Hysterosalpingography Findings in Infertile Women and Their Relationship with Demographic Variables: A Retrospective Study

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Abstract

Background: Hysterosalpingography is a vital diagnostic method for identifying anatomical causes of infertility, often used as a cost-effective screening test. This study aimed to investigate hysterosalpingography results in infertile women.
Methods: A quantitative, descriptive, and analytic cross-sectional study was conducted on 180 infertile couples referred to Ghadir Maternal and Child Hospital in Shiraz, Iran between February and July 2015-2016. Data were collected from patient records and hysterosalpingography findings. A questionnaire encompassing demographic information and hysterosalpingography results was utilized. Qualitative and quantitative variables were described using frequency and mean± standard deviation. Data were analyzed using Kolmogorov-Smirnov normality test, Chi-square, and generalized linear models via IBM SPSS version 22.
Results: Hysterosalpingography (HSG) revealed that 145 women (80.6%) exhibited normal uterine and tubal findings, while 35 women (19.4%) displayed abnormal results (classified as normal and abnormal HSG findings). Women with abnormal hysterosalpingography were observed to have a higher likelihood of primary infertility (OR=3.8, 95%CI (1.427-10.10), P=0.008). Furthermore, the study assessed the impact of Body Mass Index (BMI) and identified that women in the abnormal HSG group had a higher body mass index (OR=0.89, 95%CI (0.794-0.992), P=0.035).
Conclusions: Tubal adhesion stemming from undiagnosed and untreated sexual infections can lead to primary infertility. Limited resources may hinder timely detection and treatment access, exacerbating the issue. The correlation between obesity and infertility could be attributed to an unhealthy lifestyle in low-income families. Encouraging health education within low to middle-income communities is recommended to prevent sexually transmitted infections and promote healthier lifestyles, ultimately reducing the incidence of primary infertility.

Keywords: Demography, Hysterosalpingography, Infertility

1. Introduction

Infertility refers to the inability to achieve pregnancy within one year of engaging in sexual intercourse without employing any contraceptive methods. Primary infertility pertains to the incapacity to conceive initially, while secondary infertility involves the challenge of conceiving after a prior pregnancy (1). Globally, countless couples grapple with infertility, with prevalence rates ranging from 6% to 15.7% worldwide, 15.5% in China, and 7.88% in Iran (2, 3). The World Health Organization (WHO) data indicates that primary infertility affects 1.9% of women aged 20 to 44, while secondary infertility affects 10.5%. Notably, South Africa and South Asia exhibit higher infertility rates (4).

Couples encounter infertility primarily due to male factors, female factors, or unexplained reasons. Female factors encompass a range of issues, including disorders related to ovulation, the fallopian tubes, the peritoneum, the uterus, and the cervix (5). Tubal factor infertility accounts for roughly 30% of all infertility cases (6). This condition often stems from congenital anomalies, endometriosis, pelvic inflammatory diseases (PID), and tubal occlusion (7). The high prevalence of tubal infertility among infertile couples indicates that health policymakers should consider the

preventive policies.

Furthermore, distinguishing between primary and secondary infertility related to these factors enables the formulation of preventive policies and educational initiatives. Lifestyle and demographic variables also exert an influence on fertility health. Research demonstrated that confident lifestyle choices adversely impact fertility in both males and females, including alcohol and caffeine consumption, smoking, obesity, and engagement in high-risk sexual behavior. Alarmingly, recent study indicated a rising trend of these factors within modern lifestyles (8). Consequently, calculating the associated risk ratios can aid in prioritizing reproductive health education programs within healthcare systems.

The fundamental objective of infertility treatment lies in identifying the condition's underlying cause. Hysterosalpingography (HSG) is a diagnostic tool to assess the uterine cavity, fallopian tubes, and endocervical canal (9). HSG stands out for its affordability and accessibility, making it the predominant instrument for detecting disorders within the fallopian tubes and uterine cavity, particularly in the United States and the United Kingdom (10).

In cases of tubal pathology, HSG exhibits a sensitivity of 80% and a specificity of 76%. Conversely, for uterine pathology, HSG demonstrates a sensitivity of 67% and a specificity of 73% (11). The present study assessed and juxtaposed HSG results in women from infertile couples while also investigating its correlation with demographic factors and specific lifestyle behaviors.

