Original Article
A population-based survey on the prevalence and risk factors of infertility in Chinese Uygur and Kazak women

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Abstract: Objective: Infertility is a public health problem that seriously affects women's physical and mental health. This study aimed to determine the prevalence and risk factors of infertility in Chinese Uygur and Kazak women. Methods: Uygur and Kazak women who lived in Xinjiang of China, were enrolled in the study. Participants were chosen by stratified cluster sampling method and asked to finish the questionnaire. Lastly, 857 women were finished the questionnaire survey. The collected data were statistically analyzed. Results: The prevalence of primary infertility was significantly higher in Uygur women than Kazak women (*P*=0.009). The results showed that the risk factors of infertility for Uygur women low include income, pelvic inflammatory disease, endometriosis and low BMI, for Kazak women included low income, late marriage and endometriosis. Conclusion: More attentions should be paid on the construction of social medical security system. Furthermore, various measures should be taken to promote public awareness on the preventions of infertility. In addition, healthcare services, such as better nutrition, education, investigation and management were seriously needed in the local women.

Keywords: Infertility, prevalence, risk factor, Uygur, Kazak

Introduction

Infertility is a disease of reproductive system that means a failure to achieve clinical pregnancy after 12 months or more of regular unprotected sexual intercourse, which is defined by the World Health Organization [1]. Infertility is an important global health problem, but does not receive enough attentions, especially in developing countries [2]. Infertility may bring damaging effect to family relationships and cause negative psychological outcomes [3]. Due to most of the elderly in China, needs the care in physically and mentally from their children in their later life, childless families may face with helplessness and loneliness. Women with infertility are also blamed or subjected to domestic violence [4].

Considering the difficulty to get the accurate statistics across the world wide, there are about 10%-15% couples worldwide suffered from infertility [5]. Due to the social, economic and cultural factors, countries have different prevalence rates of infertility. As shown in the epidemiological investigations, the prevalence rate in developed countries is 6.9%-9.3%, while it is up to 3.5%-16.7% in developing countries [6]. China is a developing country with a large population and vast territory, the characteristics are varied from different regions. Xinjiang is located in the northwest frontier of China with backward economy and a high proportion of ethnic minorities. The minorities have different socioeconomic statuses, cultures, customs and religions from Han majority. Previous study reported that the prevalence rates of infertility in ethnic minorities were higher than Han women in the same areas [7].

In China, the infertility is confirmed after 24 months of regular unprotected intercourse on the hope of conceiving. In order to clarify the situation of infertility in ethnic minorities in Xinjiang areas and offer the targeted guidance for infertility prevention, a population-based study on the prevalence and risk factors was conducted. Uygur and Kazak are the two sizable

Table 1. The general information of Uygur women and Kazak women

Characteristic	Uygur (n=535)			Kazak (n=322)		
	Infertility (n= 142)	Fertility (n=393)	P	Infertility (n=70)	Fertility (n=252)	P
Age (yrs)	35.1±3.4	35.2±2.4	0.96	36.9±5.0	35.3±4.9	0.96
Husband's age (yrs)	38.5±2.9	38.1±3.4	0.35	38.0±2.3	36.6±3.6	0.53
Age of menarche (yrs)	14.5±3.3	14.6±3.2	0.53	15.2±3.5	15.1±3.2	0.423
Age of marriage (yrs)	25.5±3.9	26.6±3.8	0.58	29.5±2.9	24.6±2.8	0.02*
Age of first sexual intercourse (yrs)	25.2±2.9	25.2±1.7	0.71	28.2±2.9	24.2±2.7	0.03*
BMI (kg/m^2)	17.9±0.3	23.8±0.3	0.02*	21.9±0.4	21.8±0.5	0.35

*$P < 0.05$.

Table 2. The prevalence of infertility in Uygur women and Kazak women

Characteristic	Uygur (n=535)	Kazak (n=322)	χ^2	P
Infertility	142 (26.5%)	70 (21.7%)	2.491	0.115
Primary infertility	79 (14.7%)	28 (8.7%)**	6.780	0.009**
Secondary infertility	63 (11.8%)	42 (13.0%)	0.301	0.584

**$P < 0.01$.

ethnic minorities in Xinjiang region of China, most of the ethnical populations are Muslim with different life styles from others. This study enrolled ethnic minority women who lived in the northern rural areas of Xinjiang, allowing us to find out the prevalence and risk factors of infertility in ethnic minority women, and providing the basis for the better treatment and prevention of infertility.

