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ORIGINAL RESEARCH

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Possible involvement of lifestyle factors on reproductive ability among men from an andrology clinic in northern Vietnam

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Abstract

Background: Current research on Vietnamese men's reproductive health faces limitations. Therefore, this study investigates how lifestyle factors impact semen and reproductive hormones in men visiting an andrology clinic in Northern Vietnam. **Methods**: This cross-sectional descriptive study was conducted on men desiring children who first visited the andrology clinic, with concurrent semen and reproductive hormone tests at the Hanoi Obstetrics and Gynecology Hospital. **Results**: A total of 579 men aged 19–56 years were included in this study in 2022. The examined reasons were 60.6% for reproductive health checks, 36.1% for infertility and 3.3% for other reasons. Men reported using alcohol and smoking cigarettes at rates of 59.7% and 48.4%, respectively. Moreover, there are 13.3% and 16.6% of men arbitrarily used supplements and unknown-origin traditional products (UOTP) to improve reproductive and sexual health. Furthermore, semen analysis revealed that an overwhelming 67.3% of men exhibited abnormalities in at least one of the three key parameters studied: concentration, progressive motility and morphology. Interestingly, the study also demonstrated a notable inverse correlation between semen parameters and the levels of gonadotropin hormone ($p < 0.05$), while no significant associations were observed with prolactin and total testosterone levels. Notably, there was a statistically significant decline in sperm concentration and motility in the group that used UOTPs, accompanied by increased gonadotropin levels compared with those who did not use them ($p < 0.05$). We found no significant differences in semen parameters and reproductive hormone levels among other groups using tobacco, alcohol and supplements. According to our findings, there is a negative relationship between semen quality and serum gonadotropin levels. **Conclusions**: The indiscriminate consumption of supplements and UOTPs does not show any beneficial effects on male reproductive health. On the contrary, the utilization of UOTPs may disrupt the equilibrium between spermatogenesis and reproductive hormone concentrations.

Keywords

Lifestyle habits; Semen analysis; Reproductive hormones; Unknown-origin traditional products

1. Introduction

Although andrology has gained global recognition as an essential health issue only in recent decades, it is of increasing interest [1, 2]. This acknowledgment could be attributed to the variation in the average life span between males and females, typically ranging from 4 to 6 years across the globe [3]. Additionally, a significant decline in semen quality over time has been observed and reported in regions such as South America, Europe, Asia and Africa [4]. Biological factors likely account for the variations observed between the genders. In addition, it is common for men to engage in more unhealthy habits like smoking, alcohol consumption and obesity, while also accessing healthcare services less often than women [5, 6].

Smoking and alcohol consumption are well-documented risk factors that negatively impact global health, including male fertility [7, 8]. Research has indicated that individuals who smoke heavily tend to have a decline in the amount of semen produced, a decrease in both the total number and concentration of sperm, reduced sperm mobility, and an elevated level of sperm DNA damage in comparison to those who do not smoke [9, 10]. A meta-analysis of 5865 men also confirmed that smoking adversely affects semen parameters [11]. The consumption of excessive alcohol has been noted to hinder the maturation of sperm and cause more damage to the integrity

of sperm DNA compared to smoking [12, 13]. Additionally, alcohol use exceeding 84 grams per week has been shown to adversely affect survival rates after assisted reproduction [14].

Nonetheless, certain studies suggest that smoking and alcohol consumption may not have a significant impact on male fertility. A study conducted in the Netherlands concluded that the consumption of tobacco and alcohol did not result in statistically significant changes in semen characteristics, including volume, sperm count, motility, morphology or the outcomes of pregnancy [15]. Conversely, smoking was significantly associated with detrimental effects on seminal parameters in infertile men [16]. As a result, a definitive agreement regarding the detrimental impact of tobacco and alcohol on the reproductive and sexual health of men has yet to be reached.

