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Association of occupations with decreased semen quality in eastern China: a cross-sectional study of 12 301 semen donors

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ABSTRACT

Objectives This study aims to examine the association between occupational factors and semen quality in semen donors in eastern China.

Methods We recruited 12 301 semen donors from 2006 to 2020 as the studying population. A self-designed questionnaire was applied for collecting lifestyle and work style information. Semen samples were analysed according to WHO guidelines. A crude and adjusted linear regression model was used to analyse the association between occupational factors and semen quality.

Results College students accounted for 36.2% of all semen donors. The majority (81.3%) of semen donors were between 18 year and 30 years. Soldiers or the police had the highest semen volume (the median value=3.8 mL), however, they had the lowest sperm concentration (53.6×10^6/ml) and sperm motility (45.5%). Workers in finance or insurance had an elevated risk of low semen volume, sperm concentration and total sperm count (*OR*=1.43, 1.57 and 1.98, respectively). Unemployed men had a high risk of low sperm concentration and low total sperm count (*OR*=1.84 and 1.58, respectively). Working in the information technology industry had a deleterious effect on the progressive motility of sperm (*OR*=1.27, 95% CI 1.03 to 1.57).

Conclusion Our study indicated that sedentary work style and intensive sports in certain professions might be associated with decreased semen quality. We reported evidence of becoming unemployed on the damage to semen quality. Hence, we advocate a healthy work style to improve semen quality in eastern China.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Our study focused on the association between occupations and decreased semen quality for the first time in eastern China.
⇒ We investigated both the lifestyle and work style factors on semen quality.
⇒ We recruited 12 301 semen donors from 2006 to 2020, which is a large sample.
⇒ We did not exhaust all the measurement methods to assess semen quality such as the measurement of sperm morphology and DNA fragment.

INTRODUCTION

Male infertility affected approximately 7% of the male population worldwide.[1] An international study estimated that 72.4 million people of reproductive age were infertile.[2] Many causes could result in male infertility, including male diseases,[3] genetics, lifestyle factors[4] or environmental exposure due to living in highly polluted areas.[5] Semen quality is the cornerstone of male infertility studies. A previous report[6] suggested that semen quality could serve as a useful predictor of male fertility. Previous studies have focused on the semen quality among semen donors,[7] young men,[8] male partners in infertile couples[9] and fertile men.[10] However, semen quality has declined in several developed and developing countries in the past years.[11] A systematic review[12] reported that semen counts decreased by 50%–60% between 1973 and 2011, meanwhile, male infertility has increased in these years. The results of the Global Burden of Disease Survey showed that the age-standardised prevalence of infertility increased by 0.291% each year in men and by 0.37% in women.[12] However, the reasons for the decline of semen quality over the past decades are still not resolved worldwide.

The current knowledge about the factors associated with semen quality is often contradictory. Some data suggest that the risk factors for poor semen quality include excessive alcohol consumption, cigarette smoking, the wearing of tight-fitting underwear, being fat and the use of recreational drugs.[13] However, the factors for poor semen quality vary between different populations and regions;[14] for example, cigarette smoking has an overall detrimental effect on semen quality,[15] while another study found that smoking was not associated with sperm motility.[16] Even for some well-recognised factors, there are still

some controversies about their impacts on semen quality. Most studies suggested that physical activity was an important risk factor for sperm count and concentration in white young men.[17] However, a meta-analysis showed that elite physical activity hurts semen quality.[18] Hence, researchers are not sure whether these findings of risk factors or preventive measures can be applied worldwide and to the local population.

