Original Research Article

Changing Trends in Infertility Among Couples Seeking Treatment in Bangladesh: A Comparative Study (2007–2024)

Khaleda Nasreen[1], Selina Afroz Ansary[2], Mehnaz Mustary Shume[3], Mohammad Delwer Hossain Hawlader[4], Zahanuma Akhtar Aoishee[5], Ismat Jahan Kumkum[6], Moktarul Islam[7*]

[1]Assistant professor, Reproductive Endocrinology and Infertility, Shaheed Suhrawardy Medical College and Hospital, Dhaka, Bangladesh
[2]Assistant professor, Reproductive Endocrinology and Infertility, Dhaka Medical College & Hospital, Dhaka, Bangladesh
[3]Junior Consultant, Reproductive Endocrinology and Infertility, Shaheed Suhrawardy Medical College and Hospital, Dhaka, Bangladesh
[4]Associate professor, Department of Public Health, North South University, Dhaka, Bangladesh
[5]Alok Infertility and Research Center, Mirpur, Dhaka, Bangladesh
[6]Reproductive Endocrinology and Infertility, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh
[7]Epidemiologist, Innovation and Evidence Hub, Bangladesh (IEH, BD), Mirpur, Dhaka, Bangladesh

*Corresponding author: Moktarul Islam
Epidemiologist, Innovation and Evidence Hub, Bangladesh (IEH, BD), Mirpur, Dhaka, Bangladesh

Abstract

Infertility remains a significant public health concern in Bangladesh, with evolving socio-demographic, medical, and lifestyle factors influencing reproductive health. This study compares infertility patterns among Bangladeshi couples between 2007 and 2024 to identify key contributing factors and assess changes over time. A comparative cross-sectional study was conducted using data from 2007 and 2024. The study population included couples seeking infertility treatment at selected healthcare centers in Bangladesh. Data were collected through structured questionnaires and medical record reviews. Statistical analyses were performed using STATA 17 to evaluate trends in infertility prevalence, associated factors, and reproductive health outcomes. Among couples seeking infertility treatment, the proportion of female infertility cases increased from 43% in 2007 to 94.2% in 2024, while male infertility cases declined from 36% to 9.1%. Primary infertility cases accounted for 67% in 2007 but decreased to 51.9% in 2024, whereas secondary infertility increased from 33% to 48.1% over the same period. The proportion of women with irregular menstrual cycles and endocrine disorders, such as polycystic ovary syndrome (PCOS), rose significantly. Positive lifestyle modifications were observed, including reduced smoking and increased physical activity. Surgical histories showed a decline in laparotomy procedures among females and a shift toward minimally invasive interventions. The findings highlight shifting infertility trends, with a rise in female infertility and associated endocrine disorders. Improvements in lifestyle factors and reproductive healthcare access suggest progress in infertility management. Targeted public health strategies, enhanced diagnostic capabilities, and evidence-based interventions are essential to address the evolving infertility landscape in Bangladesh.
Keywords: Infertility, Bangladesh, Polycystic Ovary Syndrome, Reproductive Health, Socio-Demographics, Lifestyle Factors.

INTRODUCTION

Infertility, defined as the inability to conceive after 12 months of regular, unprotected intercourse, is a significant global public health issue, affecting approximately 17.5% of adults worldwide [1, 2]. It is categorized into primary infertility (where an individual has never achieved a pregnancy) and secondary infertility (where a pregnancy was previously achieved but not successfully repeated) [2]. Infertility has profound medical, psychological, and socioeconomic consequences, often leading to stress, stigma, and financial burdens for affected couples.

The burden of infertility varies across regions due to differences in socioeconomic status, cultural norms, healthcare access, and environmental influences[1]. While primary infertility is more prevalent in developed nations, secondary infertility tends to be more common in developing countries, where reproductive health issues such as infections, postpartum complications, and unsafe obstetric practices significantly impact fertility [3, 4]. In developing nations, infertility rates can be up to three times higher than in developed countries due to inadequate healthcare infrastructure and limited availability of fertility treatments [5]. Additionally, male infertility has been rising globally, particularly in regions with high-middle and middle socio-demographic indices, indicating the need for a broader understanding of infertility beyond female reproductive factors [6].

In Bangladesh, infertility has historically been a neglected issue within reproductive health policies, which have largely focused on addressing overpopulation rather than the reproductive challenges faced by couples who struggle to conceive [7]. Despite the absence of comprehensive national data, the World Infertility Survey estimated that infertility rates in South Asia are 4% in Bangladesh, 6% in Nepal, 5% in Pakistan, and 4% in Sri Lanka[8], highlighting the necessity for targeted research and interventions.

The causes of infertility in Bangladesh are complex and multifactorial, encompassing medical, genetic, lifestyle, and socio-environmental influences. Social stigma, cultural expectations, and economic constraints further exacerbate the challenges faced by affected couples, often leading to marital strain, emotional distress, and social isolation [9, 10].

