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Prevalence and Risk Factors of Infertility in a Southern Port City of Iran

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Abstract

Background: Infertility is a universal problem with very limited scientific information relating to the factors that place men and women at risk of infertility.
Objectives: To determine the prevalence and risk factors of infertility in Bandar Abbas, a Southern port city of Iran.
Methods: We conducted this cross-sectional study using a face-to-face questionnaire survey from September 2017 to March 2018 among 1,500 women at childbearing age.
Results: Data from 1469 valid questionnaires were finally assessed. There were 224 cases of current infertility with an incidence of 15.24% (95% CI, 14.79% - 15.44%), including 151 primary (10.27%; 95% CI, 10.09% - 11.14%) and 73 secondary (4.96%; 95% CI, 4.76% - 5.09%) infertilities. According to the univariate logistic regression analysis, age of men and women, women's occupation, men engaged in high-temperature professions, age at marriage, menstrual cycle pattern, previous contraceptive usage, history of infertility in family, previous abortions, previous cesarean sections, number of pregnancies, previous vaginal delivery, smoking, physical activity, and BMI were significantly associated with infertility (all $P \leq 0.05$). To determine the independent risk factors for infertility, multivariate logistic regression analysis was performed. Advanced age, heavy physical activity, obesity, men engaged in high-temperature professions, previous abortions, and previous cesarean sections were the risk factors for infertility. The number of pregnancies and previous vaginal deliveries were protective factors.
Conclusions: Although infertility risk factors are complex and multiple, and the investigated region does not represent all areas of Iran, the results can contribute to the overall reproductive health improvement among Iranians.

Keywords: Infertility, Risk Factors, Bandar Abbas, Iran

1. Background

Infertility, as a reproductive disorder, is recognized as the third most serious disease worldwide, following cancer and cardiovascular diseases. Although this disorder is not fatal, its damaging impact on couples, families, and communities should not be overlooked (1). According to the World Health Organization, infertility is defined as "inability to achieve a clinical pregnancy after 12 months or more of regular unprotected sexual intercourse."

If a woman has never experienced pregnancy or childbirth after sexual maturity, infertility is considered primary, while it is considered secondary if there are difficulties with pregnancy despite a history of successful delivery (2). Infertility occurs in nearly 48.5 million couples worldwide (3). However, the prevalence estimates of infertility vary widely, in part because there is no agreed or consistent definition for infertility, and populations vary by age, unit of measurement, and relationship status (4). Although the advantages of complicated diagnostic and treatment techniques have increased recently, precise evaluation of infertility rates is still challenging. A reliable quantitative method is necessary to assess the fertility trends. There is scarce data on the prevalence of infertility in Iran (5-7), and there are almost no reports from Southern port cities.

2. Objectives

There is limited information on factors that expose individuals to infertility in this population. A number of factors, including genetics, environmental exposure, lifestyle, and infectious diseases, have been linked to the risk of infertility (8). Therefore, determining the risk factors for infertility is helpful in certain regions. This study aimed to examine the prevalence and risk factors for infertility and

to promote infertility prevention and treatment in Southern port cities of Iran. We aimed to examine the prevalence of infertility, to compare its differences and characteristics, and to determine the relationship between infertility and risk factors in Bandar Abbas.

3. Methods

3.1. Study Population and Setting

This cross-sectional, population-based survey was performed from September 2017 to March 2018. This survey was conducted via cluster sampling in 28 regions of Bandar Abbas, a port city of the Persian Gulf and capital of Hormozgan province, Iran, with 92,517 families and 435,751 population (9). For determining the sample size, the sample size formula in prevalence surveys was used at 5% alpha error, 95% confidence interval, and 15% infertility prevalence (10). To calculate the final sample size, the cluster effect was measured to be two in 1410 households, to which we added 5% in order to address potential non-responses (total sample size, 1500). A total of 1500 households were classified into 28 clusters or enumeration areas; in other words, 54 households were surveyed per cluster.