Materials and methods

Procedure

From October 2008 to March 2009, Uygur and Kazak women, who lived in Xinjiang province, were included in this study. Based on the government population database, participants were chosen by stratified cluster sampling method. A total of 900 women were investigated, and 857 women (95.22%) provided valid responses. The inclusion criteria were listed as follows: women were married; < 50 years old; normal unprotected intercourse for pregnancy purpose; and diagnosed of infertility. The women who had non-spontaneous conception, including assisted reproductive technology or ovulation induction of pregnancy, and women with missing data for fertility status or the exposure variables were excluded. The enrolled women were asked to finish the questionnaire.

All the investigators were trained before the trial, and a pilot survey was conducted. Investigators would communicate with participators in the same language. The questionnaire was anonymous and finished in the participants' home. The questionnaire. All participants gave their informed consent, and the study was approved by the local ethics committee.

Questionnaires

The contents of questionnaire included the sociodemographic information on themselves as well as their husband, dietary habit, living habit, individual history of diseases, medication history, gynecological history, marital and reproductive history, menstrual history and the diagnosis/treatment of infertility.

Definition of infertility

In this study, infertility is defined as the inability to conceive after regular unprotected sexual intercourse for 24 months [8]. Primary infertility is defined as the failure to conceive for a woman who has never conceived, while the secondary infertility refers to the failure to conceive for a woman who has a history of previous pregnancies for at least once [9].

Statistical analysis

SPSS 17.0 (SPSS Inc., Chicago, USA) was used for data collection and statistical analysis. Normally distributed continuous data were expressed as mean ± standard deviation and assessed by independent sample t-test. Continuous data that are not normally distributed are described as median [interquartile range] and compared using the Mann-Whitney test.

Table 3. Single factor logistic regression analysis of social characteristics as risk factors for infertility in Uygur women and Kazak women

Characteristic	Uygur (n=535)				Kazak (n=322)			
	Infertility (n=142)	Fertility (n=393)	OR (95% CI)	P	Infertility (n=70)	Fertility (n=252)	OR (95% CI)	P
Education				0.404				0.906
≥ College degree	42 (29.6%)	102 (26.0%)	1.00		30 (42.9%)	110 (43.7%)	1.00	
≤ High school	100 (70.4%)	291 (74.0%)	0.84 (0.55-1.28)		40 (57.1%)	142 (56.3%)	1.03 (0.61-1.76)	
Income (RMB)				0.001**				0.001**
≥ 1000	82 (57.7%)	310 (78.9%)	1.00		50 (71.4%)	229 (90.9%)	1.00	
< 1000	60 (42.3%)	83 (21.1%)	2.73 (1.81-4.13)		20 (28.6%)	23 (9.1%)	3.98 (2.03-7.81)	
Smoking				0.807				0.518
No	122 (85.9%)	341 (86.8%)	1.00		58 (82.9%)	200 (79.4%)	1.00	
Yes	20 (14.1%)	52 (13.2%)	1.08 (0.62-1.87)		12 (17.1%)	52 (20.6%)	0.80 (0.40-1.60)	
Drinking				0.504				0.423
No	120 (84.5%)	340 (86.5%)	1.00		56 (80.0%)	190 (75.4%)	1.00	
Yes	22 (15.5%)	53 (13.5%)	1.18 (0.69-2.02)		14 (20.0%)	62 (24.6%)	0.77 (0.40-1.47)	
BMI (kg/m²)				0.001**				0.632
≥ 18.5	80 (56.3%)	300 (76.3%)	1.00		60 (85.7%)	210 (83.3%)	1.00	
< 18.5	62 (43.7%)	93 (23.7%)	2.36 (1.57-3.54)		10 (14.3%)	42 (16.7%)	0.83 (0.40-1.76)	

**P < 0.01.

Categorical data were expressed as frequency, and the statistical differences were assessed by Pearson Chi-square test. Single factor analysis and multiple logistic regression analysis were carried out to identify the risk factors of infertility. Odds ratio (OR) and 95% confidence interval (CI) were calculated in single and multifactor logistic regression analysis. *P* value less than 0.05 is indicated as statistically significant differences.

Results

Basic characteristics

A total of 1000 Uygur and Kazak married women of reproductive age who lived in elected area were stratified by age (< 20, 21-30, 31-40, 41-49 years old), and 250 women were selected randomly in each age group. Among them, 900 women were enrolled in the study, they were asked to finish the questionnaire. Lastly, 857 valid questionnaires were collected and the response rate was 95.22%. There were 535 valid questionnaires from Uygur women and 322 from Kazak women. Their general information was shown in **Table 1**.