Over the past two decades, Bangladesh's healthcare landscape has significantly changed due to urbanization, economic development, increased healthcare accessibility, and shifting reproductive behaviors[11–13]. Factors such as delayed parenthood, lifestyle modifications, rising obesity rates, and stress have likely contributed to evolving fertility patterns. However, there remains a gap in understanding how these changes have impacted infertility rates over time.

Several key biological and environmental factors contribute to infertility, including ovulatory disorders, tubal blockages, sexually transmitted infections (STIs), uterine abnormalities, and endocrine disorders[13, 14]. Additionally, indirect contributors such as malnutrition, anemia, obesity, stress, exposure to environmental toxins, and delayed childbearing have been increasingly linked to infertility [15]. Studies from South Asia have highlighted the significant impact of reproductive tract infections, postpartum complications, and unsafe obstetric practices on female infertility, with some of these conditions leading to long-term reproductive health consequences, including pelvic inflammatory disease and tubal damage [7, 10].

This study aims to compare the patterns of infertility among Bangladeshi couples between 2007 and 2024 and identify key socio-demographic, medical, and lifestyle factors contributing to infertility in both genders. It also evaluates changes in menstrual and obstetric patterns and assesses the impact of public health interventions and lifestyle modifications on reproductive health outcomes. By providing valuable insights into the evolving landscape of infertility in Bangladesh, this study aims to support evidence-based strategies to improve access to fertility treatment and enhance reproductive health outcomes.

METHODS AND MATERIALS
Study Design
This research follows a comparative cross-sectional study design. Data was initially collected in 2007 from Shaheed Suhrawardi Hospital (formerly Begum Khaleda Zia Medical College) and Infertility Care and Research Centre Ltd, Mohammadpur, Dhaka. In 2023-2024, data was collected from three healthcare centers: Alok Healthcare Centre, Somorita Medical College, and Confidence Diagnostic Centre, Narayangonj. The study compares the factors contributing to infertility between 2007 and 2024, allowing for a temporal analysis of infertility patterns.

Study Setting
The 2023-2024 phase of the study took place at the following healthcare centers in Bangladesh:
1. **Alok Healthcare Centre**, Mirpur, Dhaka, is a modern facility offering general medical services, including gynecology and reproductive health care.
2. **Somorita Medical College & Hospital**, Tejgaon, Dhaka, is a teaching hospital providing specialized services with a 500-bed capacity.
3. **Confidence Diagnostic Centre**, Araihazar, Narayangonj, is a facility offering diagnostic services for reproductive health.

Study Population and Sampling Technique
A consecutive purposive sampling method was employed to select participants actively seeking infertility treatment at specific healthcare centers. This ensured the inclusion of individuals undergoing infertility evaluations for a comparative analysis over time. The study focused exclusively on infertile couples, so findings should be interpreted within this clinical cohort rather than as general infertility prevalence.

Participants included male and female partners at these centers, with female partners aged 20-40 and male partners aged 21-60, regardless of their fertility status. All had undergone diagnostic procedures confirming infertility, and informed consent was

obtained before participation, adhering to ethical research standards.

Sample Size Determination

The sample size was calculated using the following standard formula for proportions, based on an estimated infertility prevalence of 15% (P = 0.15), with a 95% confidence level (Z = 1.96) and a 5% margin of error (d = 0.05).

$$n = \frac{Z^2 P (1-P)}{d^2}$$

The initial sample size calculation yielded 196 individuals and their partners, totalling approximately 392 participants (216 couples). To account for a 10% non-response rate, the final sample size was increased to 432 participants (216 couples).

However, during data collection, the study successfully enrolled 362 couples, resulting in a total sample size of 724 individuals, which exceeds the calculated sample size. This enhanced sample size improves the study's statistical power, allowing for more robust analyses and greater generalizability of the findings.

Data Collection and Statistics Analysis

Data were collected using a structured questionnaire, administered in-person or virtually based on participants' preferences. The questionnaire gathered information on demographic characteristics, reproductive history, medical history, lifestyle factors, and specific infertility diagnoses. Medical records were also reviewed to confirm diagnoses and treatments.

The questionnaire underwent a validation process, including expert review to ensure content validity and pilot testing with a small sample of infertile couples to assess clarity, relevance, and questionnaire reliability. Feedback from the pilot study led to refinements in question wording and structure, enhancing the tool's effectiveness for data collection.

Data were managed and analyzed using STATA 17. Descriptive statistics, including means, standard deviations, and frequencies, were calculated for

key variables. Comparative analyses were conducted to assess changes in the prevalence of infertility factors between 2007 and 2024, providing a comprehensive understanding of evolving patterns and contributing factors to infertility.

Ethical Considerations

The study received ethical approval from the Bioethics Committee (Ref: ERC-BBS/0051-29/02/2024), adhering to the Declaration of Helsinki guidelines. Informed consent was obtained from all participants, with clear information about the study's purpose, procedures, risks, and benefits. Confidentiality and anonymity were maintained, and participants were free to withdraw at any time. The study ensured cultural sensitivity, particularly regarding reproductive health and infertility discussions.

RESULTS

This study compares patterns of infertility among Bangladeshi couples from 2007 to 2024 and identifies key socio-demographic, medical, and lifestyle factors contributing to infertility in both genders.