3.2. Inclusion Criteria

The inclusion criteria were: (1) age range, 18 - 45 years; (2) Iranian nationality; and (3) permanent residence in Bandar Abbas. The exclusion criteria were as follows: (1) being widowed or divorced; (2) being separated for more than six months a year; (3) temporary residence in Bandar Abbas; and (4) not agreeing to take part in the study.

3.3. Measures

To collect the necessary information, we used a structured self-designed questionnaire. Given that there were no existing standard questionnaires available, a questionnaire was developed by the research team based on the available databases and results of other studies (11, 12). The collected information included: (1) marriage and childbearing status; (2) disease history; (3) lifestyle information; (4) menstruation status; and (5) general demographic data. Current infertility (primary or secondary) was employed in this survey study. Current infertility was described as current infertility in couples who had not achieved pregnancy in the past 12 months (2).

A panel of experts that included an epidemiologist, an obstetrician, and a midwife was invited to validate the questionnaire. Most of the questionnaire items were evaluated by the three experts as appropriate and relevant to the study. Minor amendments were made to the wording and order of the questions to achieve a more logical layout. A pilot survey was conducted in July 2017 to confirm the quality of the final survey in randomly selected regions (five regions). In several meetings, the findings were discussed, items were added or deleted, and the questionnaire structure was adjusted based on the pilot study; finally, the questionnaire was developed. The overall Cronbach's alpha coefficient of the pilot study was calculated to be 0.74, indicating that the instrument has a high level of internal consistency. To examine the questionnaire feasibility, a pre-survey study was conducted for strict quality control. Face-to-face interviews were conducted by 15 uniformly trained interviewers. The investigators confirmed the identity of the participants. The completed questionnaires were assessed by two investigators during the study to ensure consistency and validity. Following the fieldwork, data were manipulated by parallel double entry, and three verifications were done to identify inconsistent and incomplete responses. The questionnaire included lifestyle, demographic characteristics, and health-related information.

A standardized protocol was used to measure weight and height (barefoot in light indoor clothing). Weight was calculated to the nearest 0.1 kg, and height was measured to the nearest 0.1 cm. Based on the WHO criteria, BMI was measured as weight (kg) divided by the square of height (m^2) and was classified as follows: underweight, < 18.5 kg/m^2; moderate weight, 18.5 - 24.9 kg/m^2; overweight, 25.0 - 29.9 kg/m^2; and obese > 30 kg/m^2 (13).

3.4. Data Analysis

To present the subjects' characteristics, frequency distribution was measured. To determine the prevalence ratio, data were presented as percentages. Qualitative data are presented as frequency (percentage), while quantitative data are expressed as mean $\pm$ SD. To study the normal distribution of continuous variables, the Kolmogorov-Smirnov test was performed. Chi-square and *t*-test were used for group comparisons considering the homogeneity of variance between the groups. The stepwise forward method was applied for logistic regression analysis (included if $P < 0.05$) to evaluate the associations between infertility and different variables. Data are presented as odds ratios (OR) and 95% CI along with P values in the logistic regression model. For data analysis, SPSS V. 19.0 (IBM Corp., Armonk, NY, USA) was used, and the significance level was set at $P \leq 0.05$.

3.5. Ethical Approval

The Ethics Committee of Hormozgan University of Medical Sciences approved this study (HUMS.REC.1396.110), and written consent was obtained from the subjects.

4. Results

A total of 1500 women at childbearing age were studied in this survey. Data from 1469 valid questionnaires were finally assessed. The response rate was estimated at

97.9%. There were 224 cases of current infertility with an incidence of 15.24% (95% CI, 14.79%-15.44%), including 151 primary (10.27%; 95% CI, 10.09% - 11.14%) and 73 secondary (4.96%; 95% CI, 4.76% - 5.09%) infertilities. The characteristics of the participants are shown in Table 1. The mean age was 35.41 years in women with infertility and 29.32 years in those without infertility. The difference between women with infertility and those without infertility is shown in Table 1.

