Socio-psycho-behavioural factors associated with male semen quality in China: results from 1346 healthy men in Chongqing

Ying Li,[1] Yafei Li,[2] Niya Zhou,[3] Xue Han,[3] Mingfu Ma,[4] Lianbing Li,[4] Min Cai,[4] Zhihong Cui,[3] Hui Lin,[2] Ziyuan Zhou,[3] Hongyan Xiong,[2] Jia Cao[3]

[1]Third Military Medical University, Department of Social Medicine and Health Service Management, Chongqing, China
[2]Department of Epidemiology, Third Military Medical University, Chongqing, China
[3]Department of Hygienic Toxicology, Third Military Medical University, Chongqing, China
[4]Chongqing Institute of Science and Technology for Population and Family Planning, Chongqing, China

Correspondence to
Professor Jia Cao, Department of Hygienic Toxicology, College of Preventive Medicine, Key Laboratory of Medical Protection for Electromagnetic Radiation, Ministry of Education of China, Third Military Medical University, Chongqing 400038, China; caojia1962@126.com

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ABSTRACT

Background Human semen quality in China has decreased in the last few decades. A previous study found that 61.1% of healthy males in Chongqing City in Southwest China had abnormal semen parameters values according to 1999 World Health Organization criteria.

Objective This cross-sectional study explored the associations between socio-psycho-behavioural factors and semen quality in Chongqing City.

Methods The study participants comprised 1346 eligible healthy men who were examined and researched in respect to 15 socio-psycho-behavioural factors.

Results Men from a higher occupational class had better semen volume (β coefficient 1.18, p=0.034), while men who often wore underwear made from man-made fibres had a lower percentage of morphologically normal sperm (β coefficient 0.82, p=0.001). As regards psychological stress, men with less stress had an increased total sperm count and percentage of morphologically normal sperm (β coefficient 1.19 and 1.25 respectively, p=0.02 and 0.04 respectively). The other 12 factors examined in the study demonstrated no significant association with semen quality in Chongqing.

Conclusions Semen quality can be impacted by socio-psycho-behavioural factors (occupational class, psychological stress and wearing man-made fibre underwear). A health programme that deals directly with psychological health and healthy lifestyle, and the implementation of policies that address social factors for men may play a part in the improvement of male reproductive health in China.

KEY MESSAGE POINTS

- Human semen quality in China has decreased in recent decades. Previous studies have ignored many factors that may potentially affect semen quality.
- This study demonstrated that semen quality appears to be affected by three socio-psycho-behavioural factors, namely occupational class, psychological stress and wearing underwear made from man-made fibres.
- A health programme that deals directly with psychological health and healthy lifestyle, and the implementation of policies that address social factors for men, may play a part in the improvement of male reproductive health in China.

INTRODUCTION

Semen quality is one of the main indicators of general male reproductive health and fertility. In recent decades the change in semen quality has attracted interest from researchers wishing to explore the possible risk factors and determinants.[1] Great attention was paid to the effect of environmental hazards, chemicals, occupational hazards and physical factors.

In recent years, social factors, psychological factors and behaviours/lifestyles have become increasingly important health determinants.[2–7] However, the impact of these factors on semen quality is unclear. For example, the effect and mechanism of widespread social factors/determinants (such as education, occupation and income) on semen quality has been paid little attention. A number of studies indicated that different aspects of stress or life events and coping strategies

are associated with semen quality, including concentration, motility and morphology.[8] A previous meta-analysis also found stress to be a risk factor for sperm density, sperm progressive motility and sperm normal morphology, but the impact of stress on semen volume remained unclear.[1]

The question of whether daily lifestyle plays an important role in male reproductive health, in particular for the average male population whose work and living environments are unremarkable, is an interesting one.[9] However, the impact of lifestyle/behaviours other than smoking, alcohol and coffee consumption on semen quality remains inconclusive.[1 9 10] For example, more evidence is needed in order to identify the role of green tea drinking, passive smoking, sedentary posture, wearing tight-fitting underwear or underwear made from man-made fibres, and hot baths on deteriorating semen quality.[1] Physical exercise, computer use and sleep habits are often associated with general health, but their effects on semen quality have not been explored in detail.