Socio-Demographic Characteristics of Infertile Couples between 2007 and 2024

The proportion of females with postgraduate qualifications decreased from 33% in 2007 to 18% in 2024 The majority of females (65.5%) had completed undergraduate education in 2024. In 2024, the study population was predominantly Muslim (94.2%), followed by Hindu (5.3%) and Christian (0.6%) participants. Comparable data for 2007 was not available. The majority of females in 2024 were housewives (78.5%), with a similar proportion in 2007 (68%). The proportion of female service holders decreased from 20% in 2007 to 7.5% in 2024. Additionally, 5.8% of females were employed in nursing roles in 2024. Among males, the proportion of service holders decreased from 65% in 2007 to 43.7% in 2024. There was an increase in males engaged in business (21%) and worker roles (22.7%) in 2024.

The proportion of couples in the middle-income category increased from 60% in 2007 to 63.3% in 2024. The high-income bracket slightly decreased from 12% in 2007 to 11.9% in 2024 (**Table 1**).

Table 1: Comparison of Socio-Demographic Characteristics among Infertile Couples between 2007 and 2024

Variable	2007 (n=100)	2024 (n=362)
Female Education		
Under Graduate	17 (17%)	237 (65.5%)
Graduate	50 (50%)	60 (16.6%)
Post Graduate	33 (33%)	65 (18.0%)
Female Occupation		
Service Holder	20 (20%)	27 (7.5%)
Housewife	68 (68%)	284 (78.5%)
Nurse	NA	21 (5.8%)
Business	2 (2%)	3 (0.8%)

Variable	2007 (n=100)	2024 (n=362)
Teacher	6 (6%)	12 (3.3%)
Worker/Self-employment	NA	11 (3.0%)
Doctor	4 (4%)	2 (0.6%)
Lawyer and others	0 (0%)	2 (0.6%)
Male Occupation		
Service Holder	65 (65%)	173 (47.8%)
Business	3 (3%)	76 (21.0%)
Teacher	20 (20%)	14 (3.9%)
Doctor	8 (8%)	3 (0.8%)
Lawyer	2 (2%)	NA
Worker	NA	82 (22.7%)
Self-Employment	NA	7 (1.9%)
Living Abroad	NA	5 (1.4%)
Unemployed	2 (2%)	2 (0.6%)
Couple Socio-Economic Status		
Low (Less than 25000)	28 (28%)	90 (24.9%)
Middle (25000 – 60000)	60 (60%)	229 (63.3%)
High (Above 60000)	12 (12%)	43 (11.9%)

Comparison of Infertility Patterns between 2007 and 2024

In 2024, female infertility accounted for 94.2% of cases, a significant increase from 43% in 2007. Male infertility decreased from 36% to 9.1% over the same period. The proportion of infertility attributed to both partners remained relatively stable (5.5% in 2007 vs. 4.1% in 2024). Unexplained infertility slightly decreased from 10% in 2007 to 5% in 2024.

The majority of couples in 2024 reported infertility durations of 2-5 years (41.2%), compared to 38% in 2007. The proportion of couples experiencing infertility for 1-2 years increased from 22% in 2007 to 37% in 2024. Infertility durations of 5-10 years decreased from 30% to 19.3%, and above 10 years dropped from 10% to 2.5% between 2007 and 2024.

Primary infertility cases decreased from 67% in 2007 to 51.9% in 2024, while secondary infertility cases increased from 33% to 48.1%. The mean age of females at primary infertility in 2024 was 25.99 ± 4.79 years. The proportion of women aged 24 years or less increased from 6% in 2007 to 36.7% in 2024, while those above 35 decreased from 15% to 3.7%. For secondary infertility, the mean age in 2024 was 27.80 ± 4.38 years. The proportion of women aged 25-30 years rose from 15.2% in 2007 to 57.5% in 2024. Those above 35 years decreased from 45.5% to 3.5% (**Table 2**).

Table 2: Comparison of Infertility Patterns among Infertile Couples between 2007 and 2024

Variables	n available	2007, n (%)	n available	2024, n (%)
Gender-Based Infertility				
Male	100	36 (36)	362	33 (9.12)
Female	100	43 (43)	362	341 (94.20)
Both	200	11 (5.50)	724	30 (4.14)
Unexplained	100	10 (10)	362	18 (4.97)
Duration of Infertility (years)	100		362	
1-2		22 (22)		134 (37.02)
2-5		38 (38)		149 (41.16)
5-10		30 (30)		70 (19.34)
Above 10		10 (10)		9 (2.49)
Types of Infertility	100		362	
Primary		67 (67)		188 (51.93)
Secondary		33 (33)		174 (48.07)
Female Age (Years) at Infertility				
At Primary Infertility	67		188	
Mean Age ±SD		-		25.99±4.79
24 or less		4 (5.97)		69 (36.70)
25-30		36 (53.73)		86 (45.74)
31-35		17 (25.37)		26 (13.83)
Above 35		10 (14.93)		7 (3.72)