2. Methods

A comprehensive quantitative descriptive and analytical cross-sectional study was conducted involving 180 infertile couples referred to Ghadir Maternal and Child Hospital in Shiraz, Iran between 2015 and 2016. Over six months, women seeking in vitro fertilization (IVF) treatment at the hospital were selected using a simple sampling method. The dataset comprised 180 women, and their demographic profiles alongside hysterosalpingography results were meticulously documented and subjected to thorough analysis. The study encompassed infertile couples afflicted by primary and secondary infertility, adhering to specific inclusion criteria. Excluded from the study were couples who declined to provide consent, women with a history of hospitalization due to Pelvic Inflammatory Disease (PID), women actively undergoing PID treatment at the time of hysterosalpingography, and those with documented genetic reproductive disorders.

Following a comprehensive explanation of the study, the infertile couples provided their informed consent by completing consent forms and questionnaires. Subsequently, the medical records of hysterosalpingography for the women in these couples were meticulously reviewed. The questionnaire employed in this study encompassed two sections: one aimed at gathering demographic information about the women and another in the form of a checklist designed to record hysterosalpingography outcomes.

Mean± standard deviation (SD) was employed as the descriptive measure to depict qualitative, relative frequency, and quantitative variables. The collected data underwent analysis using the Kolmogorov-Smirnov normality test, Chi-square test, and generalized linear models. IBM SPSS version 22 was employed for statistical analysis, with a predetermined significance level of 0.05 for all conducted tests.

3. Results

A study involving 180 women examined the results of their hysterosalpingography (HSG). The average age of the women was 32.36±5.07 years, with a standard deviation provided in parentheses. Most participants fell within 31 to 35 age group, as indicated in Table 1. The average duration of infertility was 7.27±4.91 years, from 1 to 23 years.

The prevalence of infertility types was as follows: 152 women (84.4%) experienced primary infertility, 26 women (14.5%) experienced secondary infertility, and a mere 2 women (1.1%) had a history of both primary and secondary infertility (Table 1).

The HSG results in Table 2 revealed that 145 women (80.6%) exhibited normal findings in both the uterus and fallopian tubes, while 35 women (19.4%) displayed abnormal findings in these areas. Among the 35 women with abnormal findings, 25 had unilateral occlusion, whereas only 2 had bilateral occlusion. Additionally, 6 women had

Table 1: Age groups and types of infertility in 180 women of infertile couple referred to Ghadir Maternal and Child Hospital in Shiraz

	Groups	Sub groups	Frequency (percent)	P value
Age group	Normal group, n=145	20-25y/o	16 (11%)	0.5*
		26-30y/o	38 (26.2%)	
		31-35y/o	50 (34.5%)	
		36-40y/o	41 (28.3%)	
	Abnormal group, n=35	20-25y/o	2 (5.7%)	
		26-30y/o	9 (25.7%)	
		31-35y/o	10 (28.6%)	
		36-40y/o	14 (40%)	
Type of infertility	Normal group, n=145	Primary infertility	129 (71.67%)	0.001*
		Secondary infertility	15 (8.34%)	
		Both (primary and secondary infertility)	1 (0.55%)	
	Abnormal group, n=35	Primary infertility	23 (12.78%)	
		Secondary infertility	11 (6.11%)	
		Both (primary and secondary infertility)	1 (0.55%)	

*Chi square

Table 2: Tubal finding in 180 women of infertile couple referred to Ghadir Maternal and Child Hospital in Shiraz

Finding on hysterosalpingography	Types of infertility			Frequency (number)	Percent (%)
	Primary	Secondary	Both		
Normal finding (normal fallopian tube and uterus)	129	15	1	145	80.6
Fallopian tube blockage and adhesion	18	8	1	27	15
salpingectomy	3	3	0	6	3.3
Uterus abnormality	2	0	0	2	1.1
Total	152	26	2	180	100

Table 3: Association of income and weight between normal and abnormal groups

Parameter	Groups	Mean+SD	OR (95% C.I)	P value
Income (×107 Rial)	Normal group, n=145	1.3±0.92	0.99 (0.98-1.01)	0.007
	Abnormal group, n=35	0.97±0.91		
Weight (kg)	Normal group, n=145	64.90+9.28	0.95 (0.92-0.98)	0.044
	Abnormal group, n=35	68.68+10.03		

previously undergone unilateral tubal resection due to ectopic pregnancy. Notably, only two cases of uterine abnormalities were recorded: one instance of a unicorn uterus and another of a septal uterus.

