - 44 years. Surprisingly, all major pathologies discovered at laparoscopic examinations were most prevalent among infertile women who were overweight with BMI of 25.0 - 29.9, as illustrated in figure 3b. For example, pelvic adhesions (19, 47.5%), myoma (11, 39.3%), ovarian cysts (8, 57.1%) and endometriosis (5, 50.0%) were found more in infertile women who were overweight than among those with normal BMI (12, 30.0%; 9, 32.1%; 4 28.6% and 3, 30.0% respectively) or among obese infertile women (9, 22.5%; 8, 28.6%; 2 14.3% and 2, 20.0% respectively). This may indicate that overweight women are more prone to pelvic pathologies than obese or normal weight women. This needs further research.

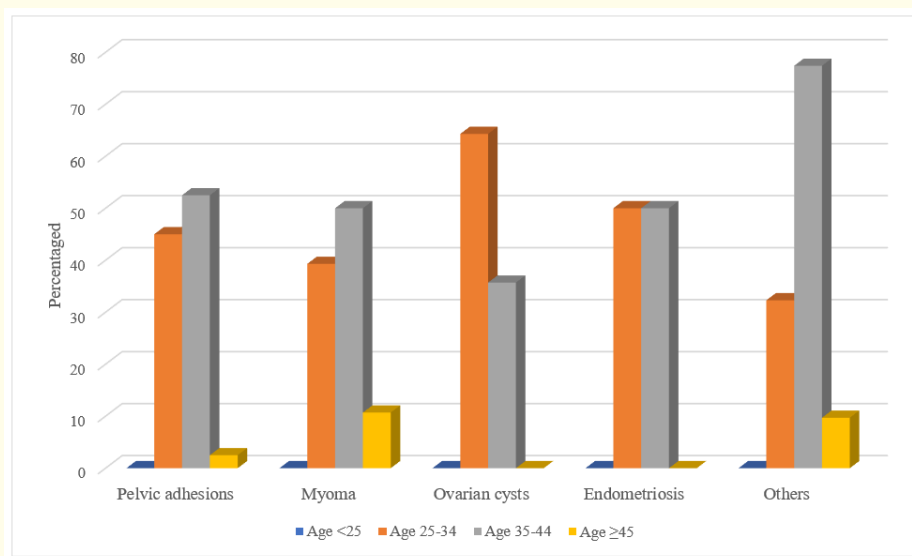


Figure 3a: Distribution of major pelvic pathologies found at laparoscopic examinations of infertile women by age (years).

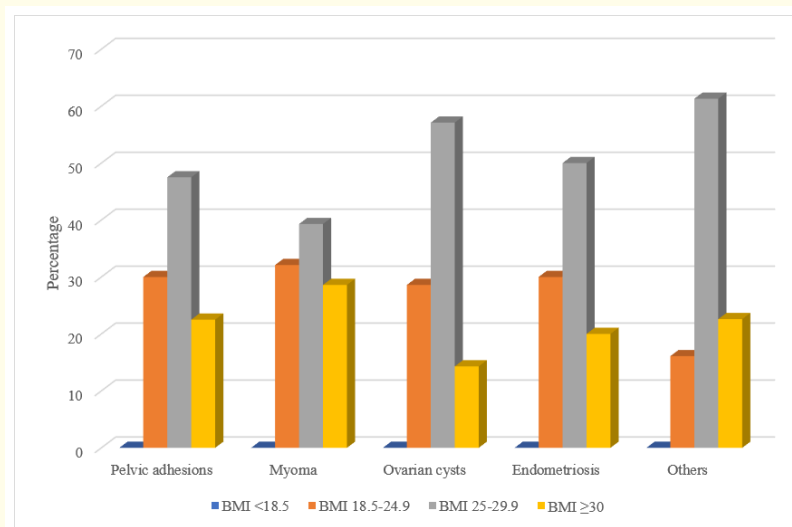


Figure 3b: Distribution of major pelvic pathologies found at laparoscopic examinations of infertile women by Body Mass Index (Kg/m²).