Variables	n available	2007, n (%)	n available	2024, n (%)
At Secondary Infertility	33		174	
Mean Age ±SD		NA		27.80±4.38
24 or less		3 (9.09)		26 (14.94)
25-30		5 (15.15)		100 (57.47)
31-35		10 (30.30)		42 (24.14)
Above 35		15 (45.45)		6 (3.45)

Comparison of Menstrual and Obstetric Patterns among Infertile Women between 2007 and 2024

The mean age at menarche in 2024 was 12.02 ± 1.28 years, while data from 2007 was unavailable. Regarding menstrual history, 67% of women had regular menstrual cycles in 2007, compared to 52.76% in 2024. Irregular cycles with durations greater than 35 days but less than or equal to 45 days were not reported in 2007, whereas 12.98% of women experienced this pattern in 2024. For irregular cycles exceeding 45 days, 31% of women were affected in 2007, while this increased to 23.75% in 2024. Menstruation only upon hormone withdrawal was reported in 2% of women in 2007, compared to 10.50% in 2024.

In terms of pregnancy outcomes among the secondary infertile group, the incidence of stillbirths was 6.06% in 2007 and 2.49% in 2024. Spontaneous abortions accounted for 30.30% of outcomes in 2007 and 29.83% in 2024. Menstrual regulation (MR) procedures were reported in 30.30% of cases in 2007, with a significant decrease to 3.04% in 2024. Ectopic pregnancies occurred in 6.06% of cases in 2007 and 1.93% in 2024. The incidence of molar pregnancies was 3.03% in 2007 and 1.93% in 2024.

For delivery methods, vaginal deliveries were noted in 15.15% of cases in 2007, dropping to 7.46% in 2024. Lower Uterine Cesarean Section (LUCS) deliveries constituted 9.09% in 2007, increasing to 17.13% in 2024 (Table 3).

Table 3: Comparison of Menstrual and Obstetric Patterns among Infertile Women between 2007 and 2024

Variable	n available	2007, n (%)	n available	2024, n (%)
Age at Menarche, (mean ±SD)		NA	358	12.022±1.28
Menstrual History	100		362	
Regular		67 (67)		191 (52.76)
Irregular (>35 to ≤45 days)		NA		47 (12.98)
Irregular (>45 days)		31 (31)		86 (23.75)
Menstruation on hormone withdrawal		2 (2)		38 (10.50)
Pregnancy Outcome (Secondary Infertility)	33		174	
Stillbirth		2 (6.06)		9 (2.49)
Spontaneous abortion		10 (30.30)		108 (29.83)
MR		10 (30.30)		11 (3.04)
Ectopic pregnancy		2 (6.06)		7 (1.93)
Molar pregnancy		1 (3.03)		7 (1.93)
Vaginal delivery		5 (15.15)		27 (7.46)
LUCS		3 (9.09)		62 (17.13)
MR denotes menstrual regulation, LUCS denotes Lower Uterine Cesarean Section.				

Comparison of Past Medical History among Infertile Male and Female Participants between 2007 and 2024

For diabetes, 4% of females and 6% of males had a history of the condition in 2007, whereas in 2024, 9.67% of females and 8.08% of males reported a history of diabetes. In terms of tuberculosis, 3% of females and 2% of males were affected in 2007, while in 2024, 1.66% of females had a history of tuberculosis, with no cases reported among males.

Regarding hypothyroidism, 2% of females had a history of this condition in 2007, with no male cases. In 2024, the prevalence of hypothyroidism increased to 37.29% among females and 0.83% among males. Puerperal sepsis was reported in 2% of females in 2007,

with no cases in males. In 2024, there were no recorded cases of puerperal sepsis among either gender.

Data on hypertension (HTN) was not available for 2007. However, in 2024, 3.31% of females had a history of hypertension, with no cases among males. For impaired glucose tolerance (IGT) / impaired fasting glucose (IFG), no data was available in 2007, but in 2024, 362 females and 18 (4.97%) males had a history of IGT/IFG. The 'Others' category included 13% of females and 8% of males in 2007, with no such category reported in 2024. Regarding participants with no history of past illness, 73% of females and 84% of males in 2007 had no significant medical history. In 2024, 56.08% of females and 91.44% of males reported no past illness (Table 4).

Table 4: Comparison of Past Medical History among Infertile Male and Female Participants between 2007 and 2024

Variable	2007 (n=100)		2024 (n=362)	
	Female	Male	Female	Male
Diabetes	4 (4)	6 (6)	35 (9.67)	29 (8.08)
Tuberculosis	3 (3)	2 (2)	6 (1.66)	0
Hypothyroidism	2 (2)	0 (0)	135 (37.29)	3 (0.83)
Puerperal Sepsis	2 (2)	0 (0)	0	NA
HTN	NA	NA	12 (3.31)	0
IGT/IFG	NA	NA	18 (4.97)	4 (1.10)
Others	13 (13)	8 (8)	0	0
No history of past illness	73 (73)	84 (84)	203 (56.08)	331 (91.44)
HTN denotes hypertension, IGT denotes impaired glucose tolerance, IFG denotes impaired fasting glucose				

Comparison of Female Gynecological and Male Surgical Histories between 2007 and 2024

In 2007, 19% of female participants reported a gynecological surgical history, increasing to 17.13% in 2024. The most common procedures in 2024 were Dilation and Curettage (D&C) (6.35%), LUCS (4.14%), and laparoscopy (3.87%). Laparotomy was reported by 10% of participants in 2007 but was absent in 2024. The percentage of female participants with no surgical history slightly decreased from 81% in 2007 to 82.87% in 2024.