According to the univariate logistic regression analysis, age of men and women, women's occupation, men engaged in high-temperature professions, age at marriage, menstrual cycle pattern, previous contraceptive usage, history of infertility in family, previous abortions, previous cesarean sections, number of pregnancies, previous vaginal delivery, smoking (using cigarette or tobacco), physical activity (exercising), and BMI were significantly associated with infertility (all $P \leq 0.05$).

To determine the independent risk factors for infertility, multivariate logistic regression analysis was performed. Risk factors with a strong influence on infertility incidence are listed in Table 2. Advanced age, heavy physical activity, obesity, men engaged in high-temperature professions, previous abortions, and previous cesarean sections were the risk factors for infertility. The number of pregnancies and previous vaginal deliveries were protective factors.

5. Discussion

The prevalence of infertility varies all over the world. Based on the results of some studies, the prevalence of current infertility was 0.9%, 6.9%, 7.4%, 14.2%, and 15.6% in rural areas of Northern China, Ghana, USA, India, and Canada, respectively (2, 14-16). According to a survey by Vahidi et al. from Iran, the prevalence of primary infertility was 3.4% in 2005 (7).

In this study, we provided prevalence estimates of current infertility in Bandar Abbas, a Southern port city in Iran. In our study, the term current infertility describes a woman who could not conceive during the study time and met the criteria of lifetime infertility. The prevalence of current infertility was 15.24% in our study, the prevalence of current primary infertility was 10.27%, and the prevalence of current secondary infertility was 4.96%. These rates are significantly higher than the prevalence rates reported from other regions of Iran or most other countries (7, 14, 15). This may be explained by the fact that female self-care is relatively poor in Southern port cities of Iran, medical conditions continue to be neglected, and women are more prone to infertility.

Infertility is commonly associated with several factors. Changes in lifestyle and new tendencies during socioeconomic changes have significant effects on the childbearing rate in Iran. This study was an attempt to identify common factors contributing to infertility. According to the results of the current study, the age of both men and women positively contributes to the incidence of infertility. The incidence of infertility increased with the advancing age of both men and women. The infertility prevalence in women aged above 35 years, and women aged 41 - 45 years was up to 2.1 and 2.9 times greater than younger women, respectively. Evidence shows that age may play an important role in fertility (1). Studies show that the risk of infertility increases with advancing age (7, 8, 17). Advanced maternal age for fertility is 35 years, beyond which there is a major increase in the risk of adverse reproductive outcomes.

Nonetheless, the advanced male age is not well-defined. Epigenetic and genetic changes occur in the spermatozoa as a result of male ageing, which could affect the offspring through fertilization, causing a variety of diseases (18). Consequently, couples should be counseled with equal emphasis on the significance of advanced maternal age and male age as risk factors for infertility. In addition, the marital age of women was higher in the infertile group compared to the fertile group. Marriage before 30 years for women and before 35 years for men had a greater chance of success (19). Based on this finding, we advocate for age-appropriate marriages.

In many preindustrial populations, the effect of marriage duration on fertility has been confirmed (8), while its meaning remains unclear. Despite the importance of this factor, few studies have been published in this area to empirically investigate alternative explanations for the impact of age of marriage. The present results showed that the duration of marriage in women with infertility was longer than those without infertility, which is different from the results of some studies (8, 18, 19). Based on the results of some studies, one explanation is that long marriage duration has a positive association with the number of childbirths, and consequently, the risk of infection-induced sub-fecundity or secondary infertility (18). A more important explanation may be low coital frequency in couples with longer marriage durations, unrelated to deliberate fertility control, and keeping the age of both partners constant (20). More studies are recommended to distinguish differences in the results obtained by these studies.