In China, the change in semen quality is marked. Zhang *et al*. found that Chinese sperm quality declined significantly faster than that in Western countries during the same period when they analysed the change in sperm quality of fertile Chinese men from 1981 to 1996[11]. Another systematic review found that the sperm parameters of fertile men decreased during the period 1980–2005. The authors' previous large survey on healthy men residing in Chongqing found that 61.1% of healthy males (aged 20–40 years) had at least one sperm parameter below normal threshold values when compared with 1999 World Health Organization (WHO) criteria.[12] However, the factors associated with this poor semen quality remain unclear. The present study aimed to explore the impact of socio-psycho- behavioural factors on the sperm quality of healthy men from communities in Chongqing in order to better understand the precise factors that may impact on semen quality in this geographical region.

METHODS

Study setting and study population

Participants in this cross-sectional study were described in detail in a previous study.[12] Briefly, the investigation was carried out in 2007 in three counties and three districts, which represent the Three Gorges Reservoir Region of Chongqing in terms of geography and the economy. The authors collaborated with the Chongqing Family Planning Commission and the local Family Planning Network to recruit volunteers from these communities as participants in this study.

Permanent male residents of Chinese Han aged 20–40 years old were eligible for the study. The exclusion criteria included: diagnosis of reproductive or urological diseases; other known reproductive disorders or an identifiable history of infertility, vasoligation or chronic diseases (diabetes, hypertension, etc.); taking medicine for physical or mental illnesses; small testis (≤12 ml); reported duration of abstinence from sexual intercourse and/or masturbation for less than 2 days or more than 7 days; and exposure to an occupation that might influence semen quality. All of the participants were informed of the purpose of the study, the requirement for 2–7 days' abstinence from sexual intercourse and/or masturbation, and the possible benefits and risks of participating in the study.

Physical examination

Physical examination of all study participants was performed by the same two experienced urologists. Secondary sexual characteristics, the possible presence of a varicocele, hydrocele, the location of the testis in the scrotum, and the consistency of the testis and epididymis were examined to exclude subjects with reproductive or urological diseases. Testicular volume was determined using a Prader orchidometer. The weights (kg) and heights (cm) of the participants were measured using a single corrected instrument in each research centre. The results of these examinations were recorded on a standard form.

Semen collection and analysis

All the participants who reported 2–7 days of abstinence from sexual intercourse and/or masturbation collected their ejaculates by masturbation in a room close to the semen analysis laboratory at the local Reproductive Health Centre. The samples were collected in sterile, wide-mouthed plastic containers and immediately delivered to the laboratory. All the semen samples were marked with an anonymous serial number and were then incubated in a water-bath at 37°C until analysis.

Semen sample analysis was started as soon as the ejaculates had liquefied and all the samples were analysed within 60 minutes of collection according to WHO criteria.[13] The pH was measured with a pH tape (pH 6.5–10.0) and recorded after 20 seconds. Sperm volume was measured by aspiration into a 10 ml pipette with an accuracy of 0.1 ml. Sperm concentration was determined using a micro-cell as a counting chamber. Only sperm with tails were counted. Sperm motility was assessed at 20× magnification on the heated stage of a microscope (at 37°C) and spermatozoa were scored in categories as A, B, C or D. For the assessment of sperm morphology, two fresh semen smears were made and stained using the method described in the 1999 WHO manual.[13] At least 200 spermatozoa were counted and categorised as normal or abnormal based on their morphology. As regards quality control, all the semen analyses were performed by two well-trained technicians using the same apparatus (one technician evaluated sperm appearance, liquefaction time, pH value and semen volume and the other measured sperm concentration, motility and

morphology). The technicians also participated in a continuous quality control system under the supervision of the Chongqing Institute of Science and Technology for Population and Family Planning.

Questionnaires

All eligible participants completed a unified questionnaire that requested detailed information on demographical characteristics, socio-economic status (education, income and occupation), psychological stress and behaviour/lifestyle. The term 'fibre' underwear was used to describe underwear made of man-made fibres as opposed to natural fibres such as cotton.

Statistics

Data were doubly entered using Epi Inform 6.0. The data were analysed using the Statistical Package for Social Science (SPSS 13.0) (IBM Corporation, Armonk, NY, USA). A two-tailed probability level of $p<0.05$ was chosen as the level of statistical significance.

