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Short Communication

An Analysis of Risk Factors for Asthenospermia: A Hospital-Based Study in China

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ABSTRACT

The objective of this study was to explore the influencing factors of asthenospermia. Electronic medical record and semen samples were collected from 201 male patients in The Fourth People's Hospital of Taizhou from November 2021 to March 2023. Multivariate logistic regression model was used to analyze the risk factors of asthenospermia after adjusting all covariables. Linear regression model was conducted to analyze risk factors for the three main indicators of asthenospermia. Men with asthenospermia have higher rates of sperm malformation and sperm DNA fragmentation (97.2% versus 95.1%; 31.4% versus 17.9%). Computer usage, sperm malformation rate and smoking were risk factors for asthenospermia, the adjusted ORs were 1.87, 3.97 and 1.40, respectively. The protective factor of sperm motility, sperm forward motility rate and sperm non-forward motility was exercise. It was concluded that lifestyle factors (computer usage hours, smoking and alcohol consumption), sperm malformation rate and sperm fragmentation rate significantly affected asthenospermia, however exercise reduces the risk of asthenospermia.

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Key words
Asthenozoospermia, Sperm motility, Sperm forward motility rate, Sperm non-forward motility, Risk factors

Male factors are thought to be responsible for about 50% of cases of infertility, which affects 10-15% of couples who are of reproductive age (Eslamian *et al*., 2016). Asthenozoospermia, defined by reduced motility or absent sperm motility in the fresh ejaculate (progressive motility<32%), is generally considered to be a complex disease involving multiple etiologic factor that leads to male infertility (Tu *et al*., 2020). More than 40% of infertile men present with asthenospermia and 24% of infertile cases exhibit isolated asthenospermia (Jungwirth *et al*., 2012). In the past few decades, there have been many studies on spatial and temporal trend change in human semen quality (Auger *et al*., 2022). Sperm motility is essential for mature sperm to behave properly and is required for sperm to reach the egg and penetrate the zona pellucida during fertilization. According to a meta-regression analysis, there was a considerable drop in sperm counts between 1973 and 2011 in Western countries, which was caused by a 50–60% decrease in the number of males who were not chosen for fertility (Levine *et al*., 2017). Another study estimated that sperm counts among American men are declining at a rate of 1.5% per year (Liu *et al*., 2022). Therefore, it is of great significance to explore the risk factors of asthenospermia and take effective preventive measures to improve male reproductive health.

Genetic factors, hormonal disorders, sperm dysfunction (such as low sperm motility and low semen quality scores), prolonged periods of sexual abstinence, and infections (including viral infections and even the most recent COVID-19 pandemic) have all been identified as well-known risk factors for asthenozoospermia in previous studies (Tu *et al*., 2020). In recent decades, a decrease in semen quality has been observed, including a decrease in semen quantity, viability, volume and morphology. Considering these significant changes in a relatively short period of time, it has been suggested that the decline in semen quality is most likely due to environmental rather than genetic factors (Carlsen *et al*., 1992). In addition, lifestyle may also play an important role in the development of asthenospermia, including smoking, alcohol consumption, exercise and time spent using computers and mobile phones (Xiao *et al*., 2022). However, the analysis of risk factors for asthenospermia differed and did not take into account the effect of computer and cell phone use time on sperm motility. To the best of our knowledge, there has been no subgroup analysis of diagnostic indicators (sperm motility, sperm forward motility rate and sperm non-forward motility) for asthenospermia.

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Materials and methods

There were 201 male patients collected from The Fourth People's Hospital of Taizhou from November 2021 to March 2023. Patients were instructed to have a minimum of two days and a maximum of three days' abstinence before delivering the semen sample on-site. For establishing three semen quality analyses but the number and density of sperm were normal. Asthenozoospermia group had 100 males while non-asthenozoospermia had 101 males. .

The variables included in demographic information were age and education, sperm quality and lifestyle. According to diagnostic criteria of asthenospermia, sperm forward motility ratio less than 32%, or sperm motility was less than 40%. Differences in continuous variables were tested with student's t test or ANOVA. Differences in categorical variables between groups were assessed by $\chi 2$ tests. Logistic regression model was used to analyze the risk factors of asthenospermia after adjusting all covariables. Linear regression model was conducted to analyze risk factors for the three main indicators of asthenospermia (total sperm motility, sperm forward movement, and sperm non-forward movement). R version 4.2.2 was used to analyze the data (https://cran.r-project.org/). The p values for two-sided tests were provided, and the significance level was set at p0.05.

Results and discussion

Characteristics stratified by asthenospermia status (Table I). The differences were statistically significant between the two groups, except for education. Men with asthenospermia have higher rates of sperm malformation and sperm DNA fragmentation (97.2% versus 95.1%; 31.4% versus 17.9%). Compared with the non-asthenospermia group, the asthenospermia group had significantly higher age, abstinence, daily computer use, smoking, alcohol consumption, daily cell phone use and sedentary time. Sperm forward motility rate, sperm non-forward motility rate, sperm motility and exercise were poorer in asthenospermia group than in non asthenospermia group.