The results indicated that the incidence of infertility was significantly higher in women with an occupation, compared to housewives. The results of univariate regression analysis also showed that there was an association between women's occupation and infertility. The results of some studies showed that job-related stress might be the reason for this issue (8). According to some studies, there is a prospective relationship between infertility and potentially modifiable factors, including stress (16, 17, 21). The mechanism contributing to the effect of stress on fertility is under investigation.

Table 2. Stepwise Logistic Regression Analyses of Sociodemographic, Reproductive and Lifestyle Variables as the Risk Factors of Infertility

Variable	Univariate			Multivariate		
	OR	95% CI	P Value	OR	95% CI	P Value
Female age (y)	2.312	1.006 - 1.119	0.001	1.512	1.003 - 2.123	0.012
Male age (y)	1.876	1.126 - 2.765	0.023	-	-	0.123
Age at marriage (y)	1.654	1.234 - 3.011	0.043	-	-	0.431
Number of pregnancies	0.350	0.150 - 0.701	0.002	0.650	0.51 - 0.69	0.012
Number of abortions	1.711	1.002 - 2.032	0.032	1.011	1.015 - 1.026	0.043
Number of cesareans	3.512	2.098 - 4.045	0.001	2.812	2.430 - 3.001	0.001
Number of vaginal deliveries	0.721	0.567 - 0.918	0.001	0.721	0.673 - 0.798	0.013
Female age						
18 - 30	0.891	0.765 - 0.923	0.052	-	-	0.098
31 - 35	1.0 (Ref)					
36 - 40	2.391	1.052 - 3.932	0.043	2.165	1.042 - 2.984	0.049
41 - 45	3.012	1.987 - 4.345	0.003	2.912	1.651 - 2.413	0.012
Female age at marriage						
Less than 18 years old	1.793	1.0512 - 1.798	0.078	-	-	0.134
18 - 30	1.0 (Ref)					
31 - 35	1.194	1.009 - 1.235	0.103	-	-	0.214
More than 35	2.572	1.987 - 3.781	0.001	2.122	1.712 - 2.964	0.017
Female occupation						
Yes	1.012	1.001 - 1.098	0.049	-	-	0.141
No	1.0 (Ref)					
Men engaged in high-temperature						
Yes	2.932	1.740 - 3.013	0.015	1.987	1.253 - 2.017	0.017
No	1.0 (Ref)					
Menstrual cycle						
Irregular	1.435	1.210 - 1.671	0.016	-	-	0.234
Regular	1.0 (Ref)					
Previous contraceptive usage						
Yes	1.980	1.435 - 1.999	0.043	-	-	0.561
No	1.0 (Ref)					
History of infertility in family						
Yes	1.651	1.305 - 1.812	0.047	-	-	0.982
No	1.0 (Ref)					
Female physical activity						
Light	1.0 (Ref)					
Regular	1.412	1.023 - 1.765	0.031	1.22	1.013 - 1.543	0.036
Heavy	1.951	1.001 - 2.312	0.001	1.801	1.202 - 2.110	0.004
Female smoking						
Yes	1.034	1.012 - 1.450	0.041	-	-	0.069
No	1.0 (Ref)					
Male smoking						
Yes	1.871	1.508 - 1.987	0.024	-	-	0.089
No	1.0 (Ref)					
Female BMI (kg/m^2)						
Less than 18.5	2.111	1.980 - 3.324	0.001	2.111	1.876 - 2.451	0.001
18.5 - 24.9	1.0 (Ref)					
25 - 29.9	1.033	0.976 - 1.243	0.132	-	-	0.156
More than 30	4.112	2.987 - 5.234	0.001	3.742	2.657 - 4.541	00.012

The incidence of infertility in the present study was higher among women whose partners had high-temperature professions. The multivariate regression analysis also revealed that high-temperature professions are the risk factors for male infertility. The results of a previous study indicated that people working in high-

temperature environments had significantly lower sperm mobility, sperm density, and number of morphologically normal sperms (22).