Percentages were used to describe the study subjects' characteristics. The sperm parameters were also summarised using median, 25th and 75th percentiles; the Kruskal–Wallis analysis of variance, a non-parametric test, was used to compare groups of each socio-psycho-behavioural factor. A multiple linear regression model was used to examine the independent effect of the significant socio-psycho-behavioural factors based on Kruskal–Wallis tests on semen parameters. All semen parameters were log-transformed (base 10) to improve the normality as dependent variables in the linear models. Finally, the regression coefficients for logarithmically transformed variables were back-transformed for ease of interpretation. Results were adjusted for potential confounders such as age, regional differences, season of semen collection, body mass index, time of semen analysis, period of abstinence from sexual intercourse and/or masturbation and fertility status. The factors possibly associated with semen quality were re-evaluated with dummy variables that represented different levels For example, occupational class was re-evaluated using dummy variables such as manual, semi-skilled and skilled.

Ethical considerations

The project proposal was approved by the Institutional Review Board of Preventive Medicine College, Third Military Medical University, Chongqing, China. Written informed consent was obtained from all participants once they agreed to take part in the study.

RESULTS

Participant selection for the study is illustrated in the flow diagram (Figure 1). A total of 1979 healthy volunteers from communities were recruited for the

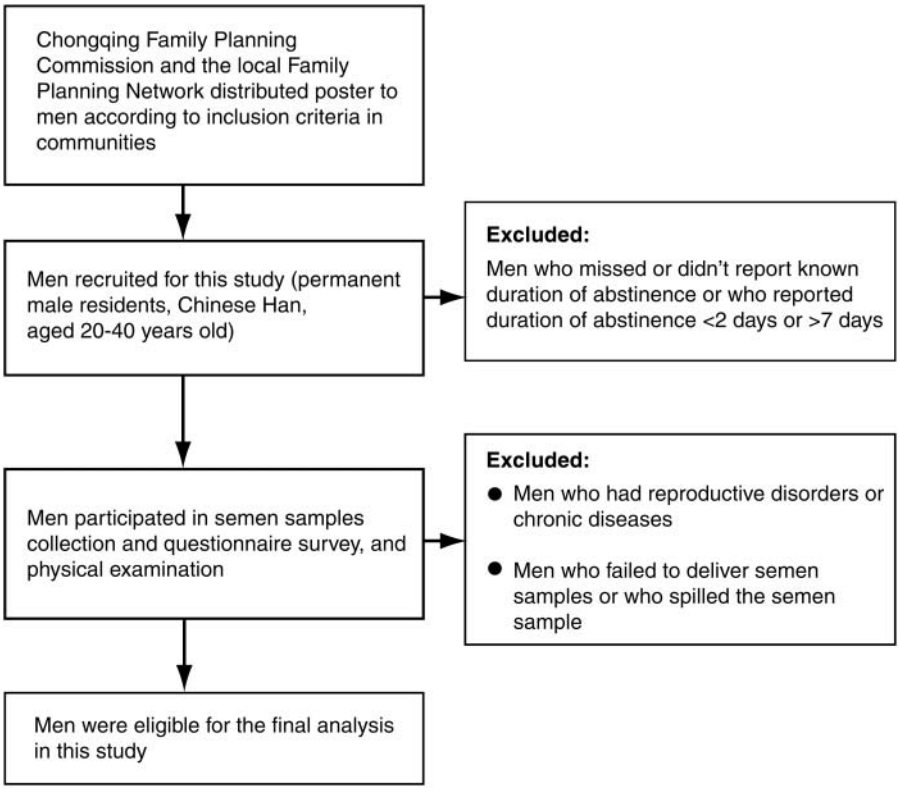

Figure 1 The flow diagram for study participant selection for the study in Chongqing, China in 2007.

study, and of this group 1346 healthy men were eligible for the final analysis after 630 individuals were excluded for the following reasons: reproductive disorders or chronic diseases (n=80), missing or unknown duration of abstinence or reported duration of abstinence from sexual intercourse and/or masturbation for <2 days or >7 days (n=210), failure to deliver a semen sample (n=226) or spillage of the sample semen (n=114).