In order to assess the findings, researchers categorized the women into two groups based on their hysterosalpingography results: those with expected results (n=145) and those with abnormal results (n=35). No significant differences were observed between the two groups concerning variables such as volume of menstrual bleeding, menstrual pain, tea, coffee consumption, cigarette and hookah use, and educational level (P>0.05 for all). However, notable discrepancies emerged in women's weight and the couples' income (P<0.05 for both), as illustrated in Table 3. Notably, women in the abnormal HSG group tended to have higher weights, while families with more significant income demonstrated fewer abnormal hysterosalpingography findings. These differences were statistically significant.

In this study, a logistic regression model was constructed to examine the influence of various factors on the type of infertility while accounting for BMI, smoking habits, tobacco usage, and caffeine consumption. The results unveiled that women with abnormal hysterosalpingography results were more commonly associated with primary infertility (OR=3.8, 95% CI [1.427-10.10], P=0.008). Furthermore, when assessing the impact of BMI through logistic regression, adjusted for smoking, tobacco usage, and caffeine consumption, it was discovered that women in the abnormal HSG group had higher body mass indices (OR=0.89, 95% CI [0.794-0.992], P=0.035) (Table 4). The predictive factors of the logistic regression are detailed in Table 5.

Table 4: Association of type of infertility and body mass index between normal and abnormal groups

Results of HSG	Predictors	OR	95% CI	P value
Abnormal HSG group	Primary infertility *	3.8	1.427-10.10	0.008
	Body mass index (BMI)**	0.89	0.794-0.992	0.035

*Women with abnormal hysterosalpingography were in the primary infertility group with odd ratio of 3.8. **Women in the abnormal HSG group had higher body mass index with odd ratio of 0.89. The model was adjusted for smoke consumption, tobacco consumption and caffeine use; HSG: Hysterosalpingography

Table 5: Association of body mass index, tobacco consumption, caffeine consumption, and type of fertility in abnormal groups

Results of HSG	Predictor	OR	95% CI	P value
Abnormal HSG group	BMI	0.891	0.793-1.001	0.052
	Tobacco consumption	1.514	0.515-4.452	0.451
	Caffeine consumption	2.547	0.397- 16.348	0.324
	Primary infertility	3.797	1.427-10.103	0.008

The model was adjusted for smoke consumption, tobacco consumption and caffeine use. HSG: Hysterosalpingography; BMI: Body Mass Index

Qualitative variables were presented using frequency (relative frequency) for descriptive purposes, while quantitative variables were expressed as mean±standard deviation (SD). The data was analyzed using the Kolmogorov-Smirnov normality test, Chi-square test, and generalized linear models. IBM SPSS version 22 was employed for these analyses, and a significance level of 0.05 was applied to all tests.

4. Discussion

The study revealed a substantial prevalence (84.4%) of primary infertility. Notably, women in the abnormal HSG group had significantly higher weights. Furthermore, women from higher-income families exhibited fewer abnormal findings in hysterosalpingography, and this correlation was statistically significant.

The most notable discovery of this study is the elevated frequency of primary infertility (84.4%), a figure almost consistent with a study conducted by Jain and Jain (12). In this study, the prevalence of secondary infertility was found to be 14.5%. This outcome carries significance, especially in light of the latest infertility statistics in Iran. The most recent data from the National Institute for Health Research (NIHR) indicates that primary and secondary infertility prevalence in Iran stands at 10% and 15%, respectively (13). According to the present study, primary infertility is linked to a higher occurrence of abnormal findings in hysterosalpingography. In a study led by Farokh Tehrani and colleagues, in 308 women referred for hysterosalpingography at Imam Reza Hospital in Mashhad, Iran, primary infertility's prevalence was 54%, while secondary infertility was 46% (14). Another study by Behroozi and co-workers revealed a primary infertility prevalence of 65% and a secondary infertility prevalence of 35% (15).

Disparities in primary infertility prevalence across studies stem from differing definitions and methodologies. Study of Safarinejad highlighted several factors influencing infertility prevalence, including participant demographics such as age, geographic location, and gender, along with the definitions of infertility, inclusion and exclusion criteria, and study methodologies (16).