Regarding male participants, 4% reported a surgical history in 2007, increasing to 5% in 2024. In 2024, the most frequently reported procedures were appendicectomy (1.10%), herniorrhaphy (0.83%), and orthopedic surgeries (0.55%). Hydrocelectomy was reported by 3% of male participants in 2007 but was absent in 2024. The proportion of male participants with no surgical history decreased from 96% in 2007 to 95% in 2024.

Table 5: Comparison of Female Gynecological and Male Surgical Histories between 2007 and 2024

Variable	2007 (n=100)	2024 (n=362)
Female Gynecological Surgical History	**19**	**62**
D&C		23 (6.35)
LUCS		15 (4.14)
Laparoscopy	6 (6.00)	14 (3.87)
Cystectomy		4 (1.10)
Salpingo-oophorectomy and Salpingectomy		4 (1.10)
Myomectomy	3 (3.00)	1 (0.28)
Hysterotomy		1 (0.28)
Laparotomy	10 (10.00)	0
No Surgery	**81 (81.00)**	**300 (82.87)**
Male Surgical History	**4**	**17**
Appendicectomy	NA	4 (1.10)
Herniorrhaphy	1 (1.00)	3 (0.83)
Hydrocelectomy	3 (3.00)	0
Hemorrhoidectomy	NA	1 (0.28)
Varicocelectomy	NA	1 (0.28)
Sinus Surgery	NA	1 (0.28)
Laparoscopic Cholecystectomy	NA	2 (0.55)
Urethral Calibration	NA	1 (0.28)
Orthopedic Surgery	NA	3 (0.55)
Circumcision	NA	1 (0.28)
No Surgery	**96 (96.00)**	**344 (95)**
D&C denotes Dilation and Curettage, LUCS denotes Lower Uterine Cesarean Section		

Comparison of contributing factors to infertility between 2007 and 2024

For female factor infertility, the prevalence of Polycystic Ovary Syndrome (PCOS) increased from 12.00% in 2007 to 75.69% in 2024. Hypothyroidism affected 2.00% of females in 2007, rising to 32.87% in 2024. Ovulatory disorders were not reported in 2007 but were present in 10.77% of cases in 2024. Tubal factors contributed to infertility in 16.00% of females in 2007, compared to 8.56% in 2024.

The incidence of fibroids was 10.00% in 2007 and 3.59% in 2024. Pelvic inflammatory disease (PID) accounted for 18.00% of cases in 2007, decreasing to 3.31% in 2024. Hyperprolactinemia was reported in 3.00% of females in 2007 and 2.76% in 2024. Endometriosis contributed to 3.00% of infertility cases in 2007 and 5.52% in 2024. Uterus and cervical factors were observed in 18.00% of cases in 2007, dropping to 1.93% in 2024. Uterine abnormalities, adenomyosis, and other factors (e.g., DOR, BUEP) were not reported in 2007 but were each present in 1.10% of cases in 2024. The proportion of normal findings among female participants was 42.00% in 2007, with no such cases

reported in 2024. Regarding male factor infertility, erectile dysfunction affected 5.00% of males in 2007, with a reduced prevalence of 0.83% in 2024. Ejaculatory dysfunction was 4.00% in 2007, increasing to 4.70% in 2024. Impotence was reported in 1.00% of cases in 2007, with no cases in 2024.

New contributing factors identified in 2024 included lower testosterone levels (0.28%), varicocele (0.55%), co-morbidity (1.10%), abnormal semen (17.13%), and other factors (e.g., epididymal cysts, 0.83%) (Table 6).

Table 6: Comparison of contributing factors to infertility between 2007 and 2024

Variable	2007 (n=100)	2024 (n=362)
Female Factor Infertility		
PCOS	12 (12.00)	274 (75.69)
Hypothyroid	2 (92.00)	119 (32.87)
Ovulatory Disorders	NA	39 (10.77)
Tubal Factors	16 (16.00)	31 (8.56)
Fibroids	10 (10.00)	13 (3.59)
Pelvic Inflammatory Disease	18 (18.00)	12 (3.31)
Hyper Prolactinemia	3 (3.00)	10 (2.76)
Endometriosis	3 (3.00)	20 (5.52)
Uterus & Cervical Factor	18 (18.00)	7 (1.93)
Uterine Abnormalities	NA	4 (1.10)
Adenomyosis	NA	4 (1.10)
Others (DOR, BUEP etc.)	NA	4 (1.10)
Normal	42 (42)	0
Male Factor Infertility	10	
Erectile Dysfunction	5 (5)	3 (0.83)
Ejaculatory Dysfunction	4 (4)	17 (4.70)
Impotence	1 (1)	0
Lower Testosterone Levels	NA	1 (0.28)
Varicocele	NA	2 (0.55)
Co-Morbidity	NA	4 (1.10)
Abnormal Semen	NA	62 (17.13)
Others (Epididymal cysts)	NA	3 (0.83)
PCOS denotes Polycystic Ovary Syndrome, DOR denotes Diminished Ovarian Reserve, BUEP denotes Bulky Uterus Endometrial polyp		