Occupational hazards are potential risk factors that might influence semen quality. A previous study[19] reported that occupational exposure to polycyclic aromatic hydrocarbons was associated with decreased sperm DNA integrity among coke oven workers. Physical or chemical hazards in the workplace may be the main cause of male infertility.[20] Some data suggested that high exposure level of formaldehyde among autopsy service workers had an adverse effect on abnormal sperm progressive motility (*OR*=4.84; 95% CI 1.83 to 12.81) and abnormal total sperm motility (*OR*=4.84; 95% CI 1.83 to 12.81).[21] A previous study[22] indicated a negative relationship between pesticide exposure or radiation and reduction of sperm motility and concentration. Occupational exposure to heat was also negatively associated with semen quality.[23]

The plausible mechanism for the association between occupational exposure and semen quality has been proposed in some recent studies. A study in Mexico[24] revealed that exposure to polycyclic aromatic hydrocarbons could lead to DNA damage, and then was negatively associated with semen quality. A recent study[25] found a positive association between 5hmC of the sperm ACHE gene and occupational exposure to bisphenol A, indicating the adverse impact of occupational hazards on human semen quality. However, the association between occupations and semen quality was not well clarified.

Hence, to clarify the occupational risk factors for decreased semen quality, we carried out an observational study to examine the association of occupational factors to semen quality in semen donors in eastern China.

METHODS

Study design

We recruited volunteers for semen donation as the study population from 2006 to 2020. The donors were aged over 18 years old across Zhejiang Province in eastern China. Donors were included if they had an education level of junior college or above. Donors were excluded if they had an infectious disease, if they had sexual abstinence for less than 3 days, or if they had a fever. Initially, we included 14 636 semen donors. Then we deleted 2335 subjects without laboratory examination data. Finally, 12 301 semen donors were included in the study. All the subjects provided written consent.

Questionnaire surveillance

Once the volunteer was recruited, he was asked to complete a questionnaire. The questionnaire included factors such as alcohol consumption, use of tobacco, the period of abstinence since the last ejaculation and the current occupation. Alcohol consumption was defined as alcohol use at least once per week in the past year. The use of tobacco was defined as current tobacco smoking at least once per month in the past year. The current occupation was self-reported by the semen donors.

Health examination

Height and weight were measured for each donor to calculate body mass index (BMI). According to WHO guidelines, BMI was calculated, and the donors were categorised as normal (18.5–24.9 kg/m^2) and overweight (25–29.9 kg/m^2) or obese (≥30 kg/m^2). The systolic and diastolic blood pressures were examined with three measurements. Hypertension was defined as systolic blood pressure ≥140 mm Hg or diastolic blood pressure ≥90 mm Hg.

Chromosome examination

The peripheral blood lymphocytes were isolated by chromosome examination and cultured in Roswell Park Memorial Institute (RPMI) 1640 medium for 72 hours. The cells were routinely collected for G-banding. Karyotype analysis was performed according to the ISCN (international nomenclature system in human cytogenetics). Chromosome normality was defined as 23 pairs of normal chromosomes according to the WHO standard, while chromosome normality was defined as abnormalities in chromosome numbers or structures.

Semen sample analysis

The participants were asked to provide a semen sample in a private room after 3–6 days of sexual abstinence. The semen sample was collected in a plastic container, and evaluated according to WHO guidelines.[26] The semen samples were liquefied in an incubator (37°C) for 30 min, and then the motility and concentration of semen samples were examined 60 min after semen donation. The semen volume was measured using the balance weighing method. The sperm concentration was calculated using a haemocytometer on a single dilution. The progressive motility of sperm was analysed by computer-assisted semen analysis.

Statistical analyses

Semen quality parameters were shown as median (25%–75% quantile). Categorical variables were shown as frequency and percentage. Kruskal-Wallis H test was used to compare the difference in semen quality between different professions. And if there was any significant difference between them, the Nemenyi test was used for the post hoc comparison. Factors that may affect semen quality were selected as independent variables, and a binary logistic regression model using the entering method was used to estimate the influencing factors of each semen quality parameter. Regression models were shown as the crude model and adjusted model. The semen parameters were classified as qualified/unqualified according to

WHO manuals, and these new binary variables were set as the dependent variables in these models. The association between occupations and decreased semen quality was calculated by dividing the odd of each occupation by that of the college students. The partial regression coefficient of each adjusted model was adjusted for age, education level, marriage status and childbearing history. A value of $p \leq 0.05$ was considered 'statistically significant'. All statistical analyses were performed using R V.4.0.5 (R Foundation for Statistical Computing, Vienna, Austria).