In Vietnam, the use of supplements or traditional products/medicines to improve health, including male reproductive health, has recently become common. These items are readily available and frequently utilized following suggestions from family members, acquaintances or online sources rather than professional medical guidance. Information regarding the impact of these products on the male reproductive system in Vietnam is currently scarce, with limited statistics or documented assessments available.

The endocrine system plays a crucial role in regulating the male reproductive system, particularly through hormones such as gonadotropins, prolactin and testosterone. These hormones work together to synchronize and control sexual functions, the production of sperm and the maturation of sperm cells [17, 18]. An imbalance in these hormones can lead to disturbances in semen parameters and abnormalities in sexual function. Consequently, the analysis of semen and reproductive hormone levels plays a crucial role in assessing a male's reproductive and sexual well-being. The objective of this research is to explore lifestyle attributes, levels of sex hormones, and semen characteristics in order to gain deeper insights into the diverse factors that affect sperm production influenced by lifestyle choices and hormonal factors.

2. Materials and methods

2.1 Study population

Men attending the Andrology Clinic at Hanoi Obstetrics and Gynecology Hospital (Hanoi, Vietnam) for a men's health examination between January and December 2022 were recruited for this study. The inclusion criteria were: (1) age ≥18 years, (2) first-time andrological evaluation with concurrent semen analysis and reproductive hormone assessment, and (3) availability of demographic and lifestyle data in electronic medical records. Exclusion criteria included: (1) diagnosed genital disorders affecting sperm quality, (2) ongoing hormone therapy or fertility treatment, and (3) current chemotherapy or radiotherapy. A total of 579 men aged 19–56 years met the eligibility criteria and were included in the study.

2.2 Lifestyle factors

General information recorded includes age, address and reason for the medical examination. The lifestyle habits assessed were smoking (including waterpipe smoking), alcohol consumption, use of supplements and use of UOTPs. All behaviors were documented over the previous half-year. Smoking habits were divided into three groups: non-smoking, light smoking (less than ten cigarettes daily) or heavy smoking (ten or more cigarettes daily). Alcohol consumption was segmented into three categories: abstinent, sporadic (less than twice weekly) or frequent (twice weekly or more). The utilization of supplements or non-tobacco nicotine products was dichotomously defined as either usage or non-usage, without adherence to medical guidelines. UOTP products were identified as liquids in sachets or tablets, with unclear details regarding ingredients, manufacturing location, license number or expiry date.

2.3 Semen analysis

Participants were instructed to abstain from sexual activity for 3–7 days before providing a semen sample. Samples were collected in a sterile container following masturbation and incubated at 37 °C for 30 minutes to facilitate liquefaction. Following liquefaction, technicians conducted semen analysis to assess semen pH, volume, concentration, count, progressive motility and normal morphology. The procedures and reference values adhered to World Health Organization 2010 guidelines. Normal sperm analysis was defined as a sperm concentration of $\geq 15 \times 10^6$/mL, normal sperm morphology ≥4% and progressive motility ≥32%. Semen samples with at least one of three abnormalities in concentration (oligozoospermia), motility (asthenozoospermia) or morphology (teratozoospermia) were classified as abnormal spermatogenesis. Samples with abnormalities in all three indicators were classified as Oligo-Astheno-Teratozoospermia (OAT). Samples with a concentration of fewer than 1 million sperm/mL were classified as cryptozoospermia. Samples with no sperm were classified as azoospermia (Azoo).

2.4 Reproductive hormone testing

The morning blood samples were obtained concurrently with the semen sample collection on the same day. The reproductive hormones under evaluation comprised follicle-stimulating hormone (FSH), luteinizing hormone (LH), prolactin (PRL) and testosterone (TES). Morning blood samples were collected to minimize variations in hormone levels due to daily biorhythms and glucose fluctuations. Serum reproductive hormone concentrations were determined using electrochemiluminescence immunoassay (ECLIA) with commercially available kits: Elecsys FSH (11775863500, Roche Diagnostics GmbH, Mannheim, BW, Germany), Elecsys LH (07027575500, Roche Diagnostics GmbH, Mannheim, BW, Germany), Elecsys Testosterone (05200067500, Roche Diagnostics GmbH, Mannheim, BW, Germany) and Elecsys Prolactin (07027737500, Roche Diagnostics GmbH, Mannheim, BW, Germany). The reference ranges for FSH, LH, total TES and PRL were 0.1–200 IU/L, 0.3–200 IU/L, 0.087–52 nmol/L and 0.094–470 μg/L, respectively.