The incidence of infertility in the current study was higher among women with irregular menstruation cycles. This finding is in line with two prospective studies, which showed that irregular cycles are associated with reduced fecundability of women, compared to women with regular menstrual cycles (23, 24). Our study showed that contraceptive usage, as one of the major determinants of fertility, is expected to be positively associated with infertility. However, findings have failed to present any explanation for the correlation between infertility and history of contraceptive usage.

According to the results of our study, 58.5% of women with infertility reported a positive history of infertility in their families. Based on the univariate regression analysis, there was a significant association between positive family history of infertility and occurrence of infertility; this is in line with a study conducted by Mallikarjuna (25).

The results of our study showed differences between women with or without infertility in terms of physical activity. Women with heavy physical activity were 1.8 times more at risk of fertility problems, compared to women with light physical activity. This finding is in line with a study on a large population from Norway, which evaluated fertility and physical activity (leisure activity and occupational activity) (26).

Cigarette smoking has been consistently associated with major harmful effects on fertility and reproductive function. According to a meta-analysis of 12 studies performed among 1,9179 unexposed and 10,928 exposed women, smokers were more likely to experience infertility compared to non-smokers (27). Our study indicated that the prevalence of infertility was much higher among smokers. Our survey also showed a significant association between infertility and female and male smoking. The toxic components of cigarette smoke, such as cotinine and cadmium, may induce intrafollicular oxidative stress, increase DNA damage in cumulus cells of ovaries, and result in reduced fertility (28).

As the present findings indicated, the incidence of infertility was significantly higher among women with BMI < 18.5 kg/m^2 and > 30 kg/m^2. In fact, both underweight and obesity were introduced as the risk factors for infertility. The prevalence of infertility in women with BMI < 18.5 kg/m^2 and > 30 kg/m^2 was almost 2.1 and 3.7 times higher than women with moderate BMI, respectively. This finding is in line with a study of lifestyle factors, which showed that time to conception increased in both underweight (BMI < 19 kg/m^2) and overweight (BMI > 35 kg/m^2) people (29). BMI and weight are closely associated with amenorrhea, anovulation, reproductive function, subfertility, and infertility at higher body weights. We assume that obesity can result in ovarian dysfunction, cause anovulatory disorder, and reduce fertility. Excessive weight loss and inadequate nutritional intake may also be correlated with gonadal function and fertility reduction (30).

In women with secondary infertility, we evaluated the association between the incidence of current secondary infertility and previous abortions, mode of previous childbirths, and number of pregnancies. The results of univariate regression analysis showed a significant association between the mentioned variables and secondary infertility. The multivariate regression analysis showed that the number of pregnancies and normal vaginal deliveries was a protective factor for secondary infertility, and the number of cesarean sections and abortions was a risk factor for infertility. To our knowledge, these findings were new, and based on our research, we could not find any study supporting these findings.

The present study was performed in the largest city of Hormozgan province in Iran (Bandar Abbas). However, the findings cannot be generalized to all provinces of Iran because of socioeconomic and cultural differences.

5.1. Conclusions

This population-based study is the first research on the prevalence of couple infertility in a southern port city of Iran. Although infertility risk factors are complex and multiple, and the investigated region does not represent all areas of Iran, the results can contribute to the overall reproductive health improvement among Iranians. In the future, we wish to present a theoretical framework for infertility prevention and treatment.

Supplementary Material

Supplementary material(s) is available here [To read supplementary materials, please refer to the journal website and open PDF/HTML].

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Footnotes

Authors' Contribution: Maryam Azizi Kutenaee conceived, designed and monitored the study. Seyedeh Nazanin Sharif conducted the study and performed the analysis. Fatemeh Darsareh wrote and edited the paper. Nasibeh Roozbeh monitored the study.

Conflict of Interests: The authors declare that they had no conflict of interests.