The semen samples were grouped separately according to 15 socio-psycho-behavioural factors (Table 1). The different semen parameters were examined and compared in relation to these variables. The results of a Kruskal–Wallis test showed that semen volume was significantly different among different occupational classes and status of physical exercise participation: men from a skilled occupational class who undertook regular physical exercise had higher semen volume. Sperm density differed significantly for different statuses of tea drinking and wearing tight-fitting underwear: men who occasionally drank tea and wore tight-fitting underwear had higher sperm density. Total sperm count was significantly different for different education periods, occupational classes, status of tea drinking and physical exercise participation: men with a higher educational level and in a higher occupational class, who occasionally drank tea and regularly took physical exercise, had an increased total sperm count. Rapid progressive motility was only affected by wearing tight-fitting underwear. Men who occasionally wore tight-fitting underwear had an increased percentage of rapid progressive motility. Progressive motility was significantly different among different statuses of tea drinking and wearing tight-fitting underwear: men who occasionally wore tight-fitting underwear or drank tea had an increased percentage of progressive motility. Morphologically normal sperm was significantly different for different levels of psychological stress, status of wearing fibre underwear and taking hot baths: men who had no psychological stress, never wore fibre underwear and who took hot baths had an increased percentage of normal sperm. However, income, smoking, coffee drinking, hours of sleep, sedentary position and computer use had no significant impact on semen quality.

The above significant factors from the Kruskal–Wallis tests were included in the multiple linear regression model for each semen parameter separately and then adjusted for its confounders. The results indicated that men of a higher occupational class had larger semen volume (β coefficient 1.18, p=0.034) and men who often wore fibre underwear had a lower percentage of morphologically normal sperm (β coefficient 0.82, p=0.001). As regards psychological stress, men with less stress had an increased total sperm count and percentage of morphologically normal sperm (β coefficient 1.19 and 1.25, respectively, p=0.02 and 0.04, respectively).

DISCUSSION

Most of the previous studies on risk factors for semen quality focus on infertile men from infertility clinics or an andrology laboratory, or recruited volunteers from a small sample as study participants.[1] The present study, with its relatively large sample (1346 participants), investigated the associations between 15 socio-psycho-behavioural factors and semen quality in healthy men from communities and found that occupational class, psychological stress and increased frequency of wearing fibre underwear were associated with semen quality.

The classic variables that measure socio-economic status are educational level, occupational class and income level,[14] and these should be considered as health determinants rather than being simply incidental to the biomedical phenomena.[15] This study attempted to evaluate the impact of these variable factors on semen quality and only observed a significant association between occupational class and semen quality after adjusting for confounders: men in higher occupational classes in the Chongqing area had better semen volume. A previous study in the UK by Cherry *et al*. similarly reported that men doing manual work have a lower motile sperm count.[16]

It was estimated that 50–80% of physical disorders have psychosomatic or stress-related origins.[17] A previous meta-analysis found that stress is a risk factor for sperm density, sperm progressive motility and sperm normal morphology.[1] The present study consistently observed the negative impact of psychological stress on normal sperm morphology. It also identified the adverse effect of stress on total sperm count of men living in the Chongqing area. However, this study only estimated stress subjectively since it is difficult to quantify. It would be better if any future study used standard scales to measure psychological stress to more specifically assess the effect of stress on health.

The effect of the type of underwear worn on semen quality has been studied widely, however the results are contradictory. For example, some studies observed that tight-fitting underwear had an adverse effect on various semen parameters[18]–[19], whereas other studies reported no adverse effect of tight-fitting underwear on semen quality.[20] [21] The present study did not observe that wearing tight-fitting underwear was significantly associated with semen quality but did find that wearing fibre underwear often lowered the percentage of normal sperm morphology (p=0.001) in men living in Chongqing after adjusting for confounders. Generally speaking, the constituent material of fibre underwear contains chemical substances (such as formaldehyde resin and anti-wrinkle treatment agents) and assists urethra bacterial growth and reproduction due to poor sweat absorption. This may be one explanation for the decreased normal sperm morphology observed in men who wore fibre underwear.