Prevalence of infertility

The prevalence rates of infertility were 26.5% and 21.7% in Uygur women and Kazak women (**Table 2**), respectively, which displayed no sta-

tistical difference between groups. For primary infertility, Uygur women had a higher prevalence rate than Kazak women (*P*=0.009). While for secondary infertility, no significant differences were observed between the two groups.

Factors for infertility

The effects of social characteristics and behavior patterns on infertility were analyzed using single factor logistic regression analysis. As **Tables 3** and **4** shown the results, there were different risk factors influenced the occurrence of infertility in Uygur and Kazak women. For Uygur women, low income, BMI < 18.5, pelvic inflammatory disease and endometriosis were the risk factors of infertility. Furthermore, the multivariate analysis (**Table 5**) showed that low income, pelvic inflammatory disease, endometriosis and low BMI were the risk factors of infertility for Uygur women. The women with a monthly income less than 1000 RMB increased the risk of infertility by 2.43 times. Women with pelvic inflammatory disease and endometriosis increased the risk of infertility by 1.54 and 2.85 times, respectively. The ones with a BMI < 18.5 increased the risk of infertility by 2.27 times.

For Kazak women, compared with fertility, low income, late age of marriage, first sexual intercourse, endometriosis and history of ectopic pregnancy were the risk factors for infertility by single factor logistic regression analysis (**Tables**

Table 4. Single factor logistic regression analysis of behavior patterns as risk factors for infertility in Uygur women and Kazak women

Characteristic	Uygur (n=535)				Kazak (n=322)			
	Infertility (n=142)	Fertility (n=393)	OR (95% CI)	P	Infertility (n=70)	Fertility (n=252)	OR (95% CI)	P
Age				0.057				0.632
< 35	42 (29.6%)	85 (21.6%)	1.00		30 (42.9%)	100 (60.3%)	1.00	
≥ 35	100 (70.4%)	308 (78.4%)	1.52 (0.99-2.35)		40 (57.1%)	152 (39.7%)	1.14 (0.67-1.95)	
Age of menarche (yrs)				0.719				0.787
≥ 14	42 (29.6%)	110 (28.0%)	1.00		36 (51.4%)	125 (49.6%)	1.00	
< 14	100 (70.4%)	283 (72.0%)	0.93 (0.61-1.41)		34 (48.6%)	127 (50.4%)	0.93 (0.55-1.58)	
Age of marriage (yrs)				0.663				0.010*
< 30	120 (84.5%)	338 (86.0%)	1.00		30 (42.9%)	152 (60.3%)	1.00	
≥ 30	22 (15.5%)	55 (14.0%)	1.13 (0.66-1.93)		40 (57.1%)	100 (39.7%)	2.03 (1.19-3.47)	
Age of first sexual intercourse (yrs)				0.808				0.012*
< 25	100 (70.4%)	281 (71.5%)	1.00		31 (44.3%)	150 (59.5%)	1.00	
≥ 25	42 (29.6%)	112 (28.5%)	1.00 (0.66-1.54)		39 (55.7%)	102 (40.5%)	1.85 (1.08-3.16)	
Premarital intercourse				0.394				0.778
No	112 (78.9%)	343 (87.3%)	1.00		32 (45.7%)	120 (47.6%)	1.00	
Yes	30 (21.1%)	50 (12.7%)	1.84 (1.11-3.03)		38 (54.3%)	132 (52.4%)	1.08 (0.64-1.84)	
Pelvic inflammatory diseases				0.001**				0.344
No	50 (35.2%)	200 (50.9%)	1.00		54 (77.1%)	180 (71.4%)	1.00	
Yes	92 (64.8%)	93 (49.1%)	3.96 (2.59-6.04)		16 (22.9%)	72 (28.6%)	0.74 (0.40-1.38)	
Uterine fibroids				0.165				0.415
No	100 (70.4%)	300 (76.3%)	1.00		50 (71.4%)	192 (76.2%)	1.00	
Yes	42 (29.6%)	93 (23.7%)	1.36 (0.88-2.08)		20 (28.6%)	60 (23.8%)	1.28 (0.71-2.32)	
Endometriosis				0.001				0.001**
No	70 (49.3%)	200 (50.9%)	1.00		30 (42.9%)	192 (76.2%)	1.00	
Yes	72 (50.7%)	93 (49.1%)	2.21 (1.47-3.34)		40 (57.1%)	60 (23.8%)	4.27 (2.45-7.43)	
History of abortion				0.390				0.197
No	104 (73.2%)	302 (76.8%)	1.00		30 (42.9%)	130 (51.6%)	1.00	
Yes	38 (26.8%)	91 (23.2%)	1.21 (0.78-1.88)		40 (57.1%)	122 (48.4%)	1.42 (0.83-2.42)	
History of ectopic pregnancy				0.147				0.001**
No	94 (66.2%)	282 (71.8%)	1.00		49 (70.0%)	222 (88.1%)	1.00	
Yes	48 (33.8%)	111 (28.2%)	1.35 (0.90-2.03)		21 (30.0%)	30 (11.9%)	3.17 (1.68-6.00)	