Comparison of Lifestyle Factors among Infertile Male and Female Participants between 2007 and 2024

Among female participants, smoking was reported by 1.00% in 2007, with no cases in 2024. Alcohol consumption was not reported in either year. Physical activity data were unavailable in 2007, while

16.85% of females reported engaging in physical activity in 2024.

For male participants, 40.00% reported smoking in 2007, compared to 18.78% in 2024. Alcohol consumption was reported by 2.00% of males in 2007, with no cases in 2024. Physical activity data were unavailable in 2007, but 17.96% of males reported physical activity in 2024 (Table 7).

Table 7: Comparison of Lifestyle Factors among Infertile Male and Female Participants between 2007 and 2024

Variable	2007 (n=100)	2024 (n=362)
Female lifestyle		
Smoking	1 (1)	0
Alcohol Consumption	0 (0)	0
Physical Activity	NA	61 (16.85)

Variable	2007 (n=100)	2024 (n=362)
Male lifestyle		
Smoking	40 (40)	68 (18.78)
Alcohol Consumption	2 (2)	0
Physical Activity	NA	65 (17.96)

DISCUSSION

The comparison of lifestyle factors among infertile male and female participants between 2007 and 2024 highlights notable shifts in health behaviors, potentially reflecting broader public health initiatives, lifestyle changes, and increased awareness of infertility risk factors.

The socio-demographic profile of infertile couples showed notable shifts between 2007 and 2024, particularly in educational attainment. The decline in female postgraduate qualifications, alongside a majority completing undergraduate education in 2024, may reflect broader educational shifts or changing socio-economic factors influencing women's education [16].

In 2024, religious affiliation was predominantly Muslim (94.2%), with Hindu (5.3%) and Christian (0.6%) minorities. While comparable religious data for 2007 was unavailable, this distribution aligns with national demographics, where Islam is the majority religion in Bangladesh [17].

The employment status of females showed stability in the proportion of housewives (68% in 2007 vs. 78.5% in 2024). According to the Bangladesh Bureau of Statistics (BBS), 17.4% of households are led by women in 2022, which aligns with our study[18]. However, the decline in female service holders from 20% in 2007 to 7.5% in 2024 may reflect socio-cultural and economic barriers limiting female workforce participation. However, the emergence of 5.8% of females in nursing roles in 2024 indicates a shift towards healthcare-related employment opportunities for women.

Among males, a decrease in service holders (from 65% in 2007 to 43.7% in 2024) and an increase in business (21%) and worker roles (22.7%) suggest a possible trend towards self-employment and labor-based occupations, potentially influenced by economic dynamics and job market changes, aligning with the recent report [19].

Our study revealed a slight increase in the middle-income category (from 60% in 2007 to 63.3% in 2024) and a marginal decrease in the high-income group (12% to 11.9%). These findings align with national trends, where approximately 25% of the population falls within the middle-class bracket, and the high-income group remains stable [20, 21]. The growth in the middle-income group may reflect improved economic conditions and enhanced healthcare access, particularly in infertility treatment.

Infertility patterns among couples shifted significantly between 2007 and 2024. Female infertility rose sharply from 43% to 94.2%, while male infertility declined from 36% to 9.1%, aligning with a 2022 study linking fertility rate declines to our findings [22]. This trend may reflect advancements in male infertility treatments, improved diagnostics for female infertility, or changing societal and environmental influences [22, 23]. The proportion of infertility attributed to both partners remained stable (5.5% in 2007 vs. 4.1% in 2024), while unexplained infertility decreased from 10% to 5%, likely due to enhanced diagnostic capabilities [24].

Infertility duration trends shifted in 2024, with more couples experiencing shorter durations. While a 2014 study reported 43.64% of infertility cases lasting 5-10 years[8], our study found an increase in 1–2-year durations from 22% in 2007 to 37% in 2024. Meanwhile, 5–10-year durations decreased from 30% to 19.3%, and cases over 10 years dropped from 10% to 2.5%. This trend suggests earlier intervention and improved access to fertility treatments.

Primary infertility decreased from 67% in 2007 to 51.9% in 2024, while secondary infertility rose from 33% to 48.1%, aligning with previous studies[8]. This shift may reflect delayed childbearing, greater fertility awareness, and improved management of pregnancy and childbirth complications.