Patient and public involvement

No patient was involved.

RESULTS

Characteristics of semen donors

The majority (81.3%) of semen donors were between 18 years and 30 years old, whereas only 1.9% were above 40 years old (online supplemental table 1). The donors were mainly from colleges (36.2%). In total, 81.6% of the semen donors were not married, and 18.1% of them were married. Meanwhile, 87.1% of them did not have any children. Smoking or excessive drinking habits were rarely reported among the studying population. Overweight or adiposity was diagnosed in 3901 semen donors, and 10 subjects had hypertension. Only two semen donors had a history of testicular surgery. The period of abstinence since the last ejaculation was 4.5 (4–5.5) days.

Semen quality was decreased in certain professions

The percentage of chromosome abnormality was 0.8% among 5510 semen donors with available data. The semen quality varied between different professions (online supplemental table 2). There was a significant difference in the semen volume between semen donors with different professions (χ^2=83.45, p<0.001). Soldiers and the police had the highest semen volume (the median value=3.8 mL). The workers in the architectural engineering industry had significantly higher semen volume (the median value=3.6 mL) than college students (the median value=3.3 mL; p=0.004). Meanwhile, the semen donors in the commercial service industry had a higher semen volume (the median value=3.7 mL), compared with college students (p=0.01). Additionally, a statistically significant difference was found in the sperm concentration between donors with different professions (χ^2=66.06, p<0.001). Businessmen and subjects in the information technology (IT) industry had a lower sperm concentration than college students (p<0.001 and p=0.04, respectively). Soldiers or the police had the lowest sperm concentration (the median value=53.6%). Meanwhile, there was a statistically significant difference in the total sperm count between different professions (χ^2=52.42, p<0.001). The total sperm count of businessman (the median value=197×10^6/mL) was significantly lower than that of college students (the median value=210×10^6/mL). Finally, the progressive motility of sperm changed much

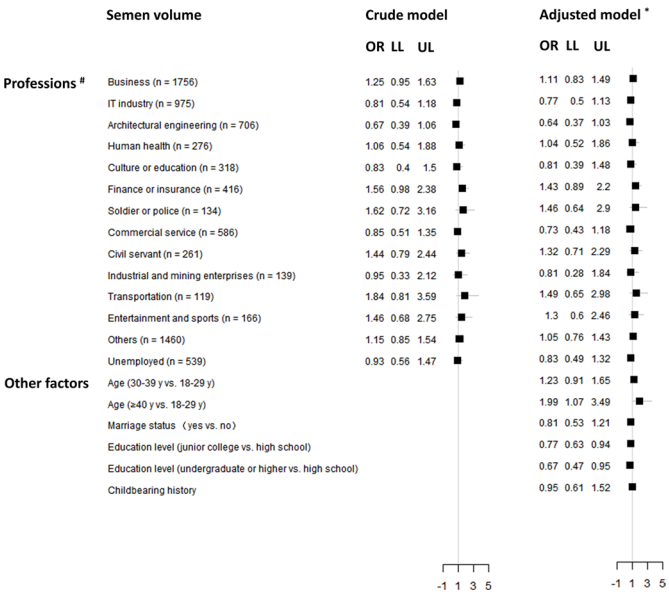

Figure 1 The risk of professions on the semen volume. LL, lower level of 95% CI for the OR; UL, upper level of 95% CI for the OR; * adjusted for age, education level, marriage status and childbearing history; smoking habit, drinking habit and hypertension were not included in the model due to the small sample size; # the risk of each profession was compared with that of college students (n=4450).

in different professions (χ^2=97.61, p<0.001). Workers in the IT industry and commercial service had higher progressive motility of sperms (the median value=47%) than college students (the median value=49%; p<0.001).