The study's high prevalence of primary infertility coupled with a low prevalence of anatomical disorders (fallopian tube and uterus) suggested that primary infertility's most prominent causes might be pelvic infections or reproductive health risk factors, such as endometriosis; urogenital bacterial infections represented a primary cause of infertility (17). These infections can impact the reproductive system, leading to pelvic inflammatory disease (PID), infertility, ectopic pregnancy, sexually transmitted infections (STIs), and endometritis. Microbial infections encompass Neisseria gonorrhea, Chlamydia trachomatis, bacterial vaginosis, and Mycobacterium tuberculosis. These organisms can cause fallopian tube dysfunction and tubal infertility (18). The World Health Organization (WHO) reported 105 million new Chlamydia infections in adults, 106 million new Neisseria gonorrhea infections, 10 million new syphilis infections, and 276 million new Trichomonas vaginalis infections (19).

Limited research has focused on vaginitis prevalence in Iran; studies in Kerman indicated a prevalence of 0.2% for Trichomonas vaginalis and 31% for Candida Albicans (20, 21).

Approximately 13-50% of infertile women are affected by endometriosis (22). Endometritis in women can be asymptomatic, potentially leading to endometriosis, infertility, in vitro fertilization (IVF) failure, tubo-ovarian abscess, and recurrent pregnancy loss (23, 24). Endometriosis can manifest not only during reproductive age but also in adolescence (25).

The study's elevated prevalence of pelvic infections and endometriosis during reproductive years underscores their significance in infertility and reproductive health. Moreover, healthcare providers must recognize that genital infections or endometriosis can remain asymptomatic, undiagnosed, and untreated. Thus, educapreventive care, diagnosis, and treatment education should commence prior to marriage.

Policymakers in reproductive health should acknowledge the necessity of sexual education and sexual and reproductive health services to enhance sexual awareness, facilitate prompt diagnosis, ensure effective intervention and treatment, and ultimately reduce female infertility (26).

Furthermore, the higher prevalence of secondary infertility could stem from the aftermath of prior pregnancies. Complications from previous pregnancies, including unsafe or illegal abortions, postpartum infections, retained placenta, manual placenta removal, and ruptured ectopic pregnancies, may contribute to secondary infertility (27).

The study revealed a noteworthy connection between women's weight and abnormal HSG results. Notably, in investigation by Kiridi and colleagues, 350 infertile women undergoing hysterosalpingography were participated; it was observed that out of 271 infertile women (77.4%), a significant number were classified as overweight or obese (9). Some studies highlighted the correlation between obesity and infertility among women of reproductive age. Obese women contend with various issues, including infertility, anovulation, menstrual irregularities, compromised outcomes in assisted reproductive technology (ART), and a higher likelihood of miscarriage (28, 29).

Obesity affects infertility through multiple mechanisms:

Anovulation: Obese women often experience increased peripheral aromatization of androgens into estrogens, resulting in hyperandrogenism and hyperestrogenism, leading to anovulation (30).

In instances where anovulation is not present, research of Nsonwu-Anyanwu and colleagues on women with tubal infertility, despite ovulation occurring, indicated that obesity could elevate oxidative stress and reduce fertility (31). A longitudinal study spanning 25 years, focused on women of reproductive age, demonstrated that obesity between the ages of 7 and 11 raised the risk of infertility in adulthood (32).

Consequently, this study identified a significant incidence of primary infertility and noted elevated body weights among the abnormal HSG group. These findings implied that obesity during the pre-marital phase may influence primary infertility. Additionally, it was discovered that women from higher-income families exhibited fewer abnormal hysterosalpingography findings. Notably, economic status in infertile women appeared to contribute to delays in seeking infertility treatments. This finding aligns with a study conducted by Datta and colleagues in Britain, which reported that nearly half of infertile women and men sought medical treatment (33). The current investigation unveiled that 18.3% of the women exhibited aberrant findings in the fallopian tube through hysterosalpingography. Within this, 10% of primary and 4.44% of secondary infertility cases were attributed to tubal dysfunction. Factors such as fallopian tube obstruction and adhesions often stem from salpingitis, sexually transmitted diseases, and pelvic inflammatory conditions. Furthermore, primary infertility exhibited a significantly higher occurrence of tubal disorders than secondary infertility. In a study conducted by Subhi and co-workers in Oman, the prevalence of tubal factors among women with primary and secondary infertility was reported as 19% and 29%, respectively (34).