2.5 Statistical analysis

Study data were collected and managed using the Research electronic data capture (REDCap (10.8.3, Vanderbilt University, Nashville, TN, USA)) tools hosted at Hanoi Obstetrics and Gynecology Hospital and analyzed using SPSS V20.0 software (International Business Machines Corporation, Armonk, NY, USA). Group comparisons were performed using the Chi-square test and Mann-Whitney U test. Analysis of variance (ANOVA) was used to compare means among different groups. Logistic regression was employed to estimate odds ratios for each lifestyle factor concerning semen results. Statistical significance was defined as a p-value < 0.05.

3. Results

3.1 Characteristics of the study population

We enrolled 579 males with a mean age of 30.8 ± 5.5 years, ranging from 19 to 56. The 25–34 age group accounted for the highest proportion, at 69.3%. Participants in the study hailed from Hanoi as well as various other provinces. The main motive behind their visit to the clinic was to undergo reproductive health examinations, which constituted 60.6% of the cases, in contrast to 36.1% seeking infertility evaluations (Table 1).

TABLE 1. General characteristics of the study population.

Variables	N (%) or mean ± SD
Age, yr	30.8 ± 5.5
Range	19–56
Below 25	48 (8.3)
25–34	402 (69.4)
35–44	115 (19.9)
From 45	14 (2.4)
Accommodations	
Ha Noi	296 (51.1)
Urban	129 (22.3)
Suburban	167 (28.8)
Other provinces	283 (48.9)
Reasons for coming	
Reproductive health check	351 (60.6)
Infertility	209 (36.1)
Others	19 (3.3)

SD: standard deviation.

The proportion of men with habits of drinking alcohol and smoking tobacco was 60% and 46%, respectively. Out of these individuals, heavy smokers made up 24.6% while regular alcohol drinkers accounted for 15.3%. Additionally, 17% of men used UOTPs and 13% used dietary supplements (Fig. 1).

3.2 Semen analysis and reproductive hormone levels

The findings from the semen analysis revealed that abnormalities were detected in at least one of the three semen parameters (concentration, progressive motility and morphology) in 67.3% of men who underwent testing for the first time. The men with one abnormal indicator (asthenozoospermia), two abnormal indicators (oligo-asthenozoospermia), OAT, cryptozoospermia, and azoospermia were 3.4%, 7.3%, 7.4%, 12.3%, 2.2% and 4.1%, respectively (Fig. 2A).

When comparing the average levels of reproductive hormones in the semen groups, we observed a significant increase in FSH and LH levels in the abnormal semen group compared to the normal semen group ($p < 0.001$ and $p < 0.0001$). No statistical differences were found in PRL and TES levels (Fig. 2B).

3.3 Impact of lifestyle factors on semen parameters and reproductive hormones

In order to assess the impact of alcohol, tobacco, supplements and UOTPs on semen parameters and reproductive hormone levels, we conducted a comparative analysis of the average values of semen parameters (including concentration, progressive motility and normal morphology) and reproductive hormone levels (such as FSH, LH, PRL and TES) between individuals who reported using these lifestyle factors and those who did not. Our results indicated a significant decrease in sperm concentration and motility, along with elevated FSH and LH hormone levels, among individuals using UOTPs compared to those who were not using UOTPs. The remaining habits had no statistically significant effect on semen parameters and reproductive hormone levels (Table 2).

Next, we compared the means of reproductive hormone levels between the groups of semen. The statistical differences were in the level of FSH and LH. No statistical differences were found in PRL and TES (Fig. 3).