Risk of decrease in semen volume was found among subjects in finance or insurance

The percentage of sperm volume abnormality was 4%. The semen donors in finance or insurance had a significant risk for decrease in semen volume in the crude model (*OR*=1.56, p=0.05; figure 1), and they had a marginally significant risk for reduced semen volume in the adjusted model (*OR*=1.43, p=0.08).

Some professions had higher risks of decreased sperm concentration

Of all the semen donors, 3.3% had a decrease in sperm concentration. In the crude model, the reduced sperm concentration was moderately associated with the occupation of finance or insurance (*OR*=1.62, p=0.05 in the crude model, and OR=1.57, p=0.08 in the adjusted model; figure 2). Unemployed men had a significantly elevated risk of decreased sperm concentration (*OR*=1.92, p=0.002). Furthermore, this risk for unemployed men was slightly elevated after adjusting for age, education level, marriage status and childbearing history (*OR*=1.84, 95% *CI* 1.18 to 2.77). Additionally, workers in the entertainment and sports industry had an elevated risk of low sperm concentration compared with college students (*OR*=1.86, p=0.04).

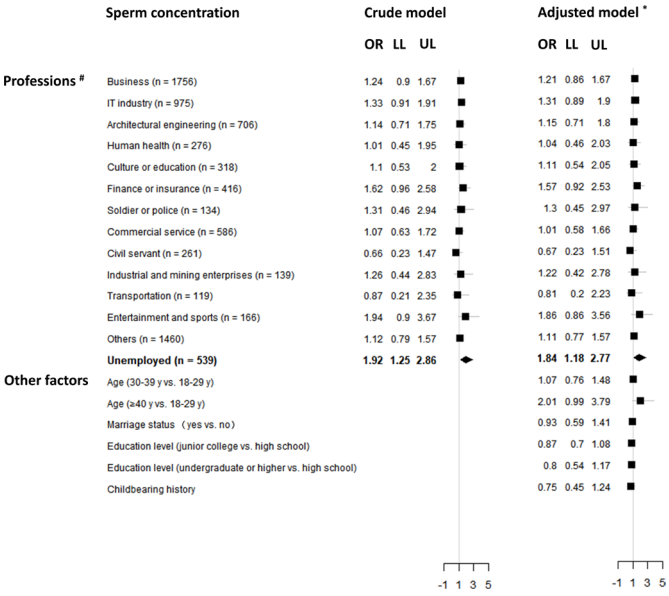

Figure 2 The risk of professions on the sperm concentration. LL, lower level of 95% CI for the OR; UL, upper level of 95% CI for the OR; * adjusted for age, education level, marriage status and childbearing history; smoking habit, drinking habit and hypertension were not included in the model due to the small sample size; # the risk of each profession was compared with college students (n=4450).

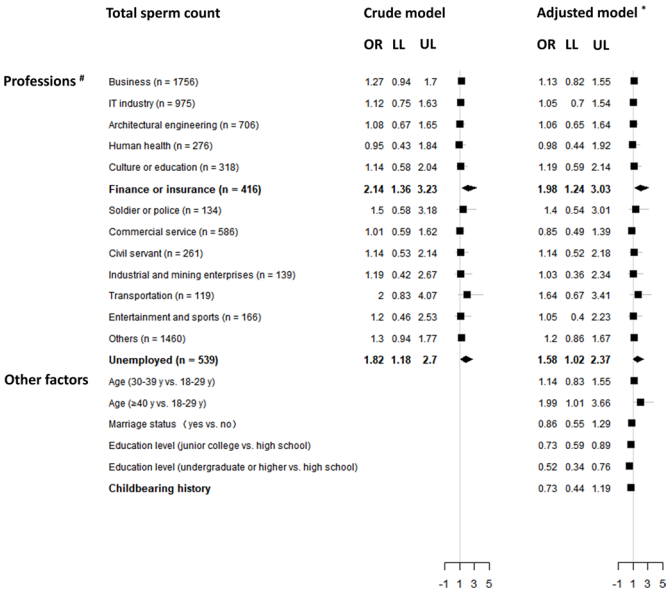

Figure 3 The risk of professions on the total sperm count. LL, lower level of 95% CI for the OR; UL, upper level of 95% CI for the OR; * adjusted for age, education level, marriage status and childbearing history; smoking habit, drinking habit and hypertension were not included in the model due to the small sample size; # the risk of each profession was compared with college students (n=4450).