Ethical Approval: This study was approved by the Ethics Committee of Hormozgan University of Medical Sciences (code: HUMS.REC.1396.110).

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Table 1. Basic Characteristics of the Study Population

Variable	Total (N = 1469)	Infertile (N = 224)	Non Infertile (N = 1245)	P Value
Female age (y)	30.53 ± 4.38	35.41 ± 4.24	29.32 ± 4.53	0.001[b]
Male age (y)	36.18 ± 4.73	40.46 ± 3.36	35.12 ± 5.13	0.001[b]
Age at marriage (y)	22.18 ± 3.67	28.39 ± 3.91	21.17 ± 4.65	0.001[b]
Duration of marriage (y)	12.02 ± 1.02	8.03 ± 0.67	12.76 ± 0.55	0.001[b]
Female age				0.01[c]
18-30	444	31 (13.83)	413 (33.17)	
31-35	460	59 (26.33)	401 (32.21)	
36-40	396	101 (45.90)	295 (23.70)	
41-45	169	33 (14.73)	136 (10.92)	
Female age at marriage				0.001[c]
Less than 18 years old	486	28 (12.50)	458 (36.79)	
18-30	533	42 (18.75)	491 (39.44)	
31-35	364	114 (50.89)	250 (20.08)	
More than 35	85	40 (17.86)	46 (3.69)	
Female level of education				0.296[c]
Illiterate	137	19 (8.48)	118 (9.48)	
Primary	369	57 (25.45)	312 (25.06)	
Diploma	714	105 (46.88)	609 (48.91)	
Advanced	249	43 (19.19)	206 (16.54)	
Female occupation				0.001[c]
Yes	398	135 (60.27)	263 (21.12)	
No	1071	8 (39.73)	982 (78.88)	
Male occupation				0.871[c]
Yes	1178	178 (79.46)	1000 (80.32)	
No	291	46 (20.54)	245 (19.68)	
Men engaged in high-temperature occupations				0.001[c]
Yes	599	198 (88.40)	401 (32.21)	
No	870	26 (11.60)	844 (67.80)	
Household income				0.644[c]
Poor	445	64 (28.58)	381 (30.60)	
Average	810	129 (57.59)	681 (54.70)	
Good	214	31 (13.83)	183 (14.70)	
Menstrual cycle				0.001[c]
Irregular	421	151 (67.41)	270 (21.69)	
Regular	1048	73 (32.59)	975 (78.31)	
Previous contraceptive usage				0.001[c]
Yes	622	135 (60.27)	487 (39.12)	
No	847	89 (39.73)	758 (60.88)	
History of infertility in family				0.031[c]
Yes	390	131 (58.48)	259 (20.80)	
No	1079	93 (41.52)	986 (79.20)	

History of chronic disease				0.501[c]
Yes	464	77 (34.37)	387 (31.08)	
No	1005	147 (65.63)	858 (68.92)	
Female Physical activity				0.001[c]
Light	1044	72 (32.14)	972 (78.08)	
Regular	291	90 (40.17)	201 (16.14)	
Heavy	134	62 (27.67)	72 (5.78)	
Female Smoking				0.036[c]
Yes	202	62 (27.67)	140 (11.24)	
No	1267	162 (72.33)	1105 (88.76)	
Male Smoking				0.042[c]
Yes	634	141 (62.95)	493 (39.60)	
No	835	83 (37.05)	752 (60.40)	
Female BMI (kg/m^2)				0.001[c]
Less than 18.5	316	79 (35.26)	237 (19.07)	
18.5 - 24.9	500	19 (8.48)	481 (38.63)	
25 - 29.9	498	47 (20.98)	451 (36.22)	
More than 30	155	79 (35.26)	76 (6.10)	

[a]Values are given as No., No. (%) or mean ± SD.
[b]Based on Independent *t*-test.
[c]Based on chi-square test.