During the univariate analysis examining the association between tobacco use, alcohol intake, supplement consumption, and the use of UOTPs in relation to abnormal semen quality, it was observed that individuals using UOTPs had a 2.46 times higher likelihood of presenting abnormal semen parameters (95% confidence interval 1.09–5.58, $p < 0.0001$) (Fig. 4).

4. Discussion

In this study, the average age of the men was 30.8 years, with the highest proportion being in the 25–34 age group. This age group also aligns with the peak in requirements for reproductive and sexual activity. Similar observations from other andrology clinics in Vietnam corroborate these results regarding the distribution of age [19, 20]. Additionally, there were no significant differences in participants' residence between Hanoi and other provinces or between urban and suburban areas.

Subsequently, we examined the factors prompting men to seek medical assistance. An overwhelming 96% of male individuals sought medical aid primarily for concerns related to their reproductive health. Within this group, 60% actively pur-

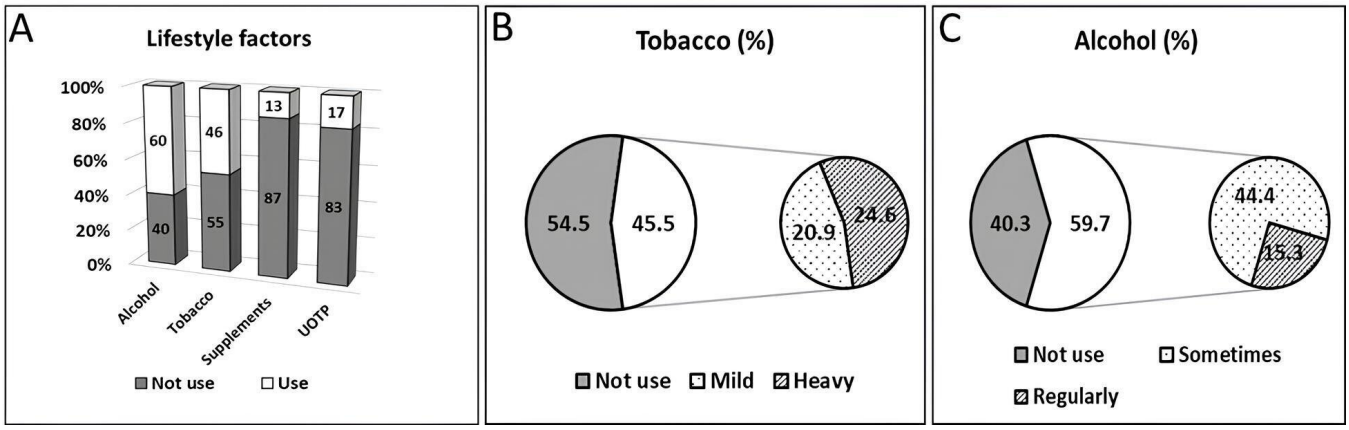

FIGURE 1. Characteristics of lifestyle factors. The figure shows the rate of lifestyle factors (A), the classification of using tobacco (B) and using alcohol (C) of the study population.