Workers in finance or insurance and unemployed men had a high risk of reduction in the total sperm count

There were 440 semen donors whose total sperm count was less than the WHO recommended value of 39×10^6/mL. The abnormality of the total sperm count was 3.6%. Working in finance or insurance had an elevated risk for the total sperm count in the adjusted model (*OR*=1.98, 95% CI 1.24 to 3.03; figure 3). Meanwhile, the association between unemployed men and the decrease in the total sperm count was significant (*OR*=1.82, 95% CI 1.18 to 2.70 in the crude model, and *OR*=1.58, 95% CI 1.02 to 2.37 in the adjusted model).

Working in the IT industry was associated with an elevated risk for the reduction of progressive motility of sperm

The reduction of progressive motility of sperm was found among 11.6% of all semen donors. Workers in the IT industry had a moderately elevated risk for the reduction of progressive motility of sperm in the adjusted model (*OR*=1.3, 95% CI 1.06 to 1.6; figure 4). After we adjusted for the confounding factors, the risk remained significant, but the OR was slightly lower (*OR*=1.27, 95% CI 1.03 to 1.57).

DISCUSSION

In the current study of 12 301 semen donors, we identified that certain professions had lower semen quality in China. Working in the finance or insurance industry was associated with decreased semen volume, sperm concentration and total sperm count. Workers in the IT industry had an elevated risk for the reduction of the progressive motility of sperm. Unemployed men had a higher risk for the reduction of sperm concentration and total sperm count. Furthermore, working in entertainment and sports was associated with an elevated risk for sperm concentration, while working in the transportation industry was associated with a high risk for the total sperm count. Most of these associations were robust in regression models, and the results were not modified by age, education level, marriage status and childbearing history. To the best of our knowledge, this was the first study in China to quantitatively assess the association between occupational factors and semen quality with a large sample size. Hence, our results provided new insights into semen quality in eastern China.

We found that soldiers and the police had the highest semen volume. Surprisingly, their progressive motility of sperm was the lowest. Soldiers and the police were always considered ‘strong’ men, however, their semen quality was not as good as we expected from the results of our research. A previous study[27] in China supported our findings that 62.5% of the soldiers had at least one semen parameter below the critical values of WHO recommendations in 2010. The aetiology of low motility might be due to surgery-related diseases, Sertoli cell-only syndrome and some idiopathic causes.[28] Besides, the high intensity of job stress[29] might play an important role in the decrease of sperm motility in the soldiers and police. However, due to the limited sample in the population of soldiers and police, our obtained results should be confirmed in longitudinal studies.