In contrast, a study by Rohani and Naroienejad in Iran revealed a 29% prevalence of fallopian tube pathology, with the prevalence of tubal factors in

primary infertility and secondary infertility cases being 14% and 44%, respectively. However, no significant difference was found between these two groups (35). This discrepancy might be attributed to genital infections linked to the pre-marital period, an often-overlooked aspect. Pre-marital infection patients usually do not seek treatment due to barriers such as a lack of clinical symptoms and the absence of pre-marital clinics in Iran.

In our study, unilateral tubal occlusion was considerably more prevalent than bilateral ones. Notably, 3.3% of women had a history of unilateral tubal resection stemming from ectopic pregnancies. Given the relevance of tubal issues in causing both primary and secondary infertility, a thorough examination of the fallopian tubes is recommended (36). While laparoscopy is the gold standard for fallopian tube assessment, the associated complications make hysterosalpingography a more practical option. Hence, hysterosalpingography is suggested as a screening tool for diagnosing and treating tubal disorders (37).

The study revealed a prevalence of 49.1% for female factors, 31.4% for male factors, and 12.2% for male and female factors. Other research indicated a range of 30-55% for the female component, 20-40% for the malefactor, and 20-40% for both male and female factors (38, 39). The variations in these findings can be attributed to differences in rates of genital infections, complications arising from abdominal and pelvic surgeries, diverse healthcare services, and economic statuses.

In this study, the highest prevalence of infertility was observed among women aged 30 to 40; the higher incidence of sexually transmitted diseases (STDs) within this age group could be attributed to increased sexual activity. The results of this study align with a global study that demonstrated the highest prevalence of infertility among individuals aged 35 to 39 years old (40).

In addition, in this study, average duration of infertility was approximately 7 years, whereas another study reported an average infertility duration of around 5 years (41). The duration of infertility plays a crucial role in determining the success rate of treatment methods (42).

These findings underscored the significance of comprehensive and timely treatment of sexual tract infections in adolescents, the importance of recognizing symptoms, and the need for addressing conditions such as endometriosis as practical measures to prevent primary infertility. Moreover, hysterosalpingography takes precedence over secondary infertility when it comes to diagnostic methods for primary infertility.

4.1. Strengths and Limitations

A notable strength of this study lies in its assessment of the correlation between hysterosalpingography results of infertile women and their fertility-related information and lifestyles within one of the foremost referral facilities. Consequently, the sample encompassed a spectrum of cultural, social, and healthcare access disparities. However, a limitation of this study pertains to the lack of pre-marriage information about women's reproductive health, including potential infections, polycystic ovary syndrome (PCOS), and other related factors.

5. Conclusion

Tubal pathology stands as a significant contributor to infertility. Conditions like pelvic inflammatory disease (PID), infections, endometriosis, pelvic surgeries, and ectopic pregnancies are known to bring about disorders in the fallopian tubes. Thus, emphasizing the reproductive well-being of adolescents, effective management of genital infections and treatment, enhancing awareness levels, and refining public health services are instrumental approaches in infertility treatment.

For young women, it is advisable to undergo pre-marital counseling and pre-conception screening. This program should encompass comprehensive reproductive health education, screening for reproductive health issues, financial assistance, medical care provisions, and guidance on lifestyle adjustments.

Ethical Approval

The research work was approved by the Ethics

Committee of Shiraz University of Medical Sciences, Shiraz, Iran with the code of CT-92-6899. Also, written informed consent was obtained from the participants.

Authors' Contribution

BMB: Substantial contributions to the design of the work and drafting the work. LD: Substantial contributions to the conception of the work and drafting the work. MEP: Analysis of data for the work and reviewing the work critically for important intellectual content. MHD: Analysis of data for the work and reviewing the work critically for important intellectual content. AJ: Substantial contributions to the conception of the work, drafting the work and reviewing it critically for important intellectual content. SZG: Substantial contributions to the conception of the work, drafting the work and reviewing it critically for important intellectual content. MZ: Substantial contributions to the design of the work and drafting the work. PG: Substantial contributions to the design of the work and drafting the work. All authors have read and approved the final manuscript and agree to be accountable for all aspects of the work, such that the questions related to the accuracy or integrity of any part of the work.

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