Table 1 Sperm parameter distribution among different socio-psycho-behavioural factors in 1346 healthy men recruited for the study in Chongqing, China in 2007

Socio-psycho-behavioural factors	*n* (%)	Sperm parameters [M (P25–P75)]					
		Semen volume (ml)	Sperm concentration (106/ml)	Total sperm count (106)	Rapid progress motility (A%)	Progress motility [(A+B)%]	Morphologically normal sperm (%)
Education (years) (*n*=1335)							
7–12	874 (65.5)	2.5 (1.6–3.0)	83.8 (50.2–107.8)	196.5 (94.4–263.9)	29.6 (13.5–42.2)	44.9 (22.5–63.3)	29.4 (20.6–36.6)
≥12	296 (22.2)	2.6 (1.9–3.2)	88.9 (53.0–113.8)	229.4 (122.7–298.2)	31.8 (15.0–44.2)	47.4 (23.7–65.9)	28.8 (20.6–36.1)
*p**	—	0.075	0.202	**0.007**	0.072	0.138	0.257
Occupational class (*n*=1324)							
Manual	450 (33.97)	2.6 (1.6–3.2)	85.9 (52.8–111.0)	211.5 (101.4–280.3)	30.6 (13.7–43.2)	46.6 (23.4–64.9)	29.6 (20.6–37.1)
Semi-skilled	574 (43.32)	2.4 (1.6–3.0)	81.6 (49.0–110.5)	191.6 (94.4–259.2)	27.9 (12.6–40.4)	43.5 (22.2–62.2)	30.5 (21.0–38.5)
Skilled	300 (22.71)	2.7 (2.0–3.2)	90.7 (51.6–109.8)	224.8 (109.8–293.7)	31.0 (14.8–43.7)	45.7 (22.4–64.3)	28.2 (19.60–35.6)
*p**	—	**0.004**	0.61	**0.019**	0.157	0.63	0.064
Annual income per person (Yuan RMB) (*n*=1316)							
<3000	642 (48.78)	2.5 (1.6–3.0)	85.0 (49.5–110.5)	200.2 (94.3–272.0)	29.4 (12.9–42.7)	44.7 (21.9–62.9)	29.6 (19.8–38.5)
3000–7999	378 (28.72)	2.5 (1.7–3.2)	83.3 (53.8–109.5)	206.4 (100.9–266.4)	30.6 (15.2–42.8)	46.4 (24.7–63.9)	29.7 (20.8–37.1)
8000–12999	193 (14.67)	2.5 (1.6–3.0)	89.9 (51.8–112.1)	208.7 (100.6–276.3)	29.9 (13.1–42.9)	45.2 (21.4–66.0)	28.0 (20.5–34.9)