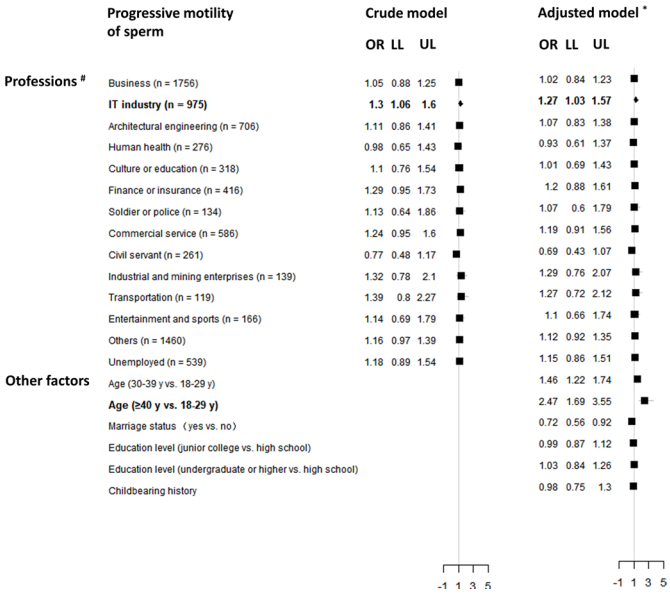

Figure 4 The risk of professions on the progressive motility of sperm. LL, lower level of 95% CI for the OR; UL, upper level of 95% CI for the OR; * adjusted for age, education level, marriage status,and childbearing history; smoking habit, drinking habit,and hypertension were not included in the model due to the small sample size; # the risk of each profession was compared with college students (n=4450).

We found that workers in the IT industry had a risk of reduction of sperm progressive motility. It was well known that most of the workers in the IT industry were programmers, and they had a long-time sedentary work style. As we have known, germ cells were quite sensitive to localised warming of the testes. So the underlying reason for this elevated risk might be due to the localised high temperature in the testes of IT workers. A previous study in Poland[30] documented that heat stress after sedentary work could double the risk of sperm DNA damage. The possible mechanism might be that long-time sedentary work style in the IT industry increased testicular temperature, and triggered reactive oxygen species and DNA damage,[31] leading to the destruction of germ cells by apoptosis. On the other hand, heat stress could induce altered chromatin condensation during spermatogenesis.[32] An experimental study[33] found that spermatozoa at postmeiotic stages of development were more sensitive to heat stress, and suggested that DNA methylation reprogramming could play an important role in the process. Conclusively, we conferred that heat exposure might be a crucial factor for deleterious semen quality among workers in the IT industry. In the same way, our study demonstrated that working in the financial industry was related to sedentary work. Furthermore, either working in the IT industry or the financial industry radiation needed prolonged video operation. The association between video operation and semen quality has not been well studied in previous studies. Controversially, more physical activity and less TV watching were significantly associated with improved sperm count and sperm concentration. Furthermore, whether the sedentary job and video manipulation had a joint harmful effect on semen quality needs to be confirmed by further research.

Importantly, we found that working in finance or insurance was significantly linked with decreased semen quality, especially with semen volume, sperm concentration and sperm count. The reason why working in finance or insurance could affect semen quality was not fully understood. There were some plausible reasons. First, the workers in finance or insurance, for example, the bank employees, always spend the majority of their working time sitting in front of the computer and engaged in sedentary work.[34] Their sedentary working characteristics increased the temperature of their testis, just like the workers in the IT industry. Hence, our data supported the association between sedentary working behaviour in finance or insurance and decreased semen quality. Therefore, more strategies should be applied to make the workers shift from a sedentary work style to a more active work style.[35] Second, the current data suggested that a job in finance or insurance involved high levels of job stress.[36] A previous study in India[37] found that 75.5% of bank employees had a high and very high level of job stress. A study in China[38] believed that the high job stress in financial workers was related to a high concentration of attention during working. Hence, the association between working in finance or insurance and decreased semen quality might also be explained by the synergistic effect of local temperature in testis and high job stress. More effects should be provided to improve the work initiative, shorten the working hours per day, and improve the social support for workers in the finance or insurance industry.[39] However, these results need to be proved by better study design, and be confirmed in further studies.

Our study found that unemployment was associated with a decrease in sperm concentration and total sperm count. One possible explanation for this association might be that unemployment was associated with decreased health.[40] Unemployed men formed a very specious group, however, various demographic and lifestyle factors might result in negative effects on the well-being of the unemployed. Previous studies reported that unemployed men could have more physically deleterious behaviours, such as living an unhealthy diet, alcohol abuse and smoking.[41–43] Moreover, unemployment had a detrimental effect on mental health. Therefore, the decrease in semen quality among unemployed men could also be explained by depression and distress.[44] Hence, interventions, therapeutic methods and job-search training might be beneficial for the increase of employment,[45] and then provide useful help for improving semen quality.