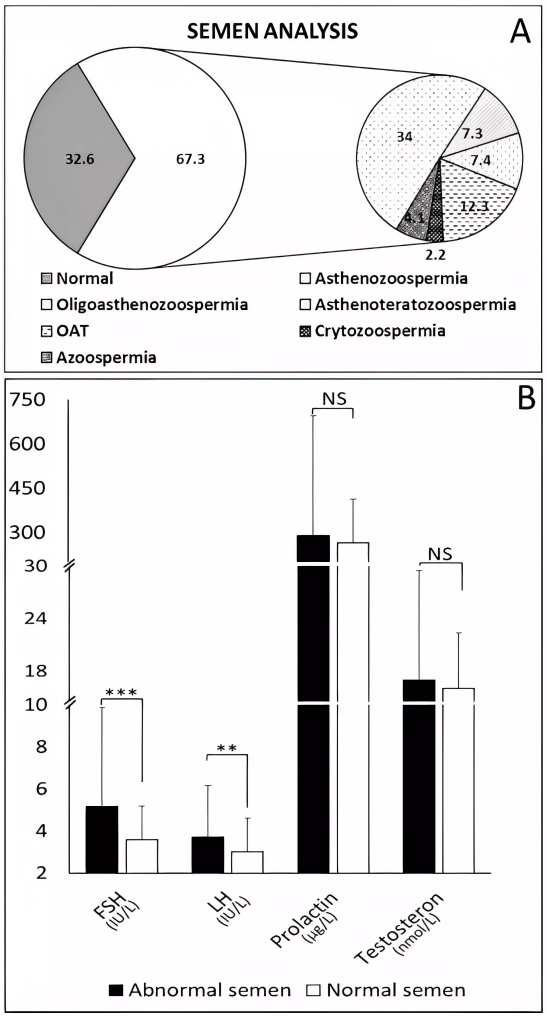

FIGURE 2. Semen analysis and reproductive hormone levels. (A) Classification of Semen Analysis: Semen analysis is considered normal if all three parameters—concentration, progressive motility and morphology—are within normal ranges. One Indicator Abnormality: Includes only Asthenospermia. Two Indicator Abnormalities: Include Oligoasthenospermia and Asthenotetarospermia. Three Indicator Abnormalities: Include Oligoasthenotetatozospermia (OAT) with a concentration of over 1 million sperm/mL. And Cryptozoospermia, which has a concentration of less than 1 million sperm/mL. (B) Mean of Follicle-stimulating Hormone (FSH), Luteinizing Hormone (LH), Prolactin and Testosteron Values Associated with Semen Parameters: Shows the average concentrations of FSH, LH, PRL and testosterone (TES) in relation to semen parameters. OAT: Oligoasthenotetarospermia. NS: non-significant; FSH: follicle Stimulating Hormone; LH: Luteinizing Hormone. ***$p < 0.001$, **$p < 0.01$.

TABLE 2. Semen quality parameters and reproductive hormone levels according to lifestyle factors.

Variables	Alcohol	Tobacco	Supplements	UOTP
Sperm concentration (million/mL)				
Non-use	32.3 ± 29.1	33.8 ± 21.1	31.9 ± 24.7	33.1 ± 25.5
Use	32.6 ± 21.9	31.3 ± 28.6	30.4 ± 24.8	24.1 ± 18.8
p	0.95	0.47	0.77	0.02
Progressive motility (% motile)				
Non-use	42.5 ± 19.3	45.3 ± 17.3	42.7 ± 20.2	43.6 ± 19.3
Use	44.3 ± 19.3	41.5 ± 21.1	41.0 ± 18.8	36.3 ± 22.6
p	0.53	0.17	0.65	0.04
Sperm morphology (% normal)				
Non-use	2.2 ± 1.8	2.6 ± 1.7	2.3 ± 1.8	2.3 ± 1.8
Use	2.5 ± 1.8	2.1 ± 1.8	2.1 ± 1.7	2.1 ± 1.7
p	0.34	0.09	0.54	0.03
FSH (IU/L)				
Non-use	4.5 ± 2.5	3.8 ± 2.3	4.4 ± 3.2	4.1 ± 2.3
Use	3.9 ± 2.2	4.4 ± 2.3	4.1 ± 2.1	5.4 ± 5.5
p	0.09	0.05	0.50	0.03
LH (IU/L)				
Non-use	3.2 ± 1.5	3.1 ± 1.6	3.4 ± 2.0	3.1 ± 1.5
Use	3.2 ± 1.6	3.3 ± 1.6	3.1 ± 1.5	4.4 ± 3.2
p	0.98	0.50	0.37	0.02
Prolactin (μg/L)				
Non-use	241.9 ± 100.8	257.4 ± 120.0	253.5 ± 119.0	245.9 ± 115.3
Use	245.5 ± 130.2	229.7 ± 114.9	232.4 ±117.3	269.2 ± 131.1
p	0.83	0.10	0.37	0.33
Testosterone (nmol/L)				
Non-use	17.0 ± 7.9	16.4 ± 7.3	16.3 ± 6.8	16.0 ± 6.1
Use	16.0 ± 6.1	16.7 ± 6.1	16.1 ± 9.2	17.3 ± 11.1
p	0.31	0.80	0.92	0.50