≥13000	103 (7.83)	2.4 (1.5–3.1)	74.7 (49.1–104.9)	185.5 (98.9–256.0)	27.8 (13.0–38.5)	41.3 (21.5–57.3)	30.9 (22.2–36.8)
*p**	—	0.811	0.331	0.517	0.407	0.245	0.469
Psychological stress (*n*=1338)							
Extremely	132 (9.9)	2.7 (1.7–3.2)	82.3 (53.5–111.7)	221.0 (89.8–272.5)	28.3 (14.3–40.6)	43.3 (27.2–60.5)	27.3 (19.0–33.0)
Quite a bit	609 (45.5)	2.5 (1.6–3.1)	86.6 (52.5–110.5)	200.8 (97.6–266.4)	29.9 (13.5–42.7)	45.1 (23.1–63.3)	29.4 (20.6–37.1)
Moderately	536 (40.1)	2.5 (1.6–3.0)	84.9 (51.1–109.9)	205.8 (96.8–271.3)	30.6 (13.9–43.8)	46.5 (23.1–65.1)	29.8 (20.8–37.9)
Not at all	59 (4.4)	2.6 (1.9–3.2)	79.3 (43.8–107.4)	229.9 (125.6–296.9)	26.4 (9.9–37.7)	40.4 (18.7–55.9)	30.4 (21.8–38.9)
*p**	—	0.2	0.52	0.315	0.179	0.24	0.029
Smoking (number of cigarettes/day) (*n*=1343)							
Never	483 (36.0)	2.5 (1.7–3.0)	85.7 (51.1–109.9)	212.2 (99.9–280.8)	29.9 (13.7–42.6)	45.8 (23.2–63.3)	29.4 (21.0–36.6)
Current	774 (57.6)	2.5 (1.6–3.1)	84.3 (49.4–109.5)	196.1 (95.9–263.4.)	29.8 (13.4–42.6)	45.1 (22.4–64.4)	29.3 (19.8–37.6)
Ex-smoker	86 (6.4)	2.7 (1.7–3.3)	84.6 (55.2–110.1)	216.4 (98.9–301.7)	29.3 (12.6–41.6)	41.9 (20.9–61.0)	30.0 (20.8–39.6)
*p**	—	0.315	0.562	0.113	0.912	0.7	0.809
Alcohol consumption (number of drinks/month) (*n*=1343)							
Never	474 (35.2)	2.5 (1.6–3.1)	79.9 (48.7–105.3)	199.2 (95.5–265.3)	28.4 (12.7–40.0)	42.9 (20.9–60.5)	29.9 (21.1–37.6)
Current	853 (63.4)	2.5 (1.6–3.1)	87.8 (51.6–112.7)	206.4 (98.3–275.7)	30.7 (14.2–43.4)	46.6 (23.6–64.9)	28.8 (19.6–36.6)
Before	19 (1.4)	2.5 (1.8–2.9)	81.7 (49.5–110.1)	186.1 (94.0–245.5)	27.1 (8.2–40.6)	42. 7 (17.9–65.2)	33.0 (22.6–42.4)
*p**	—	0.966	0.148	0.718	0.087	0.121	0.337