When the patients who conducted hysteroscopic examination were disaggregated into different age groups and BMI groups, the picture was slightly similar to what was observed among those who had laparoscopic examination, especially in reference to age (Table 4 and Figures 4a and 4b). All the major intrauterine pathologies found at hysteroscopy were primarily among those aged 35 - 44 years and secondarily among those aged 25 - 34 years. The highest proportions of infertile women with intrauterine adhesions (134, 62.6%) and myoma (77, 61.6%) were among those aged 35 - 44 years, followed by those aged ≥ 45 years (42, 19.6% and 25, 20.0% respectively), as shown in figure 4a. Also, the highest proportions of infertile women with endometrial polyps (70, 58.3%) and cervical adhesions (17, 70.8%) were aged 35 - 44 years but followed by those aged 25 - 34 years (32, 26.7% and 6, 25.0% respectively). Other intrauterine pathologies were more prevalent (116, 45.9%) in infertile women aged 35 - 44 years than in other age groups.

Variable	Item	Total	%	Conducted laparoscopic examination		Pelvic adhesions		Myoma		Ovarian cysts		Endometriosis		Others	
				Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
All		3,044	100.0	123	4.0	40	32.5	28	22.8	14	11.4	10	8.1	31	25.2
Age group	< 25	36	1.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	25 - 34	1,110	36.5	52	42.3	19	47.5	11	39.3	9	64.3	5	50.0	10	32.3
	35 - 44	1,555	51.1	65	52.8	21	52.5	14	50.0	5	35.7	5	50.0	24	77.4
	≥ 45	343	11.3	6	4.9	0	0.0	3	10.7	0	0.0	0	0.0	3	9.7
BMI group	< 18.5	31	1.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	18.5 - 24.9	844	27.7	32	26.0	12	30.0	9	32.1	4	28.6	3	30.0	5	16.1
	25.0 - 29.9	1,260	41.4	61	49.6	19	47.5	11	39.3	8	57.1	5	50.0	19	61.3
	≥ 30	909	29.9	30	24.4	9	22.5	8	28.6	2	14.3	2	20.0	7	22.6
Freq. %				Conducted hysteroscopic examination		Intrauterine adhesions		Myoma		Endometrial polyps		Cervical adhesions		Others	
Freq.				%	Freq.	%	Freq.	%	Freq.	%	Freq.	%			
All		3,044	100.0	736	24.0	214	28.1	125	16.4	120	15.8	24	3.1	253	36.5
Age group	< 25	36	1.2	1	0.1	0	0.0	0	0.0	1	0.8	0	0.0	0	0.0
	25 - 34	1,110	36.5	197	26.8	39	18.2	23	18.4	32	26.7	6	25.0	97	38.3
	35 - 44	1,555	51.1	414	56.3	134	62.6	77	61.6	70	58.3	17	70.8	116	45.9
	≥ 45	343	11.3	124	16.8	41	19.2	25	20.0	17	14.2	1	4.2	40	15.8
BMI group	< 18.5	31	1.0	8	1.1	2	0.9	2	1.6	1	0.8	0	0.0	3	1.2
	18.5 - 24.9	844	27.7	202	27.4	51	23.8	32	25.6	39	32.5	8	33.4	72	28.5
	25.0 - 29.9	1,260	41.4	293	39.8	99	46.3	51	40.8	35	29.2	11	45.8	97	38.3
	≥ 30	909	29.9	233	31.7	62	29.0	40	32.0	45	37.5	5	20.8	81	32.0

Table 4: Major pelvic and intrauterine pathologies detected at laparoscopic and at hysteroscopic examinations relative to age and by BMI of study subjects.

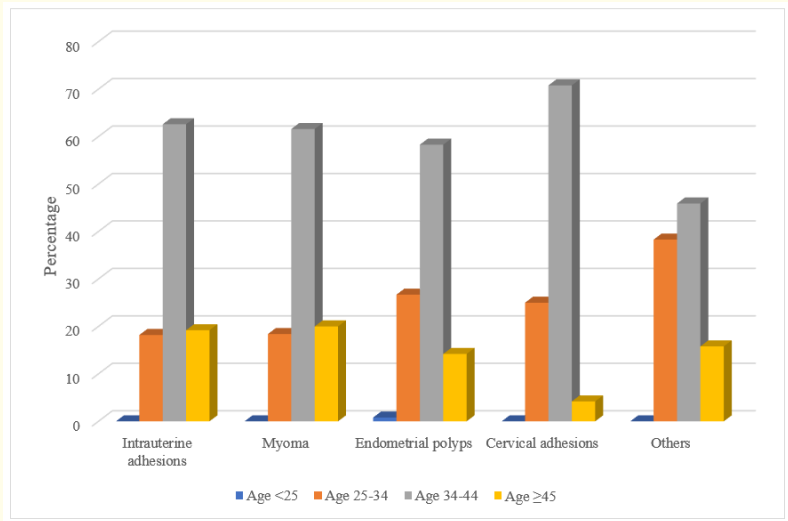


Figure 4a: Distribution of major intrauterine pathologies discovered at hysteroscopic assessment of infertile women relative to age.