UOTP: unknown-origin traditional products; FSH: Follicle-stimulating Hormone; LH: Luteinizing Hormone.

sued fertility evaluations in anticipation of starting a family or prior to marriage, while around 30% sought assistance specifically for issues related to infertility. Historically, infertility-related reasons were the primary drivers for Vietnamese men to visit andrology clinics. This shift indicates an increase in proactive reproductive health care among men in Vietnam.

The men exhibited various unhealthy lifestyle behaviors, such as smoking tobacco, indulging in excessive alcohol consumption, substance abuse, engaging in late-night gaming sessions, consuming fast food and neglecting regular health check-ups [21]. The smoking rate in this study was consistent with the 43.7% smoking rate reported for Vietnamese men in 2021 [22]. Notably, our study is among the first to observe the spontaneous use of supplements and UOTPs in men of reproductive age. It should be emphasized that these items are frequently utilized in Vietnam, with individuals typically relying on personal research rather than professional medical guidance. As a result, pinpointing the components of such items, particularly UOTPs, can prove to be quite perplexing. The subsequent discussion will delve into the potential impact of these practices on the reproductive health of men.

Sperms are produced in the seminiferous tubules of the testis, mature and stored in the epididymis and seminal vesicles. Spermatogenesis regulation involves internal and external factors through the negative feedback mechanism of the hypothalamic-pituitary-testicular axis [23]. In the present research, it was found that there was a notable increase in gonadotropin levels (specifically FSH and LH) in samples exhibiting abnormal semen characteristics when contrasted with those displaying normal semen parameters. The extent of the semen abnormalities was directly proportional to the heightened levels of gonadotropins. Conversely, the distinctions in average PRL and TES levels between samples with normal and abnormal semen were deemed statistically insignificant. These findings are consistent with the investigations conducted by Babu *et al.* [24] and Gangwar *et al.* [25], which found

