Clinical, demographic and psychological characteristics of infertile male smokers in Northeast China

Ming Zhang, Qiu-Shuang Zhang, Hong-Shu Zheng, Xiu-Yan Wang, Shu-Qiang Feng, Wen-Jie Tian and Hai-Tao Fan

Abstract

Objectives: To investigate clinical, demographic and psychological characteristics of infertile male smokers in northeast China.

Methods: Serum and semen samples were collected from infertile men. Semen analysis was performed according to conventional procedures. Serum follicle-stimulating hormone, luteinizing hormone and testosterone levels were quantified. Psychological anxiety and depression were evaluated by the self-rating anxiety scale (SAS) and self-rating depression scale (SDS), respectively.

Results: Both SDS and SAS scores were significantly higher in smokers \((n = 704)\) than in nonsmokers \((n = 372)\); in addition, sperm viability and motility were significantly lower in smokers than in nonsmokers. Spearman's correlation coefficient analysis revealed significant positive correlations between duration of smoking and SDS and SAS scores, and between cigarettes smoked per day and SDS and SAS scores.

Conclusions: Cigarette smoking has a negative effect on sperm viability and motility, and is associated with increased SDS and SAS scores.

Keywords
Male infertility, Semen quality, Smoking, Psychological anxiety

Date received: 28 April 2015; accepted: 24 August 2015

Introduction

Smoking is a known risk factor in male infertility, but the effects of smoking on semen quality are unclear. In infertile men, cigarette smoking is associated with damaging effects on sperm density, viability, motility and morphology,\(^1\)-\(^6\) as well as affecting semen volume.\(^6\)-\(^8\) Smoking has

Andrology Laboratory, Department of Urology, the Second Hospital of Jilin University, Changchun, China

Corresponding author:
Ming Zhang, Department of Urology, the Second Hospital, Jilin University, 218 Ziqiang Street, Jilin Province, Changchun, 130041, China.
Email: zhangming1982jdey@126.com

Creative Commons CC-BY-NC: This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 3.0 License (http://www.creativecommons.org/licenses/by-nc/3.0/) which permits non-commercial use, reproduction and distribution of the work without further permission provided the original work is attributed as specified on the SAGE and Open Access page (https://us.sagepub.com/en-us/nam/open-access-at-sage).
also been shown to have detrimental effects on sperm parameters and seminal zinc levels in both fertile and infertile men,\textsuperscript{2,4,9} and heavy smoking can affect sperm concentrations.\textsuperscript{10,11} These effects are related to the both the number of cigarettes smoked and the duration of smoking.\textsuperscript{2} Others have reported, however, that cigarette smoking has no effect on semen or sperm parameters.\textsuperscript{12,13} The effects of smoking on reproductive hormones are also unclear, with studies showing varying and contradictory effects on serum follicle-stimulating hormone (FSH), luteinizing hormone (LH), testosterone, and total testosterone (TT) levels.\textsuperscript{3,8,14–16}

Infertility can have psychological effects.\textsuperscript{17} Infertile men are socially isolated, show more anxiety\textsuperscript{18} and are more vulnerable to severe anxiety than fertile men.\textsuperscript{19} Male partners in infertile couples experience greater psychological distress than fertile men,\textsuperscript{20} and hormonal disturbances and the effectiveness of infertility management are related to mood disorders.\textsuperscript{21} Additionally, psychological stress may be associated with the effect of cigarette smoking on the quality of semen, since lower sperm density and abnormal sperm are related to psychological stress,\textsuperscript{9} and psychosocial anxiety is related to cigarette smoking.\textsuperscript{22}

The present study investigated clinical, demographic and psychological characteristics of infertile male smokers in northeast China. The relationships among psychological stress, smoking and quality of semen were also evaluated.

**Patients and methods**

**Study population**

The study enrolled men who sought treatment for infertility at the Andrology Outpatient Clinic, the Second Hospital of Jilin University, Changchun, China, between January 2013 and December 2014. A physical examination was conducted in each participant to determine age, height, weight, and testicular volume (assessed using a Prader orchidometer). All patients completed a detailed questionnaire regarding smoking history and frequency, marital history, education level, monthly income, working conditions and medical history.

The study protocol was approved by the ethics committee of the Second Hospital of Jilin University, Changchun, China, and all participants provided written informed consent.

**Study parameters**

Anxiety and depression were evaluated using the self-rating anxiety scale (SAS) and the self-rating depression scale (SDS), respectively, as validated for Chinese populations.\textsuperscript{23} An SAS score \( \geq 50 \) and SDS score \( \geq 53 \) indicated anxiety and depression, respectively.