Continued

Table 1 Continued

Socio-psycho-behavioural factors	*n* (%)	Sperm parameters [M (P25–P75)]					
		Semen volume (ml)	Sperm concentration (106/ml)	Total sperm count (106)	Rapid progress motility (A%)	Progress motility [(A+B)%]	Morphologically normal sperm (%)
Tea drinking (*n*=1328)							
Seldom	394 (29.7)	2.5 (1.6–3.0)	83.9 (50.9–106.7)	204.7 (97.4–276.2)	29.0 (12.9–41.7)	44.9 (22.4–63.9)	29.0 (20.7–36.6)
Occasional	670 (50.5)	2.5 (1.7–3.1)	88.3 (53.3–111.7)	211.0 (102.9–280.0)	30.8 (14.8–42.7)	46.4 (24.2–64.2)	29.5 (20.8–37.1)
Often	264 (19.9)	2.5 (1.5–3.1)	77.5 (43.5–106.2)	181.4 (84.4–232.9)	28.0 (11.9–41.1)	41.8 (19.1–60.8)	29.8 (19.1–39.4)
*p**	—	0.724	**0.011**	**0.002**	0.08	**0.032**	0.838
Coffee drinking (*n*=1321)							
Seldom	1108 (83.9)	2.5 (1.0–3.1)	84.8 (50.8–109.2)	203.3 (97.5–272.7)	29.6 (13.38–42.6)	45.2 (22.7–63.3)	29.5 (20.8–37.3)
Occasional	201 (15.2)	2.3 (1.5–3.0)	83.1 (50.5–117.7)	199.2 (96.9–269.5)	29.7 (13.38–41.6)	42.9 (20.3–62.5)	29.2 (20.6–36.4)
Often	12 (0.9)	2.4 (1.7–3.4)	83.8 (49.2–122.1)	174.9 (109.9–242.2)	38.8 (20.6–57.6)	52.7 (25.1–80.6)	31.6 (15.1–47.8)
*p**	—	0.099	0.94	0.733	0.316	0.316	0.884
Tight-fitting underwear (*n*=1337)							
No	885 (66.2)	2.5 (1.7–3.1)	83.5 (48.2–107.1)	199.3 (94.3–266.9)	28.8 (12.5–40.6)	44.0 (20.9–62.3)	29.8 (20.8–37.5)
Occasional	363 (27.2)	2.4 (1.6–3.0)	88.4 (57.7–111.9)	212.8 (110.3–277.1)	32.4 (17.1–44.9)	47.9 (26.6–64.9)	28.7 (20.2–35.0)
Often	89 (6.7)	2.5 (1.9–3.0)	82.9 (54.2–113.5)	205.1 (92.6–273.9)	29.3 (13.7–41.6)	45.4 (23.4–62.9)	28.1 (17.5–36.7)
*p**	—	0.159	**0.004**	0.338	**0.003**	**0.017**	0.156
†Fibre underwear (*n*=1337)							
No	877 (65.6)	2.5 (1.6–3.1)	84.3 (49.1–110.3)	203.1 (98.6–274.3)	29.4 (12.9–41.8)	44.3 (21.1–62.1)	30.2 (21.3–38.0)
Occasional	353 (26.4)	2.4 (1.5–3.0)	85.5 (55.2–108.5)	203.8 (96.0–265.7)	30.4 (14.2–43. 9)	46.9 (24.8–66.1)	28.2 (18.6–36.1)
Often	107 (8.0)	2.5 (2.0–3.1)	87.6 (53.3–121.2)	203.8 (94.4–279.7)	30.8 (15.5–43.3)	46.7 (24.7–65.8)	25.9 (17.6–31.1)
*p**	—	0.215	0.323	0.8	0.293	0.095	**0.001**
Takes hot baths (*n*=1339)							
No	578 (43.2)	2.6 (1.7–3.2)	85.1 (49.8–19.9)	204.4 (96.9–276.4)	28.6 (13.0–41.4)	43.9 (21.2–63.9)	30.9 (21.4–39.2)
Occasional	464 (34.7)	2.4 (1.5–3.0)	86.1 (53.3–111.8)	208.5 (100.6–279.9)	31.8 (15.5–44.2)	47.2 (24.4–64.4)	28.7 (20.4–35.9)
Often	279 (20.8)	2.4 (1.5–3.0)	82.7 (51.0–108.6)	191.6 (96.0–252.6)	29.3 (12.8–36.2)	44.4 (22.2–61.8)	27.4 (18.1–32.9)
*p**	—	0.054	0.345	0.284	0.091	0.173	**0.001**
Sleep (hours/day) (*n*=1340)							
<4	13 (1.0)	3.2 (2.0–4.0)	58.8 (40.6–77.1)	214.1 (114.4–245.6)	21.9 (10.3–27.7)	30.9 (14.4–38.3)	27.0 (15.7–40.9)
4–6	180 (13.4)	2.4 (1.6–3.0)	87.8 (56.6–111.6)	204.6 (95.8–270.9)	32.1 (16.7–41.6)	47.2 (27.5–63.3)	31.4 (21.7–38.2)
6–8	819 (61.1)	2.6 (1.7–3.1)	85.7 (50.3–110.5)	207.7 (98.7–275.7)	29.6 (12.9–42.8)	45.7 (22.2–64.2)	29.0 (19.9–36.5)
>8	328 (24.5)	2.4 (1.5–3.0)	82.5 (49.8–108.4)	191.6 (96.0–263.9)	29.2 (13.3–40.4)	43.4 (21.8–62.1)	29.4 (20.8–37.8)
*p**	—	0.052	0.099	0.509	0.229	0.114	0.224