We found an elevated risk of decreased sperm concentration among the semen donors in the entertainment and sports industry, consistent with a previous study in the USA.[46] However, a previous study in China[47] supported our results that physical activity could improve semen quality parameters among healthy men. Several explanations existed for this association between working in

the entertainment and sports industry and decreased semen quality. First, there was a large difference in the intensity of exercise between athletes and ordinary persons. Undoubtedly, moderate exercise was beneficial for a healthy man. A systematic review and meta-analysis[18] pointed out that physical activity was beneficial for men's reproductive health. However, intensive sports practices could have a negative effect on semen quality, such as DNA fragmentation.[48] On the contrary, restricting sports activity in athletes could reduce the deleterious effect of sports on semen quality.[49] Hence, we speculated that it was the excessive physical activity discrepancy that leads to the increase in semen quality among the workers in entertainment and sports. The second possible reason for the elevated risk might be the use of anabolic-androgenic steroids, which were testosterone derivatives usually used by the workers in the entertainment and sports industry to improve sports performance or enhance appearance.

Our study had notable advantages. Our findings provided new insight into the association between occupational factors and semen quality. We gave an intuitive understanding of what occupation tended to damage semen quality. We found a novel association between working in the finance or insurance industry and the elevated risk of damaged sperm quality. Unemployed men were at high risk of decreased sperm concentration and total sperm count. Working in the IT industry was associated with an elevated risk for the progressive motility of sperm. Interestingly, we found that soldiers and the police had the highest semen volume but the lowest sperm motility.

Although we used a large sample of semen donors, our study does have some methodological disadvantages. First, we did not exhaust all the measurement methods to assess semen quality. For example, data on sperm morphology and DNA fragment measurement were not applied in our study, because of incomplete data in these indexes. A prospective cohort study is needed to improve the study quality. Second, there was some selection bias in this study. We selected semen donors in a province as the studying population, while some studies studied infertile men.[49] Inevitably, there was a selection bias in either of the two populations. However, a study in the USA[50] proved that the use of semen donors did not raise the risk of selection bias in male fertility studies. Moreover, it is not possible to get an unbiased sample that represents the whole male population. Hence, our study population could be a good representation of male fertility studies. Third, we investigated some lifestyle and occupational factors; however, we did not focus on environmental exposure due to living in polluted areas or other factors such as stress. A previous study[50] conducted in highly polluted areas has suggested the negative role of environmental pollution on semen quality. Furthermore, Levine and colleagues[51] reported that semen quality deteriorated during the summer due to a deleterious effect of heat. Hence, it is important to clarify the association between environmental exposure, psychological stress and semen quality in future studies. Finally, we did not include smoking and drinking habits in the current study because we only investigated a few semen donors about their smoking and drinking habits. Moreover, the number of men with drinking habits was only seven, leading to instability of our models. Hence, a prospective cohort study is warranted, and the association between smoking and semen quality in China needs to be verified in further studies.

To sum up, our study provided new insight into the impact of occupations on semen quality in China. We found decreased effects in some professions, reflecting the association of adverse work style with semen quality. In other words, work style factors might contribute to the changes in the semen parameters of semen donors. The results of our study suggested the need and importance to avoid adverse occupational hazards to maintain satisfactory semen quality. We should pay more attention to semen quality of sedentary workers, unemployed men, the workers in the entertainment and sports industry, and the IT industry. Our findings also suggested keeping good work styles in occupational activities, and our study is of valuable public health significance for human fertility.

Contributors Guarantor: JL and FT. Conceptualisation: ZJ and JL. Data curation: ZJ. Formal analysis: ZJ. Funding acquisition: ZJ. Investigation: ZJ, MJ, HS, LF, JC, YL and JH. Methodology: HS and LX. Project administration: JL and LX. Resources: FT, HS and LX. Software: ZJ and MJ. Supervision: FT, HS and LX. Validation: MJ. Visualisation: MJ and ZJ. Roles/writing of the original draft: FT, ZJ and JL.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by the medical ethics committee of Zhejiang maternal, child and reproductive health center (Ref. No. 2019-002). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request.