Semen analysis was performed according to procedures recommended by the World Health Organization, 1999.\textsuperscript{24} From all patients, peripheral blood (5 ml) was collected using routine methods into sterile tubes without additives, stored at room temperature for 30 min, then centrifuged at 1000 g for 10 min. Serum was stored in sterile tubes at \(-20^\circ C\) until use. Serum FSH, LH and testosterone levels were quantified via electrochemiluminescence immunoassay (Roche Diagnostics, Mannheim, Germany).

**Statistical analyses**

Data were presented as mean \( \pm SD \) or \( n (%) \) and compared using independent-samples \( t \)-test or \( \chi^2 \)-test. Spearman’s correlation coefficient analysis was used to determine possible correlations with smoking status. Data were analysed using SPSS\textsuperscript{®} version 17.0 (SPSS Inc., Chicago, IL, USA) for Windows\textsuperscript{®}. \( P \)-values \( < 0.05 \) were considered statistically significant.
Results

The study included 1076 male patients with infertility (mean age 30.1 ± 4.75 years; age range 19–54 years). Of these, 704 were smokers (duration 1–20 years, 2–40 cigarettes/day) and 372 were nonsmokers. Demographic and psychological characteristics of the study population are shown in Table 1. Both left and right testicular volumes were significantly lower in smokers than in nonsmokers (P < 0.001 for each comparison). SDS and SAS scores were significantly higher in infertile male smokers than in nonsmokers (P < 0.01 and P < 0.001, respectively). There were no significant between-group differences in age, duration of infertility, height, weight, education level or monthly income.

The clinical characteristics of infertile men are shown in Table 2. Sperm viability and motility were significantly lower in smokers than in nonsmokers (P = 0.005 and P = 0.002, respectively). There were no significant between-group differences in semen volume, sperm count or FSH, LH and testosterone levels.

Spearman’s correlation coefficient analysis revealed significant negative correlations between duration of smoking and sperm viability (r = −0.106, P < 0.01) and motility (r = −0.093, P < 0.01), and between cigarettes smoked per day and sperm viability (r = −0.123, P < 0.01) and motility (r = −0.121, P < 0.01). There were significant positive correlations between duration of smoking and SDS (r = 0.062, P < 0.05) and SAS scores (r = 0.088, P < 0.01), and between cigarettes smoked/day and SDS (r = 0.070, P = 0.05) and SAS scores (r = 0.103, P = 0.01).

Discussion

The effect of smoking on semen quality in infertile men is unclear. The Practice

---

### Table 1. Demographic and psychological characteristics of infertile men from northeastern China, stratified according to tobacco smoking.

| Characteristic                      | Smokers n = 704 | Nonsmokers n = 372 | Statistical significancea |
|------------------------------------|-----------------|--------------------|---------------------------|
| Age, years                         | 29.88 ± 4.71    | 30.41 ± 4.81       | NS                        |
| Duration of infertility, years     | 3.34 ± 2.91     | 3.66 ± 3.32        | NS                        |
| Height, cm                         | 175.96 ± 7.82   | 176.26 ± 7.53      | NS                        |
| Weight, kg                         | 76.05 ± 6.83    | 75.28 ± 7.53       | NS                        |
| Left testicular volume, cc         | 14.11 ± 4.74    | 16.80 ± 4.02       | P < 0.001                 |
| Right testicular volume, cc        | 14.38 ± 4.75    | 17.09 ± 4.18       | P < 0.001                 |
| Education level                    |                 |                    | NS                        |
| Graduate                           | 31 (4.4)        | 17 (4.6)           |                           |
| University                         | 249 (35.4)      | 135 (36.3)         |                           |
| Senior high                        | 385 (54.7)      | 195 (52.4)         |                           |
| Junior high                        | 39 (5.5)        | 25 (6.7)           |                           |
| Monthly Income, RMB                |                 |                    | NS                        |
| Low, <2000                         | 483 (68.6)      | 241 (64.8)         |                           |
| High, ≥2000                        | 221 (31.4)      | 131 (35.2)         |                           |
| SDS score                          | 43.15 ± 8.75    | 41.46 ± 9.49       | P = 0.005                 |
| SAS score                          | 47.64 ± 7.34    | 45.69 ± 8.18       | P < 0.001                 |

Data presented as mean ± SD or n (%).

aStudent’s t-test or χ²-test.

NS, not statistically significant (P ≥ 0.05); SDS, Self-rating Depression Scale; SAS, Self-rating Anxiety Scale.
Committee of the American Society for Reproductive Medicine reported that, according to available biological, experimental and epidemiological data, up to 13% of infertility can be attributed to cigarette smoking. Cigarette smoking can accelerate the loss of reproductive function; 22% of semen parameters and sperm function are poorer in smokers than nonsmokers, and these effects are dose-dependent. Testicular volume was significantly lower in smokers than nonsmokers in the present study, although this finding may be related to the varying aetiology of the study population.