Logistic and linear regression for the study variables (Table II). We observed that computer usage hours, sperm malformation rate and smoking were risk factors for asthenospermia, the adjusted ORs were 1.87, 3.97 and 1.40, respectively. However, exercise has a protective effect against asthenospermia (OR=0.83).

We further analyzed the influencing factors for diagnostic indicators of asthenospermia, including sperm motility, sperm forward motility rate and sperm non-forward motility. Risk factors for sperm motility were sperm malformation rate, sperm fragmentation rate, smoking, computer usage hours, alcohol consumption, sperm forward motility and sperm non-forward movement (Table II). The protective factor was exercise.

Table I. Characteristics of included samples.

Variable	Non-asthenospermia (N=100)	Asthenospermia (N=101)	P value
Age (years)	30.6 (4.59)	32.6 (5.45)	<0.001
Bachelor	20 (20%)	18 (17.8%)	<0.001
Education			
High school	8 (8%)	9 (8.91%)	<0.001
Junior college	38 (38%)	37 (36.6%)	<0.001
Postgraduate	34 (34%)	37 (36.6%)	<0.001
Sperm quality			
Forward (%)	38.4 (7.01)	15.1 (8.87)	<0.001
Non. forward (%)	14.6 (5.80)	8.48 (4.88)	<0.001
Motility (%)	53.1 (9.25)	23.6 (12.4)	<0.001
Malformation (%)	95.1 (1.93)	97.2 (1.59)	<0.001
Fragmentation (%)	17.9 (13.4)	31.4 (13.3)	<0.001
Abstinence (d)	5.03 (2.78)	7.70 (4.32)	<0.001
Computer (h)	3.26 (3.02)	5.50 (3.12)	<0.001
Cigarettes (no/d)	5.28 (6.11)	15.6 (7.51)	<0.001
Alcohol (ml)	20.7 (27.8)	47.4 (35.4)	<0.001
Time			
Phone (h)	2.39 (2.05)	6.68 (3.33)	<0.001
Sedentary (h)	3.26 (3.02)	5.69 (2.91)	<0.001
Exercise (min)	74.6 (21.0)	25.3 (15.2)	<0.001

The present study showed that smoking and alcohol consumption were important risk factors for asthenospermia. According to the previous studies, smoking was linked to reduced sperm counts and a rise in spermatozoa with morphological abnormalities (Bundhun *et al*., 2019). Ramlau-Hansen *et al*. (2007) found a dose-dependent effect of smoking on semen volume, concentration and motility. Another study evaluated the effect of smoking on sperm parameters, and found that smoking was more likely to impair motility than impaired sperm count (Lingappa *et al*., 2015). The mechanism by which smoking causes as the nospermia is very complex, and have been explained in previously published papers (Condorelli *et al*., 2018). Smoking can have an impact on sperm by reducing their capacity to combat free oxygen radicals in seminal fluid, which increases the sperm's sensitivity to oxidative stress. In short, the possible mechanism of smoking on asthenospermia is that the toxic substances found in tobacco may have harmful effects on male germ cells and their developmental processes (Chen *et al*., 2015). The expression of many proteins was considerably altered in the sperm of smokers, suggesting additional mechanisms by which smoking damages the 8nAChR subunit prevalent in human sperm and causes sperm damage (Fariello *et al*., 2012). Spending too much time on the computer is a sedentary lifestyle that can do great harm to semen quality.

Table II. Results of risk factors for asthenospermia.