In 2024, the mean age for primary infertility among females was 25.99 ± 4.79 years, with a notable increase in women aged 24 years or younger (from 6% in 2007 to 36.7%) and a decline in those over 35 years (from 15% to 3.7%). This trend may indicate improved pregnancy management, better healthcare access, and earlier fertility interventions[25, 26]. For secondary infertility, the mean age was 27.80 ± 4.38 years, with a sharp rise in the 25-30 years age group (from 15.2% to 57.5%) and a drop in women above 35 years (from 45.5% to 3.5%), suggesting earlier fertility planning and increased age-related fertility awareness[22].

Menstrual and obstetric patterns among infertile women showed notable changes between 2007 and 2024. The mean age at menarche in 2024 was 12.02 ± 1.28 years, aligning with recent reports. While comparative data for 2007 is unavailable, early menarche is linked to hormonal imbalances and potential

reproductive health issues, possibly influencing infertility trends [27].

The decrease in regular menstrual cycles from 67% in 2007 to 52.76% in 2024, along with emerging prolonged cycles (35–45 days in 12.98% of women) and an increase in hormonal withdrawal-induced menstruation (from 2% to 10.50%), suggests rising menstrual irregularities. These trends may indicate a higher prevalence of PCOS and other endocrine disorders, aligning with studies linking such conditions to menstrual disruptions and infertility [28, 29]. Lifestyle changes, obesity, stress, and improved diagnostics could be contributing factors[30].

Pregnancy outcomes among the secondary infertile group showed notable changes. Stillbirth rates decreased from 6.06% in 2007 to 2.49% in 2024, indicating potential improvements in prenatal care and maternal health [31]. Spontaneous abortion rates remained stable (30.30% in 2007 vs. 29.83% in 2024). The sharp decline in MR procedures from 30.30% to 3.04% suggests enhanced contraceptive use or improved reproductive health education[31, 32]. Similarly, Ectopic and molar pregnancies showed reductions from 6.06% to 1.93% and 3.03% to 1.93%, respectively, between 2007 and 2024, indicating improved early diagnosis and management of high-risk pregnancies.

In terms of delivery methods, vaginal deliveries among the secondary infertile group decreased from 15.15% in 2007 to 7.46% in 2024. Conversely, LUCS deliveries increased from 9.09% to 17.13%, potentially reflecting broader global trends toward higher cesarean section rates due to medical indications or elective preferences [33].

In 2024, the prevalence of diabetes among infertile participants rose to 9.67% in females and 8.08% in males, up from 4% and 6%, respectively, in 2007. This trend mirrors broader South Asian epidemiological patterns, where urbanization, dietary shifts, and reduced physical activity drive metabolic disorders [34]. Diabetes can impair fertility by disrupting hormonal balance, affecting ovulatory function in females, and contributing to erectile dysfunction and reduced sperm quality in males [35, 36].

Our study found a decline in tuberculosis (TB) cases among females from 3% in 2007 to 1.66% in 2024, with no male cases reported in 2024 (2% in 2007). Genital TB is a known risk factor for infertility, particularly because it affects the fallopian tubes in women and the reproductive tract in men. This decline may reflect improved public health measures and enhanced TB control programs in Bangladesh [37, 38].

A notable increase in hypothyroidism prevalence among females was observed, rising sharply from 2% in 2007 to 37.29% in 2024, while male prevalence remained low (0.83%). Hypothyroidism can significantly impact reproductive health by causing menstrual irregularities, anovulation, and reduced fertility [39].

Puerperal sepsis was reported in 2% of females in 2007, with no cases in 2024. The absence of puerperal sepsis in the recent cohort may indicate better maternal healthcare practices, enhanced hygiene during childbirth, and improved access to medical facilities [25, 26]. Puerperal sepsis can lead to secondary infertility due to pelvic inflammatory disease and scarring of reproductive organs [40].

Hypertension data was not available for 2007; however, in 2024, 3.31% of females had a history of hypertension, with no reported male cases. Hypertension and associated medications can affect fertility by impairing ovarian function and contributing to erectile dysfunction and reduced sperm quality in males (10).

In 2024, impaired glucose tolerance (IGT) and impaired fasting glucose (IFG) were reported in 4.97% of females and 1.10% of males, with no data available for 2007. This emerging trend may indicate a rising prevalence of prediabetes, potentially impacting fertility similarly to diabetes by affecting hormonal regulation and increasing the risk of metabolic syndrome [41].

The proportion of participants with no significant medical history decreased among females from 73% in 2007 to 56.08% in 2024, while it increased among males from 84% to 91.44%, respectively. This difference suggests a potential rise in the burden of chronic conditions among females, which may impact infertility rates [42].

Between 2007 and 2024, the proportion of female participants reporting a gynecological surgical history decreased from 19% to 17.13%. Notably, laparotomy cases declined from 10% in 2007 to none in 2024, while procedures such as Dilation and Curettage (6.35%), LUCS (4.14%), and laparoscopy (3.87%) were prevalent in 2024. This shift may reflect a global trend toward minimally invasive gynecological surgeries, as evidenced by a 46% reduction in such procedures from 1979 to 2006[43].