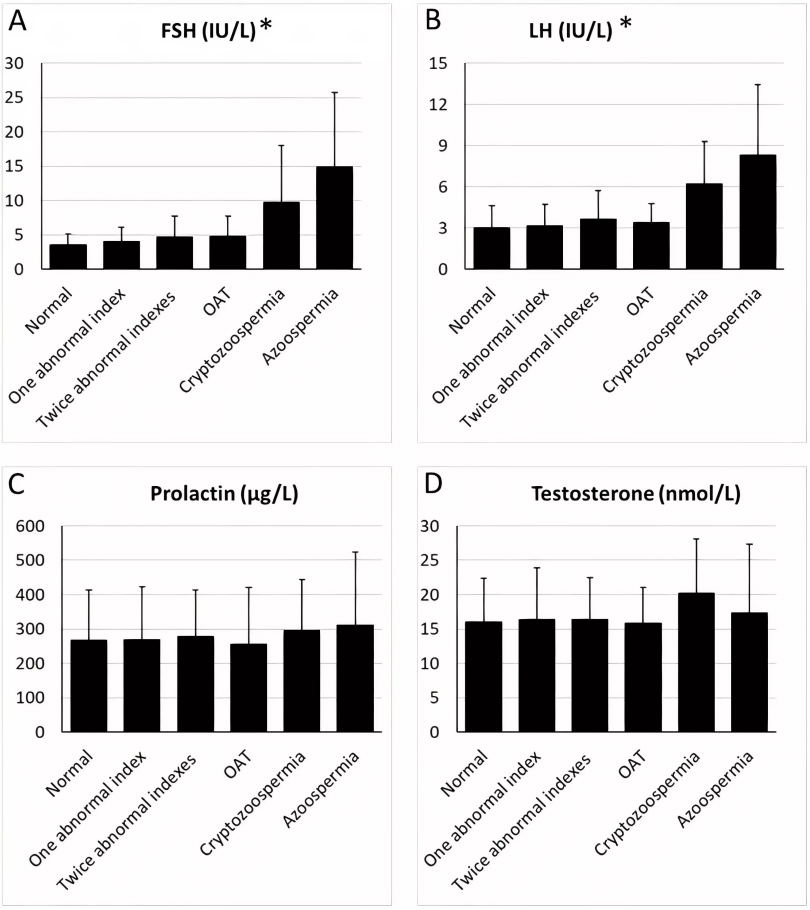

FIGURE 3. Mean values of FSH (A), LH (B), PRL (C) and TES (D) values associated with groups of semen. *$p < 0.0001$ with ANOVA test. OAT: Oligoasthenotetarospermia; FSH: follicle-stimulating hormone; LH: luteinizing hormone.

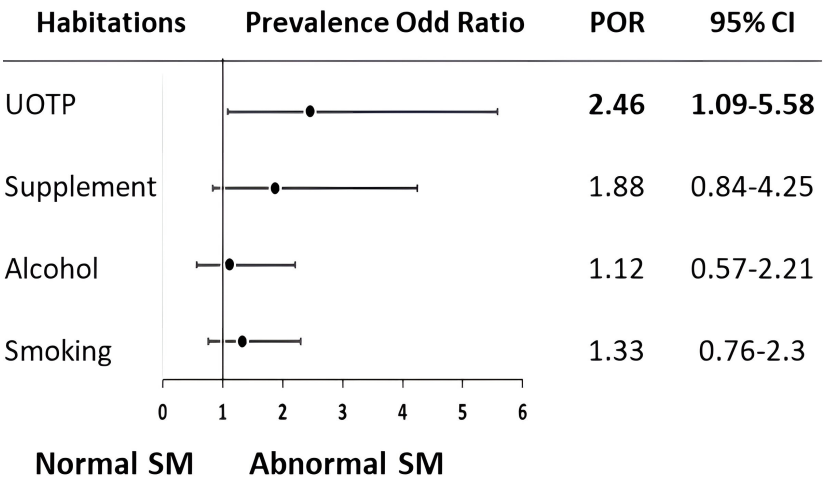

FIGURE 4. Forest plot of lifestyle factors and semen analysis. POR: Prevalence Odd Rate; CI: Confidence Interval; UOTP: unknown-origin traditional products; SM: semen.

elevated FSH and LH levels in infertile males. The levels of PRL and testosterone between infertile males and fertile controls were not consistent. Gangwar *et al.* [25] observed increased levels of PRL and decreased levels of testosterone in males with infertility issues. Conversely, other studies found no significant differences in TES or PRL levels among semen subgroups [24, 26].

Despite being recognized as global health risk factors, there is no consensus on the effects of smoking and alcohol abuse on male reproductive health. This study found no significant differences in cigarette smoking or alcohol intake between normal and abnormal semen samples. No statistical significance was found between light and heavy smoking or occasional and regular drinking across semen groups. Furthermore, there were no associations found between semen analysis outcomes and the use of alcohol or cigarettes. This outcome aligns with the

results of Jong *et al.* [15], who similarly documented that smoking cigarettes and drinking alcohol did not have a notable effect on sperm characteristics or fertility outcomes within their research cohort. However, some studies mentioned earlier did find correlations or negative effects of smoking and alcohol on semen parameters [11–13]. The variability in research findings could be due to variations in the study samples, posing difficulties in making comparisons. Additionally, our study did not assess alterations in sperm DNA, which could offer further understanding of the impacts of alcohol and tobacco on sperm quality and fertility.

