

Sperm cryopreservation in the human sperm bank: 11-year results of the Chinese mainland sperm banking network

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To the Editor: Montegazza in 1866 was the first to suggest banks for frozen human semen.^[1] In 1981, China's first human sperm bank was successfully established at the CITIC Xiangya Hospital. During the previous four decades, from 1981 to 2020, there were 27 human sperm banks in Chinese mainland. Human sperm banks provide cryopreservation of spermatozoa services for males needing to preserve fertility for an extended period in the Chinese mainland.

The main sector of the population undergoing fertility preservation (FP) is cancer patients.^[2] Chemotherapy with alkylating agents and pelvic radiation are the main reasons for impaired semen quality. However, both patients' and clinicians' awareness of treatment for non-oncological

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conditions with medications having a negative impact on fertility and requiring FP is steadily increasing. International FP experts suggest that non-oncological systemic diseases requiring male FP include hematological diseases, autoimmune diseases, Klinefelter's syndrome, and testicular damage.^[3] Moreover, non-medically indicated FP, such as social sperm banking, gender dysphoria before affirmation procedures, and posthumous reproduction preservation are becoming more common. At present, research has mostly focused on cancer, which is the main indication for FP, given its impact on male reproductive health. However, few studies have reported on other indications for FP.

To investigate the current situation of male FP in the sperm bank, a national meeting with sperm bank representatives was held in Chengdu (Sichuan) in March 2021. Our retrospective study, covering a period of 11 years (2010–2020), reports on the latest survey data on male FP services in the Chinese mainland. This study was approved by the Ethics Committee of West China Second Hospital, Sichuan University (No: 2020-001).

There are 27 Chinese regional sperm banks affiliated with the Chinese mainland sperm banking network which includes Beijing (two human sperm banks), Hebei, Liaoning, Shanghai (two human sperm banks), Jiangsu, Zhejiang, Shandong, Guangdong, Hainan, Shanxi, Jilin, Anhui, Jiangxi, Henan (two human sperm banks), Hubei, Hunan, Inner Mongolia, Guangxi, Chongqing, Sichuan, Yunnan, Shaanxi, Gansu, and Xinjiang. FP project was not carried out in Liaoning and Hebei. A total of 23 sperm banks approved to provide sperm cryopreservation data. Four clinics were excluded from the data analysis, because two of them did not carry out FP, and the other two did not upload data. In total, 85% of the human sperm banks reported data, which is representative of the national data.

The provinces were clustered into eastern, central, and western provinces, geographically. The eastern region includes six provinces: Beijing, Shanghai, Jiangsu, Zhejiang, Guangdong, and Hainan; the central region includes seven provinces or cities: Shanxi, Jilin, Anhui, Jiangxi, Henan, Hubei, and Hunan; and the western region includes eight provinces or cities: Inner Mongolia, Guangxi, Chongqing, Sichuan, Yunnan, Shaanxi, Gansu, and Xinjiang.

First, from January 1, 2010, to December 31, 2020, 5055 males chose sperm cryopreservation for FP in 23 human sperm banks. Between 2010 and 2020, the number of male FPs in the country showed an overall upward trend, and in 2020, it showed a downward trend that may have been affected by the coronavirus disease 2019 (COVID-19) pandemic. In our study population, we observed a mean yearly increase in the rate of patients with sperm cryopreservation in per 10,000 male resident populations of 45.8 (95% confidence interval [CI], 15.3–75.0) between 2010 and 2020. In this study, male FP was divided into three major types: cancer, fertility backup, and non-oncologic diseases that may affect male fertility. Statistically significant mean yearly increases were observed for all types of male FPs. The FP increase was 46.7% (95% CI, 4.3–103.1%) for cancer, 53.7% (95% CI, 8.9–111.6%)

for fertility backup (delayed childbearing), and 40.4% (95% CI, 7.2–73.6%) for non-oncologic diseases [Supplementary Figure 1, <http://links.lww.com/CM9/B364>].

In our study, the distribution of male FP was calculated in the eastern, central, and western geographical clusters. Detailed data are presented in Table 1. Due to the different development times and directions of each sperm bank, the number and types of male FP in eastern, central, and western populations displayed an imbalance. In 2020, there were 465 subjects with sperm cryopreservation in the eastern region, almost 2.0 times the number (228) in the central region and 1.8 times the number in the western region (257). The average percentage of males receiving sperm cryopreservation in the male resident population of regional distribution in 2020 (Data source: National Bureau of Statistics) was 2.05 per 10,000 residents, 2.52 per 10,000 residents in the eastern regions, 1.72 per 10,000 residents in the central regions, and 1.92 per 10,000 residents in the western regions.