*P < 0.05, **P < 0.01.

3 and **4**). By multivariate analysis, low income, marriage age ≥ 30 years old and endometriosis remained the significant risk factors of infertility (**Table 5**). The women with a monthly income less than 1000 RMB increased the risk of infertility by 1.77 times. Women with married age ≥ 30 years old increased the risk of infertility by 2.39 times. The ones who suffered from endometriosis increased the risk of infertility by 1.89 times.

Discussion

To investigate the prevalence and risk factors of infertility in Chinese Uygur and Kazak women, the study conducted a questionnaire survey in ethnic minority women at reproductive age in Xinjiang, China. The prevalence rates of infertil-

ity were 26.5% and 21.7% in Uygur women and Kazak women, respectively. There had no significant differences in term of infertility prevalence between the two minorities. However, both of them were apparently higher than that of other ethnic groups in other areas of China. In a study based on other minorities in Guangdong, China [10], the prevalence rate in Han majority was 12%, Yao ethnic minority was 16.7% and Zhuang ethnic minority was 13.9%, there had significant differences among them. The different results from our study might come from the different participants. The study by Huang only enrolled newlyweds, while the enrolled women in our study were at reproductive age, which might contribute to the high prevalence to some extent. In our study, infertility was defined as no pregnancy after 2 years of

Table 5. Multiple factor analysis for infertility in Uygur women and Kazak women

Characteristic	Uygur (n=535)				Kazak (n=322)			
	Infertility (n=142)	Fertility (n=393)	OR (95% CI)	P	Infertility (n=70)	Fertility (n=252)	OR (95% CI)	P
Income (RMB)				0.034*				0.029*
≥ 1000	82 (57.7%)	310 (78.9%)	1.00		50 (71.4%)	229 (90.9%)	1.00	
< 1000	60 (42.3%)	83 (21.1%)	2.43 (1.25-4.75)		20 (28.6%)	23 (9.1%)	1.77 (1.44-3.36)	
Age of marriage (yrs)				-				0.027*
< 30	-	-	-		30 (42.9%)	152 (60.3%)	1.00	
≥ 30	-	-	-		40 (57.1%)	100 (39.7%)	2.39 (1.31-4.37)	
Age of first sexual intercourse (yrs)				-				0.324
< 25	-	-	-		31 (44.3%)	150 (59.5%)	1.00	
≥ 25	-	-	-		39 (55.7%)	102 (40.5%)	1.01 (0.62-1.78)	
Pelvic inflammatory diseases				0.031*				-
No	50 (35.2%)	200 (50.9%)	1.00		-	-	-	
Yes	92 (64.8%)	93 (49.1%)	1.54 (1.87-3.71)		-	-	-	
Endometriosis				0.015*				0.046*
No	70 (49.3%)	200 (50.9%)	1.00		30 (42.9%)	192 (76.2%)	1.00	
Yes	72 (50.7%)	93 (49.1%)	2.85 (1.59-5.13)		40 (57.1%)	60 (23.8%)	1.89 (1.04-3.41)	
History of ectopic pregnancy								0.217
No	-	-	-	-	49 (70.0%)	222 (88.1%)	1.00	
Yes	-	-	-		21 (30.0%)	30 (11.9%)	1.21 (0.66-2.24)	
BMI (kg/m^2)				0.027*				-
≥ 18.5	80 (56.3%)	300 (76.3%)	1.00		-	-	-	
< 18.5	62 (43.7%)	93 (23.7%)	2.27 (1.32-5.04)		-	-	-	

*P < 0.05.

unprotected intercourse instead of 1 year [11]. The unique daily habits and the undeveloped local medical conditions might lead to the extremely higher prevalence rate compared with other studies. They directly use unrefined cottonseed oil as edible oil, while unrefined cottonseed oil could inhibit the development of spermatogenic cells for male and the growth of endometrium for female [12]. Moreover, Uygur and Kazak women have lower education levels, coupled with undeveloped local medical conditions, they lack active consciousness of seeking medical attention, and they are more believed in the folk methods, such as drinking more mare's/camel's milk, exposure to more natural sunlight. All these might lead to the high occurrence of infertility in this population.