We did not find any positive relationships between supplement use and sperm quality, including semen parameters such as concentration, motility and morphology. Dietary supplements, which are commonly taken on a daily basis by people of various age groups, including males, are readily available over the counter. In Vietnam and other nations, users typically start consuming these products without prior health screenings. Our research highlighted that males attempting to conceive often include dietary supplements such as oyster essence, multivitamins like Menevit and PregnaCare, as well as products containing zinc, Coenzyme Q10 (CoQ10), L-Arginine and L-Carnitine in their regimen. While some review studies have shown that antioxidants (*e.g.*, CoQ10 and Carnitine) can improve sperm motility and morphology, they did not increase pregnancy rates [27, 28]. Furthermore, some supplement components may not yield positive results; for example, L-Arginine could exacerbate varicocele in certain individuals and potentially lead to a decline in semen quality. Hence, the efficacy of supplements relies on evaluation and prescription by healthcare providers.

Similarly, traditional products/medicines, considered tonics and easily accessible without medical advice in Vietnam, can also negatively impact health. Men in our study preferred traditional medicines for their perceived safety and absence of side effects compared to modern medicines. Nevertheless, conventional medications may consist of additives and, if misused or taken excessively, could lead to toxicity in organs like the liver, kidneys and reproductive system [29, 30]. Recent practices of mixing modern and traditional medicines in unlicensed clinics have led to reports of poisoning due to inappropriate drug use. Our study indicates that unlicensed UOTPs negatively affect spermatogenesis, reducing sperm quality and increasing FSH/LH hormone levels. Thus, the use of UOTPs may interfere with spermatogenesis regulation, reducing sperm production and leading to increased FSH/LH hormone concentrations. Our findings contribute scientific evidence on the negative effects of unlicensed UOTPs on reproductive health.

There are certain constraints in this study. It is retrospective and observational in nature, thereby constraining our capacity to formulate decisive conclusions regarding causal mechanisms. Moreover, the self-reporting of lifestyle factor status introduces a potential bias. The precise quantification of alcohol intake per occasion was challenging due to the subjects' limited ability to accurately remember the alcohol concentration of the beverage and the specific quantity consumed. UOTPs were not analyzed for their components, preventing a deeper investigation of their effects on spermatogenesis. Furthermore, the study did not examine other lifestyle elements like cellphone usage and exposure to radio-frequency electromagnetic radiation, which have the potential to impact sperm quality. It is recommended that future research endeavors address these gaps and explore the correlation between lifestyle factors and sperm DNA fragmentation.

5. Conclusions

Research has shown that semen parameters are significantly inversely related to FSH and LH hormone concentrations. The indiscriminate utilization of UOTPs resulted in adverse impacts on semen parameters and led to an elevation in the levels of FSH/LH reproductive hormones. No discernible influence on semen quality and reproductive hormone concentrations was noted in relation to other lifestyle factors such as smoking, alcohol consumption or dietary supplement intake in the course of this study.

Research has demonstrated that semen parameters are significantly inversely related to FSH and LH hormone concentrations. In this study, the arbitrary use of UOTPs was found to negatively impact semen parameters and increase the concentrations of FSH and LH reproductive hormones. Nevertheless, this study found that smoking, alcohol consumption, and the intake of dietary supplements did not exhibit a noteworthy impact on semen quality or concentrations of reproductive hormones.

ABBREVIATIONS

Azoo, Azoospermia; CoQ10, Coenzyme Q10; FSH, follicle-stimulating hormone; LH, luteinizing hormone; OAT, oligoasthenoteratozoospermia; PRL, prolactin; TES, testosterone; UOTPs, unknown origin traditional products.

AVAILABILITY OF DATA AND MATERIALS

The authors declare that all data supporting the findings of this study are available within the paper and any raw data can be obtained from the corresponding author upon request.

AUTHOR CONTRIBUTIONS

TTVT and NTP—designed the research study. TTVT, HTM and LQTT—performed the research. TTVT—analyzed the data and wrote the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval was obtained from the Ethics Committee of Hanoi Obstetrics and Gynecology Hospital (IRB code IRB-VN02.030) with approval no. CS/PSHN/DC/22/29. Written informed consent was obtained from a legally authorized representative for anonymized patient information to be published in this article.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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