	Asthenospermia		Sperm motility		Sperm forward motility		Non-sperm forward movement	
	OR	**95%CI**	**Rate**	**95%CI**	**Rate**	**95%CI**	**Rate**	**95%CI**
(Intercept)	-	-	175.96	88.64, 263.28	147.82	82.76, 212.88	28.14	-12.59, 68.87
Age	1.17	(0.91, 1.64)	-0.20	-0.53, 0.14	-0.11	-0.36, 0.14	-0.09	-0.24, 0.07
High school	14.11	(0.14, 3080.47)	-1.25	-7.87, 5.38	-3.13	-8.06, 1.81	1.88	-1.21, 4.97
Junior college	0.54	(0.01, 17.98)	1.30	-3.27, 5.87	-0.21	-3.61, 3.20	1.51	-0.62, 3.64
Postgraduate	0.46	(0.02, 8.89)	0.32	-4.31, 4.96	-1.37	-4.82, 2.09	1.69	-0.47, 3.86
Malformation	3.97	(1.85, 13.55)	-1.29	-2.18, -0.40	-1.14	-1.80, -0.47	-0.15	-0.57, 0.26
Fragmentation	1.01	(0.92, 1.11)	-0.30	-0.43, -0.17	-0.21	-0.30, -0.12	-0.09	-0.15, -0.03
Computer	1.87	(0.93, 4.87)	-0.86	-1.87, 0.16	-0.65	-1.41, 0.11	-0.21	-0.68, 0.27
Abstinence	0.97	(0.61, 1.57)	-0.26	-0.73, 0.21	-0.23	-0.58, 0.11	-0.03	-0.24, 0.19
Cigarettes	1.40	(1.14, 1.95)	-0.39	-0.62, -0.16	-0.26	-0.44, -0.09	-0.13	-0.24, -0.02
Alcohol	1.04	(1, 1.11)	-0.06	-0.11, -0.01	-0.06	-0.09, -0.02	-0.00	-0.03, 0.02
Phone	1.07	(0.72, 1.63)	-0.39	-1.00, 0.22	-0.39	-0.84, 0.07	-0.00	-0.29, 0.28
Sedentary	0.57	(0.23, 1.17)	0.64	-0.42, 1.71	0.28	-0.51, 1.07	0.36	-0.13, 0.86
Exercise	0.83	(0.70, 0.91)	0.20	0.12, 0.27	0.14	0.09, 0.20	0.05	0.02, 0.09

Findings from this study showed that alcohol consumption has a negative effect on asthenospermia. Rahimipour *et al.* (2013). reported reduced sperm concentration, motility, and percentage of normal morphology in ethano-fed mice compared to controls. According to Sharma *et al.* (2016) investigation into the effect of alcohol consumption on semen parameters, drinking impairs sperm development and weakens DNA integrity. Alcohol intake is linked to poor semen quality, which is mostly brought about by the oxidative stress it causes, as well as genotoxic effects on hormone control and DNA integrity (Ricci *et al.*, 2018). In this study, we also found that exercise was the protective factor for asthenospermia and its diagnostic indicators. Many studies have shown that semen parameters can change significantly due to certain types, intensity, and duration of exercise (Jóźków and Rossato, 2017). Several studies have shown that men with sedentary lifestyles are more likely to experience delayed-onset male hypogonadism, which is caused by low testosterone levels, decreased libido, erectile dysfunction and reduced sperm viability (Vaamonde *et al.*, 2012). Modern life is becoming more and more sedentary, including travel, employment, and leisure. Other than working and sleeping, watching TV and engaging in other forms of screen time make up the majority of sedentary activity in many Western countries (Patterson *et al.*, 2018). In this study, we also discovered that the frequency of computer use was a significant risk factor for asthenospermia. However, it is unknown what factors link long computer sessions to a reduced ability to produce sperm. Sitting might raise the scrotal temperature and interfere with spermatogenesis. Additionally, continued computer use will undoubtedly result in an increase in ionizing radiation and have an impact on spermatogenic function (Priskorn *et al.*, 2016). Several observational studies have confirmed that the association between exercise and asthenospermia.

Sperm malformation and fragmentation rate are major drivers of sperm motility, sperm forward movement and sperm non-forward movement. The important role of sperm malformation and DNA fragments as an important component of male factor infertility is supported by our results. Research confirms that sperm malformation is a direct factor for male infertility (Liu *et al.*, 2020). It was found that DNA fragmentation index was a simple, informative and reliable measure of sperm quality, which can accurately predict the fertility of male mice (Li and Lloyd, 2020). The infertile males are found to have a higher percentage of sperm with defective DNA than fertile controls. There are many, intricate reasons why sperm DNA can become damaged. Numerous internal and external causes, which may have hereditary or environmental roots, can be responsible for sperm DNA fragmentation. The risk of sperm DNA fragmentation has been linked to genetic variants and polymorphisms in genes involved in maintaining genome integrity. Infertile men with chromosomal structural rearrangements, such as reciprocal translocations, have more DNA damage (Al-Omrani *et al.*, 2018). As the rate of sperm DNA fragmentation rises, asthenospermia eventually develops as a result of abnormal chromatin condensation in the sperm.

Conclusion

The study results suggest that several lifestyle factors (computer usage hours, tobacco smoking and alcohol consumption) are associated with asthenozoospermia, exercise reduces the risk of asthenospermia. Sperm malformation and fragmentation rate significantly affected

sperm motility, sperm forward movement and sperm non-forward movement.

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Ethical approval and IRB approval

This study was approved by the Advanced Studies Research Board of the Fourth People's Hospital of Taizhou, Taizhou, 225300, China. It was carried out in compliance with guidelines issued by ethical review board committee of The Fourth People's Hospital of Taizhou, Taizhou, China. The official letter would be available on fair request to corresponding author.

Statement of conflict of interest

The authors have declared no conflict of interest.

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