For male participants, those reporting a surgical history increased from 4% in 2007 to 5% in 2024. Appendicectomy (1.10%), herniorrhaphy (0.83%), and orthopedic surgeries (0.55%) were the most common procedures in 2024. The absence of hydrocelectomy cases in 2024, previously at 3% in 2007, suggests advancements in less invasive treatments for conditions like hydrocele.

In our study, one of the most striking findings is the sharp increase in the prevalence of PCOS from 12.00% in 2007 to 75.69% in 2024. PCOS is a leading

cause of anovulatory infertility, associated with hormonal imbalances, insulin resistance, and metabolic syndrome [44]. The dramatic rise may be attributed to increased awareness, improved diagnostic techniques, and possibly a genuine surge influenced by lifestyle changes, such as poor diet and reduced physical activity, which contribute to metabolic disturbances [45].

The prevalence of hypothyroidism also rose substantially, from 2.00% in 2007 to 32.87% in 2024. Hypothyroidism impacts reproductive health by disrupting menstrual cycles and impairing ovulation [46]. This increase might reflect better screening and detection practices or an actual rise in autoimmune thyroid disorders, potentially linked to environmental or dietary factors [45]. Additionally, ovulatory disorders, not reported in 2007, emerged as a significant contributing factor in 10.77% of cases in 2024, possibly due to improved diagnostic criteria and the inclusion of conditions like anovulation and luteal phase defects.

Tubal factors decreased, from 16.00% of infertility cases in 2007 to just 8.56% in 2024. This reduction might reflect advancements in managing infections and conditions like Pelvic Inflammatory Disease (PID), which decreased from 18.00% in 2007 to 3.31% in 2024. Improved public health measures, early diagnosis, and treatment of STIs could have contributed to this trend [47].

Conversely, the incidence of endometriosis slightly increased from 3.00% in 2007 to 5.52% in 2024. Endometriosis is often underdiagnosed due to its varied presentation, and this increase could indicate heightened clinical awareness and diagnostic improvements [45]. Uterus and cervical factors decreased from 18.00% in 2007 to 1.93% in 2024, likely due to better gynecological care and advancements in minimally invasive treatments.

The data also reveal a significant reduction in cases categorized as normal findings among female participants, dropping from 42.00% in 2007 to 0% in 2024. This change might suggest that advancements in diagnostic technology and a deeper understanding of infertility factors have reduced the proportion of unexplained infertility [45].

In terms of male factor infertility, the prevalence of erectile dysfunction declined from 5.00% in 2007 to 0.83% in 2024. This improvement might be associated with better management of contributing conditions such as cardiovascular diseases and psychological factors [48]. However, ejaculatory dysfunction increased slightly from 4.00% in 2007 to 4.70% in 2024, potentially reflecting more precise reporting and diagnosis. Impotence, reported at 1.00% in 2007, was not observed in 2024, possibly due to advances in treatment options, including pharmacological interventions.

New contributing factors to male infertility were identified in 2024, including lower testosterone levels (0.28%), varicocele (0.55%), co-morbidity (1.10%), abnormal semen (17.13%), and other factors (e.g., epididymal cysts, 0.83%). These findings reflect enhanced diagnostic capabilities, including hormonal assessments and semen analysis, which were less prevalent in 2007 [49, 50]. The detection of abnormal semen in a significant proportion of cases underscores the importance of comprehensive semen analysis as part of the male infertility workup [49].

Comparison of Lifestyle Factors Among Infertile Male and Female Participants in 2007 and 2024. The minimal smoking and absence of alcohol consumption among female participants in both 2007 and 2024 likely reflect cultural and religious norms in Bangladesh, where such behaviors among women are traditionally low [51, 52]. The introduction of physical activity data in 2024, with 16.85% of females reporting regular exercise, suggests a growing emphasis on lifestyle modifications to improve fertility outcomes, as regular physical activity is linked to better reproductive health [53].

Existing literature reports male smoking prevalence at 40%-50% and alcohol consumption at 3.60% in Bangladesh [51, 52, 54]. However, our study showed that the significant reduction in smoking rates among males indicates positive lifestyle changes that may benefit reproductive health, particularly given smoking's impact on sperm quality. Alcohol consumption also dropped from 2% to 0%, which may reflect underreporting or cultural and religious influences that discourage alcohol use in Bangladesh. Additionally, 17.96% of males reported engaging in physical activity in 2024, underscoring the potential of lifestyle interventions in improving male fertility [53].

CONCLUSION
Our study reveals notable shifts in infertility patterns from 2007 to 2024, with a rise in female infertility and a decline in male infertility, likely due to advancements in male reproductive care and better diagnostic approaches for female infertility. Increasing menstrual irregularities and endocrine disorders, such as PCOS, highlight emerging challenges to female fertility. Positive lifestyle changes, including reduced smoking and alcohol use and increased physical activity, suggest a growing focus on reproductive health. Improvements in maternal care are reflected in reduced stillbirths and MR procedures. These findings underscore the need for targeted public health strategies, enhanced diagnostics, and lifestyle interventions to address evolving infertility challenges in Bangladesh.

Conflict of Interest Disclosure: The authors declare no conflicts of interest.

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