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Supplementary table 1. Geographic characteristics, life habits, and disease histories of 12,301 semen donors

Characteristic	n (%)
Age, years	
18-30	9996 (81.3)
30-39	2062 (16.8)
40-50	239 (1.9)
Ethnicity	
Han	12054 (98.0)
Others	247 (2.0)
Education	
High school	4669 (38.0)
Junior college	6272 (51.0)
Undergraduate or higher	1360 (11.1)
Marital status	
Unmarried	10033 (81.6)
Married	2169 (17.6)
Divorced	99 (0.8)
Childbearing history	
Never	10720 (87.1)
Ever	1581 (12.9)
Native geographical region	
South	9151 (74.4)
North	3150 (25.6)
Smoking habit	
Non-smoker	4327 (35.2)
Smoker	186 (1.5)
NA	7788 (63.3)
Drinking habit	
Never	4506 (36.6)
Ever	7 (0.1)
NA	7788 (63.3)
Overweight or fat	
No	3901 (31.7)
Yes	608 (5.0)
NA	7792 (63.3)
Hypertension	
No	4495 (36.5)
Yes	10 (0.1)
NA	7796 (63.4)
History of testicular surgery	
No	4511 (36.7)
Yes	2 (0.0)
NA	7788 (63.3)

NA: not available

Supplementary table 2. Semen quality parameters among different professions

Occupation	*n* (%)	Semen volume (ml)	Sperm concentration (10^6/ml)	Sperm count (10^6)	Sperm mobility (%)
College students	4450 (36.2)	3.3 (2.5-4.5)	63.7 (44.8-83.7)	210 (141-290)	49.0 (40.3-55.0)
Business	1756 (14.3)	3.3 (2.5-4.5)	59.5 (41.0-78.4)	197 (126-282)	48.2 (40.0-53.0)
IT industry	975 (7.9)	3.5 (2.6-4.6)	60.0 (41.8-79.0)	211 (135-289)	47.0 (39.0-51.5)
Architectural engineering	706 (5.7)	3.6 (2.8-4.8)	61.8 (44.0-80.0)	220 (152-307)	48.5 (40.0-53.5)
Human health	276 (2.2)	3.7 (2.7-4.7)	60.2 (43.4-82.3)	214 (142-299)	47.0 (40.0-51.1)
Culture or education	318 (2.6)	3.7 (2.8-4.6)	60.2 (41.0-78.3)	213 (137-299)	47.0 (38.2-52.0)
Finance or insurance	416 (3.4)	3.3 (2.3-4.3)	60.0 (41.0-81.0)	200 (123-282)	48.6 (38.2-53.8)
Soldier or police	134 (1.1)	3.8 (2.6-4.8)	53.6 (40.4-75.1)	191 (131-302)	45.5 (38.0-52.8)
Commercial service	586 (4.8)	3.7 (2.7-5.0)	59.9 (41.0-79.0)	210 (141-301)	47.0 (39.0-52.0)
Civil servant	261 (2.1)	3.1 (2.3-4.1)	61.4 (44.0-80.5)	197 (120-280)	49.4 (41.2-55.3)
Industrial and mining enterprises	139 (1.1)	3.0 (2.3-4.0)	65.5 (45.8-84.5)	198 (135-270)	48.0 (38.4-55.0)
Transportation	119 (1.0)	3.3 (2.4-4.2)	60.0 (44.5-78.9)	200 (117-300)	49.0 (39.0-54.2)
Entertainment and sports	166 (1.3)	3.0 (2.3-4.0)	62.5 (43.0-80.8)	187 (109-251)	52.2 (40.0-58.1)
Others	1460 (11.9)	3.4 (2.5-4.4)	62.2 (43.8-80.3)	204 (138-282)	49.5 (40.0-55.0)
Unemployed	539 (4.4)	3.5 (2.5-4.7)	56.0 (38.7-73.5)	194 (119-275)	48.0 (39.0-52.5)

IT: Information Technology