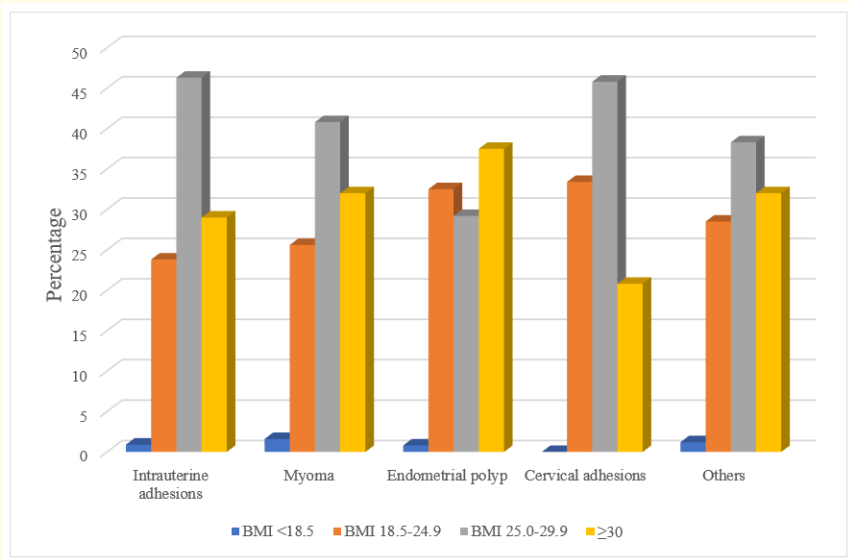


Figure 4b: Distribution of intrauterine pathologies discovered at hysteroscopic examinations of infertile women relative to BMI (Kg/m²).

Intrauterine adhesions (99, 46.3%), myoma (51, 40.8%), cervical adhesions (11, 45.8%) and other intrauterine pathologies (97, 38.3%), were most prevalent among overweight women with BMI of 25 -29.9 Kg/m², compared to obese infertile women (62, 29.0%; 40, 32.0%; 5, 20.8% and 81, 32.0% respectively), as illustrated in figure 4b. The least proportions of intrauterine adhesions (2, 0.9%), myoma (2, 1.6%), endometrial polyp (1, 0.8%) and other pathologies were found among underweight women with BMI < 18.5 kg/m². Women

with normal BMI who had intrauterine adhesions (51, 23.8%), myoma (32, 25.6%) and endometrial polyps (39, 32.5%) were in lower proportions than obese women though cervical adhesions were seen more among infertile women with normal BMI (8, 33.4%) compared to their obese counterpart (5, 20.8%).

Discussion

Laparoscopy and hysteroscopy have found important places in reproductive health. The shorter recovery time, fewer complications, benefits in infertility diagnosis and management are some of the desirable advantages. In some cases, women with reproductive failure present with abnormal uterine findings which may be related to poor endometrial receptivity, requiring assessment of the uterine cavity [15]. Hysteroscopic examination of the uterine cavity plays a vital role in distinguishing possible intrauterine alterations capable of obstructing implantation or growth, or both, of the fetus, and in evaluating the advantages of variable management modalities in reestablishing a normal endometrial environment [20]. There are four major findings in this study which assesses pelvic and uterine environments among infertile Black African women. The first is that the mean age of the patients was about 36.9 ± 6.2 years indicating late presentation for gynecological intervention, the mean BMI was 27.8 ± 5.1 Kg/m² indicating that our study subjects were mostly overweight women and the mean years of trying to conceive was 6.5 ± 5.0 years showing delayed presentation for infertility probably due to seeking help from other sources. These variables were much higher than the 25.2 ± 3.9 years, 23.3 ± 3.2 Kg/m² and the 5.1 ± 3.4 duration of infertility that Siam [15] reported from Egypt in North Africa or the 32.9 ± 4.1 reported for age in Poland [24]. Earlier study has shown that most Black Africans, especially Nigerians, often present for fertility challenges in the fourth decade of life, when they are usually overweight. There is possibly a socio-psychological reason for this. Infertile women often would try as much as possible to get pregnant naturally and when this fails, they probably would consult non-clinical practitioners who are cheaper and more accessible before finally consulting a gynecologist. The Nigerian Health System and lack of health insurance drives most women to high out-of-pocket expenses, eroding funds for family sustenance. From another perspective, not having an immediate solution to their fertility challenges, after many years, possibly drives most women to eating disorders. This appears to lead to being overweight that triggers reduced sex drive, higher risk of developing Polycystic Ovarian Syndrome (PCOS), failure to ovulate and low egg production [25].