Continued

Table 1 Continued

Socio-psycho-behavioural factors	*n* (%)	Sperm parameters [M (P25–P75)]					
		Semen volume (ml)	Sperm concentration (106/ml)	Total sperm count (106)	Rapid progress motility (A%)	Progress motility [(A+B)%]	Morphologically normal sperm (%)
Computer use (hours/day) (*n*=1334)							
0 or <1	968 (72.6)	2.5 (1.6–3.1)	84.1 (50.6–108.7)	199.2 (96.1–263.9)	28.9 (13.3–41.3)	44.5 (22.5–62.6)	29.6 (20.7–37.2)
1–3	192 (14.4)	2.5 (1.6–3.0)	87.1 (51.9–109.3)	211.5 (107.9–269.7)	32.2 (14.2–43.8)	46.8 (22.6–63.1)	29.2 (20.8–36.8)
3–5	105 (7.9)	2.7 (2.0–3.4)	85.8 (48.6–116.3)	231.8 (106.9–329.9)	33.6 (15.3–46.4)	47.7 (23.1–68.4)	27.8 (18.4–36.7)
>5	69 (5.2)	2.4 (1.5–3.0)	86.4 (49.9–119.2)	199.9 (99.4–258.4)	29.4 (13.2–45.1)	45.5 (22.4–66.4)	27.5 (20.4–33.7)
*p**	—	0.111	0.621	0.243	0.13	0.497	0.46
Sedentary position (hours/day) (*n*=1341)							
<1	202 (15.1)	2.4 (1.5–3. 0)	84.1 (48.3–110.7)	197. 7 (87.8–262.7)	28.7 (13.6–40.2)	45.4 (22.2–63.3)	28.5 (18.4–37.0)
1–3	449 (33.5)	2.5 (1.7–3.2)	85.7 (52.3–108.2)	206.7 (98.8–280.5)	29.5 (14.0–40.5)	45.0 (23.2–63.2)	29.6 (20.8–37.0)
3–5	361 (26.9)	2. 6 (1.7–3.2)	82.4 (48.6–110.7)	200.6 (94.6–274.4)	29.9 (12.7–42.7)	44.4 (21.9–61.9)	29.2 (20.4–36.7)
>5	329 (24.5)	2.4 (1.6–3.0)	86.5 (53. 3–113.8)	203.9 (102.5–263.0)	30.7 (13.8–44.3)	45.9 (22.6–65.6)	29.9 (21.6–38.6)
*p**	—	0.55	0.512	0.559	0.64	0.707	0.55
Physical activity (*n*=1287)							
No	913 (70.9)	2.5 (1.6–3.1)	82.6 (48.6–109.9)	196.9 (94.1–264.3)	30.1 (13.1–43.3)	45.1 (22.3–63.4)	29.4 (20.3–37.4)
Yes	374 (29.1)	2.6 (1.8–3.2)	85.5 (51.5–108.2)	217.8 (108.2–280.9)	28.9 (14.4–39.9)	44.7 (22.6–62.7)	29.2 (20.9–35.3)
*p**	—	**0.034**	0.545	**0.049**	0.451	0.646	0.837

Bold type denotes significance values of p<0.05.
*Kruskal–Wallis H test used to compare the median between categories of each socio-psycho-behavioural factor. B refers to slow or sluggish progressive motility.
†Fibre underwear refers to underwear made of man-made fibres as opposed to natural fibres such as cotton.
M, median; P25, 25th percentile; P75, 75th percentile.

Although some studies observed that intensive exercise in athletes resulted in a decline in sperm density, motility and morphology,[22 23] one study[20] that focused on exercise in ordinary men did not find a significant association between physical exercise and any semen parameters. Similarly, the present study did not establish any relationship between regular exercise and semen parameters in men living in the Chongqing area. The impact of a sedentary lifestyle and having saunas on semen quality has attracted interest from researchers but the results have been inconsistent.[10 19–21 24–28] The present study observed no significant association between a sedentary lifestyle or taking saunas and semen quality. Few studies to date have investigated the effect of green tea drinking, sleep habits and computer use on semen quality. The present study failed to identify any significant associations, and so further studies are needed to confirm these results since only a small proportion of the participants in the present study exhibited these particular lifestyle habits.

The strengths of the present study included utilising a large study sample and having community-based participants, and compared with earlier similar studies the present study provided a new viewpoint on socio-psycho-behavioural factors and semen quality. However, the present study also had limitations. First, participants were volunteers and were not randomly selected, which might have introduced selection bias between participants and other males in the community.[29] Second, it was not possible to estimate the participation rate, and the reason(s) for refusal rate were unknown because the subjects were recruited by local Family Planning Institutions. Also the study did not administer a questionnaire to those men who refused to participate. Third, a single semen sample was obtained for each participant, which may not reflect the participants' average semen quality since this may vary over time. Fourth, the authors conducted multiple Kruskal–Wallis tests, which could reduce their significance. Finally, this study was a cross-sectional study, and its results ideally need to be confirmed by well-designed retrospective and prospective studies in the future in order to make reliable inferences on cause-effect mechanisms.

In conclusion, the present study observed that psychological stress and certain social factors (i.e. occupational status) and living habits (i.e. wearing underwear made from man-made fibres) are associated with semen quality. Any proposed solutions for improving human semen quality should definitely take social factors into account. A health programme aimed at improving mental health and providing lifestyle guidance is likely to have a beneficial effect on male reproductive health in Chongqing, China.

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