Low-income individuals have been shown to consume more tobacco products than those with higher incomes. There were no significant between-group differences in age, duration of infertility, height, weight, education level or monthly income in the present study, but sperm viability and motility were significantly lower in smokers than in non-smokers: these findings are in accordance with those of others. In addition, we found no significant between-group differences in semen volume, sperm count, or FSH, LH and testosterone levels, which is also consistent with other studies.

Infertile men have an increased risk of psychological problems, and consideration of such issues is important in the diagnosis and treatment of infertility. Psychosocial interventions are efficacious for couples undergoing infertility treatment, since reducing psychological distress can improve clinical pregnancy rates. The management of psychological factors has an important preventative role in treating infertility: psychological interventions from each person in a partnership can help each partner to support the other.

A key factor in the relationship between infertility and psychological anxiety is the duration of infertility and treatment, since treatment-related psychological anxiety is linked to cigarette smoking level. Both SDS and SAS scores were significantly higher in smokers than in nonsmokers in the present study, but they remained within the normal range. Correlation analysis revealed that both duration of smoking and number of cigarettes smoked per day were positively correlated with SDS and SAS scores in the present study.

In conclusion, cigarette smoking has a negative effect on sperm viability and motility, and is associated with increased SDS and SAS scores in men from Northeast China. Infertile men with psychological anxiety tend to smoke more cigarettes than fertile men, therefore psychological effects should be taken into account in the treatment of male infertility. Infertile men who are smokers should be encouraged to stop smoking to improve their reproductive potential.

Table 2. Clinical characteristics of infertile men from northeastern China, stratified according to tobacco smoking.

| Parameter            | Smokers \(n = 704\) | Non-smokers \(n = 372\) | Statistical significance\(^a\) |
|----------------------|---------------------|--------------------------|--------------------------------|
| Semen volume, ml     | 3.57 ± 2.68         | 3.75 ± 3.42              | NS                             |
| Sperm concentration, \(\times 10^6\)/ml | 52.46 ± 50.27       | 56.14 ± 51.01            | NS                             |
| Sperm viability, %    | 48.30 ± 24.08       | 52.53 ± 22.66            | \(P = 0.005\)                  |
| Sperm motility, %     | 24.43 ± 19.95       | 28.57 ± 21.26            | \(P = 0.002\)                  |
| FSH, mIU/ml           | 6.97 ± 5.18         | 6.80 ± 5.27              | NS                             |
| LH, mIU/ml            | 7.16 ± 5.45         | 6.94 ± 5.56              | NS                             |
| Testosterone, ng/ml   | 3.12 ± 1.86         | 3.27 ± 2.58              | NS                             |

Data presented as mean ± SD.

\(^a\)Student’s t-test.
Acknowledgement

We are sincerely grateful to all of the staff of the Andrology Laboratory, Department of Urology, the Second Hospital of Jilin University, Changchun, China, for their excellent work.

Declaration of Conflicting Interest

The authors declare that there are no conflicts of interest.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