In addition, the percentage distribution of the three types of male FP in the nation was cancer (3341, 66.1%), fertility backup (1163, 23.0%), and non-oncologic diseases (551, 10.9%) [Supplementary Figure 2A, <http://links.lww.com/CM9/B365>]. According to the literature,^[4] major tumors creating the highest need for FP in men (including testicular tumor, lymphoma, leukemia, gastrointestinal tumor, sarcoma, brain tumor, prostate cancer, and remaining tumors categorized as “other tumors”) were investigated. Among the 3341 cancer patients, the most frequent types were testicular cancers (28.9%), lymphoma (18.9%), and leukemia (10.0%) [Supplementary Figure 2B, <http://links.lww.com/CM9/B365>]. Fertility backup mainly includes the need for delayed childbearing, separation, pre-vasectomy, and high-risk occupations. Delayed childbearing was the main factor for fertility backup, accounting for 88.7% of cases [Supplementary Figure 2C, <http://links.lww.com/CM9/B365>]. Non-oncologic diseases that can affect male fertility include autoimmune diseases, chronic diseases, aplastic anemia, severe thalassemia, varicocele, and other specific diseases. Chronic diseases mainly include chronic nephritis and diabetes. Autoimmune diseases include systemic lupus erythematosus, multiple sclerosis, and Crohn's disease. The proportion of FP for chronic and autoimmune diseases was low, accounting for 18% [Supplementary Figure 2D, <http://links.lww.com/CM9/B365>].

FP started late in China and is relatively backward compared to that in developed countries.^[5] Lack of information, awareness, and knowledge for both doctors and patients are another main reasons. However, the preservation of male fertility has received increasing attention in China, especially since 2013. The number of FPs has increased linearly since then.

The results show that the development difference of male FPs in regions is remarkable. Among them, the number of FPs in Guangzhou sperm bank reached 1386, whereas the number in Inner Mongolia was only 6. Furthermore, the eastern, western, and central regions developed unevenly. Moreover, the distribution types of male FP manifest a

Table 1: Regional distribution and the average percent of male FP among resident population (15–59 years old) in 2020.

Region	Provinces	Number of subjects having sperm cryopreservation	Average percentage of male FP in per 10,000 male resident populations (15–59 years old)
East	Guangdong	256	5.91
	Zhejiang	86	1.96
	Jiangsu	29	0.54
	Beijing	68	4.53
	Shanghai	19	1.14
	Hainan	7	1.06
	Total 465		Mean 2.52
Central	Hunan	72	3.58
	Hubei	29	1.59
	Henan	42	1.44
	Anhui	61	3.23
	Jiangxi	12	0.87
	Shanxi	5	0.44
	Jilin	7	0.89
	Total 228		Mean 1.72
West	Sichuan	121	4.65
	Guangxi	55	3.68
	Yunnan	45	2.91
	Chongqing	11	1.10
	Shaanxi	2	0.16
	Gansu	9	1.13
	Xinjiang	6	0.70
	Inner Mongolia	8	1.01
	Total 257		Mean 1.92

The data of resident population (15–59 years old) in each region in 2020 are from the China National Bureau of Statistics. Estimated male to female ratio is 1:1. FP: Fertility preservation.

consistency in the regions of China. Oncologic conditions account for approximately 66% of the overall demand for FPs. According to the literature, the seven most common tumor types associated with the need for FP were analyzed, and we found that prostate cancer and brain tumors accounted for a relatively small proportion. A large gap was noted between our findings and the proportions reported in the literature. It appears that the incidence of certain tumors in China differs from that in other countries, which requires further analysis. In the analysis of non-oncologic indications for male FP, it was found that other special diseases accounted for 55%, indicating that the chronic, autoimmune, and hematological diseases in our study were not the main indications.

To summarize, by conducting this large-sample study over a long period, we demonstrated that the availability of male FP services has improved significantly in recent years in the Chinese mainland. The results show that the development difference of male FPs in eastern, western, and central regions is remarkable. Efforts must be made toward better training for all healthcare providers.

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Conflicts of interest

None.

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