This study found that the prevalence of primary infertility in Uygur women was significantly higher than Kazak women. However, there were no significant differences between the prevalence of secondary infertility. Previous studies reported the incidence of primary infertility was 2% in India, 2.8% in Sri Lanka and 2.6% in Thailand [13], all of them were significantly lower than that in the study in Xinjiang. The inci-

dence of secondary infertility was 18.9%-26.5% in Central Africa [14], which was higher than the result in this study. In addition, in USA, the prevalence was 11% [15], which was just a litter lower than the present result. Due to the different population policies in different countries, the prevalence of secondary infertility was easily to be misevaluated [16].

Multiple logistic regression analysis showed that low income and endometriosis were the risk factors for infertility both in Uygur women and Kazak women. Income level could indirectly influence the expenditures for health care [17], people with a low-income usually have a poor consciousness of self-health care, some potential risk factors for infertility couldn't be eliminated at early stage and finally result in the occurrence of infertility. The same risk factors were found in Mongolian women who lived in Xinjiang, China [18]. Endometriosis was another important risk factor, it could lead to the changes in pelvic structure and the distortions of fallopian tube [2], as well as the change in pelvic micro environment [19]. Furthermore, the increased inflammatory cytokines and macrophages had a toxic effect on fertilized ovum

[2]. Therefore, the women who were diagnosed as endometriosis should be treated as early as possible.

Besides, late marriage was a risk factor of infertility for Kazak women. More attentions should be paid to enhance their awareness of bearing at reproductive age. Pelvic inflammatory disease and low BMI were the risk factors of infertility for Uygur women. Pelvic inflammatory disease refers to the infection in upper part of the female reproductive system. Previous studies found that tubal obstruction was the key cause of secondary infertility [2], and pelvic inflammatory disease was the primary cause of tubal obstruction. Women with low or high BMI had the risk of infertility too. High BMI leaded to the imbalance of sex hormone and affected sexual function [2]. Women with low BMI had less fat in bodies that would influence the normal metabolism of estrogen. Therefore, the pelvic inflammatory disease and weight management should receive enough attentions in Uygur women.

Based on the study in Uyghur women and Kazak women, we have a good understanding on their prevalence of infertility. It is helpful to the prevention of infertility, and also could make some basis for the development of healthcare guidance. On one hand, the health administrative departments should pay more attentions to the construction of social medical security system for the farmers/herdsmen. Government investments should be increased to ensure their effective healthcare. Healthcare services, such as better nutrition, education, investigation and management were seriously needed in the local women. On the other hand, various measures should be taken to enhance publicity of knowledge in sexual health care, and strengthen peoples' awareness on their personal health. More importantly, much attention should be paid to the prevention of pelvic inflammatory disease.

Conclusion

This study first surveyed the prevalence and risk factors of infertility for Uygur women and Kazak women in Xinjiang Uygur Autonomous Region of China. During our clinic work, more attentions should be paid to the ones with risk factors for infertility, such as the ones who had pelvic inflammatory disease, endometriosis,

low income, low BMI, late marriage. This thesis offered us the information on the risk factors and helped to reduce the occurrence of infertility. However, the present study also had some limitations. Firstly, the definition of infertility did not adopt the international standard, which caused some differences from other studies. Secondly, due to the limitations of the local medical conditions, the records on medical history of gynecological diseases were not complete, which brought some interference in the prediction of the roles of other factors. Lastly, we did not exclude the participants of history of abortion and ectopic pregnancy subject to primary infertility women in the logistical regression analysis. However, Primary infertility only reached 8.7% of Kazak women, and history of ectopic pregnancy was nonsignificant in the Multiple factor analysis, which might be not influence the results. Based on the information obtained in this study, a more comprehensive investigation on infertility will be conducted in the near future.

Disclosure of conflict of interest

None.

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