References

1. Caserta D, Bordi G, Di Segni N, et al. The influence of cigarette smoking on a population of infertile men and women. Arch Gynecol Obstet 2013; 287: 813–818.
2. Taha EA, Ez-Aldin AM, Sayed SK, et al. Effect of smoking on sperm vitality, DNA integrity, seminal oxidative stress, zinc in fertile men. Urology 2012; 80: 822–825.
3. Al-Matubsi HY, Kanaan RA, Hamdan F, et al. Smoking practices in Jordanian people and their impact on semen quality and hormonal levels among adult men. Cent Eur J Public Health 2011; 19: 54–59.
4. Liu RZ, Gao JC, Zhang HG, et al. Seminal plasma zinc level may be associated with the effect of cigarette smoking on sperm parameters. J Int Med Res 2010; 38: 923–928.
5. Wu JQ, Li YY, Gao ES, et al. The influence of smoking on the routine parameters of semen quality. Zhonghua Liu Xing Bing Xue Za Zhi 2012; 33: 1228–1232. (in Chinese, English abstract).
6. Zhang ZH, Zhu HB, Li LL, et al. Decline of semen quality and increase of leukocytes with cigarette smoking in infertile men. Iran J Reprod Med 2013; 11: 589–596.
7. Anifandis G, Bounartzi T, Messini CI, et al. The impact of cigarette smoking and alcohol consumption on sperm parameters and sperm DNA fragmentation (SDF) measured by Halosperm™. Arch Gynecol Obstet 2014; 290: 777–782.
8. Pasqualotto FF, Sobreiro BP, Hallak J, et al. Cigarette smoking is related to a decrease in semen volume in a population of fertile men. BJU Int 2006; 97: 324–326.
9. Li Y, Lin H, Li Y, et al. Association between socio-psycho-behavioral factors and male semen quality: systematic review and meta-analyses. Fertil Steril 2011; 95: 116–123.
10. Joo KJ, Kwon YW, Myung SC, et al. The effects of smoking and alcohol intake on sperm quality: light and transmission electron microscopy findings. J Int Med Res 2012; 40: 2327–2335.
11. Collodel G, Capitani S, Pammolli A, et al. Semen quality of male idiopathic infertile smokers and nonsmokers: an ultrastructural study. J Androl 2010; 31: 108–113.
12. de Jong AM, Menkveld R, Lens JW, et al. Effect of alcohol intake and cigarette smoking on sperm parameters and pregnancy. Andrologia 2014; 46: 112–117.
13. Davar R, Sekhavat L and Naserzadeh N. Semen parameters of non-infertile smoker and non-smoker men. J Med Life 2012; 5: 465–468.
14. Mitra A, Chakraborty B, Mukhopadhay D, et al. Effect of smoking on semen quality, FSH, testosterone level, and CAG repeat length in androgen receptor gene of infertile men in an Indian city. Syst Biol Reprod Med 2012; 58: 255–262.
15. Jeng HA, Chen YL and Kantaria KN. Association of cigarette smoking with reproductive hormone levels and semen quality in healthy adult men in Taiwan. J Environ Sci Health A Tox Hazard Subst Environ Eng 2014; 49: 262–268.
16. Halmenschlager G, Rossetto S, Lara GM, et al. Evaluation of the effects of cigarette smoking on testosterone levels in adult men. J Sex Med 2009; 6: 1763–1772.
17. Akhondi MM, Binaafar S, Ardakani ZB, et al. Aspects of psychosocial development in infertile versus fertile men. J Reprod Infertil 2013; 14: 90–93.
18. Klemetti R, Raitanen J, Sihvo S, et al. Infertility, mental disorders and well-being—a nationwide survey. Acta Obstet Gynecol Scand 2010; 89: 677–682.
19. Fisher JR and Hammarberg K. Psychological and social aspects of infertility in men: an overview of the evidence and implications for psychologically informed clinical care and future research. *Asian J Androl* 2012; 14: 121–129.

20. Dyer S, Lombard C and Van der Spuy Z. Psychological distress among men suffering from couple infertility in South Africa: a quantitative assessment. *Hum Reprod* 2009; 24: 2821–2826.

21. Kocelak P, Chudek J, Naworska B, et al. Psychological disturbances and quality of life in obese and infertile women and men. *Int J Endocrinol* 2012; 2012: 236217.

22. Zorn B, Auger J, Velikonja V, et al. Psychological factors in male partners of infertile couples: relationship with semen quality and early miscarriage. *Int J Androl* 2008; 31: 557–564.

23. Gao J, Zhang X, Su P, et al. Relationship between sexual dysfunction and psychological burden in men with infertility: a large observational study in China. *J Sex Med* 2013; 10: 1935–1942.

24. World Health Organization. *Laboratory manual for the examination of human semen and sperm-cervical mucus interaction*, 4th ed. Cambridge: Cambridge University Press, 1999.

25. Practice Committee of the American Society for Reproductive Medicine. Smoking and infertility: a committee opinion. *Fertil Steril* 2012; 98: 1400–1406.

26. Frederiksen Y, Farver-Vestergaard I, Skovgard NG, et al. Efficacy of psychosocial interventions for psychological and pregnancy outcomes in infertile women and men: a systematic review and meta-analysis. *BMJ Open* 2015; 5: e006592.

27. Nagy E and Nagy BE. Coping with infertility: comparison of coping mechanisms and psychological immune competence in fertile and infertile couples. *J Health Psychol.* 2015 Jan 23. pii: 1359105314567206. (Epub ahead of print).

28. Podolska MZ and Bidzan M. Infertility as a psychological problem. *Ginekol Pol* 2011; 82: 44–49.

29. Chiaffarino F, Baldini MP, Scarduelli C, et al. Prevalence and incidence of depressive and anxious symptoms in couples undergoing assisted reproductive treatment in an Italian infertility department. *Eur J Obstet Gynecol Reprod Biol* 2011; 158: 235–241.

30. Greil AL. Infertility and psychological distress: a critical review of the literature. *Soc Sci Med* 1997; 45: 1679–1704.

31. Mikkelsen AT, Madsen SA and Humaidan P. Psychological aspects of male fertility treatment. *J Adv Nurs* 2013; 69: 1977–1986.