Laparoscopy was performed for only 123 (4.0%) of all the patients amongst whom 100 (81.3%) had abnormal findings. From these laparoscopic examinations, the prevalence of pelvic adhesion (40, 40.0%) was higher than the 23.9% reported by Hu., *et al.* [26] in China. Unrestricted contractile, ciliary and peristaltic mechanisms in the fallopian tubes are the main mechanisms responsible for ovum pick-up, sperm transport and zygote transfer and when adhesions inhibit these mechanisms, infertility results [27]. Pelvic adhesions were probably caused also by endometriosis or pelvic inflammatory diseases.

Fibroids are known to be more prevalent in black women and in infertile women. The prevalence of sub-serosal fibroid in our study (27, 27.0%) was higher than the 10.7% reported for all gynecological admissions in a 4-year period at Nnewi in South-east Nigeria [28], though the method of diagnosis was missing. Desai and Patel [29] assert that fibroids are present in about 5 - 10% of patients presenting with infertility, while Buttram and Reiter [30] found uterine fibroids to be the sole cause of infertility in only 2.4%, though these figures do not represent correct estimate of the prevalence of fibroids in infertile patients. Laparoscopic examination of the pelvis conveniently detects, especially, sub-serosal fibroids which bulge into the pelvis. Sub-serosal fibroids, especially when large enough, often result in significant pelvic and back pain episodes, chronic abdominal pain with intermittent spasms, dysuria, constipation, chronic bladder and bowel spasms and even to peritonitis [31].

Another remarkable finding in this study was that hysteroscopy was normal in only 27.3% of the patients, a finding that was far below the 65.12% normal hysteroscopic results reported by Sahu., *et al.* [20] in India, the 74.7% reported by Palshetkar., *et al.* [32] also in India and the 60.7% reported by Koskas., *et al.* [33] in France. The commonest pathology discovered at hysteroscopy was intrauterine adhesions, seen in 214 (28.1%) patients similar to the 25.0% reported elsewhere in Nigeria [34] but higher than the 15 (5.1%) reported by

Palshetkar, *et al* [32]. An earlier study found a higher prevalence of intrauterine adhesions among Nigerians (44.9%) but a lower prevalence (13.3%) among Indians indicating that Nigerians were 5 times more likely to have intrauterine adhesions than Indians [35].

One of the sequelae from gynecological procedures on the uterus, especially D&C and myomectomy, is the development of intrauterine adhesion [36]. Apart from its impact on fertility, intra-uterine adhesions may present as abdominal/pelvic pain or bowel obstruction [37]. Certain trauma inflicted on the endometrium, such as curettage, Caesarian section and myomectomy, are thought to be risk factors for the development of intra-uterine adhesions [38,39].

Another interesting observation was that the 15.8% prevalence of endometrial polyps in this study which doubled the 7.8% (48/619) reported by Dreisler, *et al.* [40] in Denmark. Clinically, endometrial polyps have been associated with symptoms such as postmenopausal bleeding, menorrhagia, intermenstrual bleeding and infertility.

Conclusion

Pelvic and intra-uterine adhesions were the most frequent pathologies when infertile women were investigated by laparoscopy and hysteroscopy in Nigeria. Diverse theories have been proposed to describe the mechanism of fertility challenges resulting from pelvic and intrauterine pathologies. Intra-uterine polyps probably impact fertility due to their exact position in the uterine cavity, producing mechanical block as tubo-cornual polyp, by relating to endometrium, or by producing the enzyme aromatase. Fibroids that protrude into the cavity may decrease vascular supply to the trophoblastic tissue when implantation takes place on the overlying endometrium. Other pathologies like synechiae, endometritis and cervical stenosis can be causes of subfertility. In addition, our paper indicates poor health seeking behavior in this part of the world. Enlightenment on importance and benefits of early presentation to fertility experts needs to be improved.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Acknowledgement

All the patients who participated in this study are acknowledged

Funding

There was no external funding for this study.

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Volume 8 Issue 9 September 2019

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