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Impact of cigarette smoking on semen parameters in infertile men in an African setting

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Abstract

Introduction: Infertility is a major public health issue in sub-Saharan Africa, particularly in Mali, where it represents one of the leading causes of marital discord and divorce. Male infertility has been increasingly recognized as a key determinant. This study aimed to provide local epidemiological data on sperm abnormalities among tobacco-consuming infertile men, with the goal of improving couple management and strengthening preventive strategies in our setting.

Materials and Methods: We conducted a prospective, descriptive study from January to August 2023 at the Laboratory of Cytogenetics and Reproductive Biology, University Hospital Center Point G, Bamako. All male patients who underwent semen analysis during this period and reported tobacco consumption were included; non-smokers were excluded. Data were recorded using Microsoft Word and Excel, then analyzed with SPSS software. A p-value <0.05 was considered statistically significant.

Results: The prevalence of sperm abnormalities among tobacco users was 25.6%. The mean age of patients was 41 years. The informal sector accounted for the majority of occupations (72%). A smoking duration of ≥11 years was observed in 42% of participants, and 62% reported consuming 1–5 packs of cigarettes per year. A history of schistosomiasis was present in 68% of cases. Abnormal semen parameters were detected in 80% of patients, with oligoasthénospermia being the most frequent alteration (50%). The proportion of normal semen analyses decreased with increasing daily tobacco consumption; notably, no patient consuming more than 16 packs per year had a normal semen profile.

Conclusion: Tobacco use exerts a significant deleterious effect on semen quality among infertile men in Bamako. The severity of sperm abnormalities correlates with both the duration and intensity of tobacco exposure. These findings underscore the need to promote complete smoking cessation prior to conception attempts in order to optimize male fertility and improve reproductive outcomes for couples.

Keywords: Tobacco smoking, male infertility, semen analysis, azoospermia

Introduction

Infertility is a major public health issue worldwide, particularly in sub-Saharan Africa and in Mali, where it represents one of the leading causes of marital discord and divorce. Historically, infertility was often attributed primarily to women, and male factors were under-recognized. However, current evidence demonstrates that male infertility contributes substantially to couples' reproductive challenges. Studies from France and North America estimate that male factors account for approximately 20–30% of infertility cases, a proportion that has increased significantly since the mid-20th century ^[1].

Among the risk factors identified, tobacco smoking plays a prominent role. Tobacco use has been consistently associated with impaired semen parameters, including reduced ejaculate volume, decreased sperm motility and concentration, and increased morphological abnormalities. Beyond its well-established systemic health risks, smoking thus represents a modifiable determinant of male reproductive dysfunction ^[2].

In Mali, where infertility carries a heavy social burden, local data on male infertility and its modifiable risk factors remain scarce. Generating context-specific evidence is essential to improve diagnosis, optimize clinical management, and inform preventive strategies. The present study was therefore undertaken to assess the impact of smoking on male infertility in Mali.

Materials and Methods

This was a prospective study conducted from January to August 2023 (eight months) at the *Institut National de Santé Publique* (INSP) in Bamako, Mali. A total of 50 patients were included. Semen analyses were performed using Olympus CX21 and CX41 microscopes.

Semen samples were collected either by masturbation at the laboratory after 3 to 5 days of sexual abstinence, or, when this was not feasible, at home by masturbation. In cases where masturbation was not possible, collection by coitus interruptus into a sterile, wide-mouthed polystyrene container was permitted. Prior to collection, patients were instructed to urinate to eliminate commensal urethral flora, wash their hands and glans with antibacterial and antifungal soap, and rinse with sterile physiological saline. Complete collection of the entire ejaculate was required. All male patients who underwent semen analysis at the Laboratory of Integrative Biology and Chronic Diseases, INSP Bamako, during the study period and who reported tobacco consumption were included. Patients undergoing semen analysis during the same period but who did not consume tobacco were excluded. Data were collected using a structured questionnaire. Data entry and descriptive analyses were performed with Microsoft Excel 2016. Statistical analyses were carried out using SPSS software, with a significance threshold set at $p < 0.005$. Informed consent was obtained from all participants prior to enrollment, and medical confidentiality was strictly observed.

Results

A total of 195 patients were included in our study, of whom 50 were smokers (25.64%). The mean age was 41 years (range: 23–58 years). The most represented age group was 30–39 years (56%) (Table 1). Regarding occupational status, the majority of patients were civil servants (40%), followed by traders (26.60%) and manual workers (26.60%). Concerning marital status, most patients were in a monogamous union (78%) (Table 1). A history of schistosomiasis was reported in 68% of the

patients (Figure 1). Primary infertility was the most frequent type, accounting for 62% of cases. Concerning smoking patterns, 43.3% had been smoking for more than 15 years, and 23.3% consumed between 6 and 10 packs of cigarettes per year (Table 2). Semen analysis revealed that the majority of patients presented with abnormalities: Hypospermia (30 %), Oligoasthenospermia (50 %), Azoospermia (13.30 %) (Table 3). Only 20 % of the patients had a normal semen analysis. Our study showed that the rate of normal semen parameters decreased with the number of cigarettes smoked per day. Notably, in patients consuming ≥ 16 packs per year, none had a normal semen analysis (Table 4).

Table 1: Sociodemographic characteristics of the study population

Variable	Number (n)	Percentage (%)
Age (years)		
22–31	5	16.7
32–41	15	50.0
42–51	8	26.7
52–61	2	6.6
Residence		
Bamako	23	76.7
Outside Bamako	7	23.3
Occupation		
Civil servant	12	40.0
Trader	8	26.7
Farmer	1	3.3
Student	1	3.3
Manual worker	8	26.7
Marital status		
Monogamous	26	86.7
Polygamous	4	13.3

Table 2: Distribution of patients according to smoking characteristics

Variable	Frequency	Percentage
Number of cigarette packs consumed per year		
1 – 5	15	50.0
6 – 10	7	23.3
11 – 15	6	20.0
16 – 20	2	6.7
Duration of smoking (years)		
3 – 8	12	40.0
9 – 14	5	16.7
15 – 20	13	43.3

Table 3: Distribution of patients according to type of sperm abnormalities

Variable	Frequency	Percentage
Semen volume (ml)		
< 1.5 ml	9	30.0
1.5 – 6 ml	21	70.0
Semen viscosity		
Normal	28	93.7
High	2	6.3
Sperm quality		
Normal	6	20.0
Asthenospermia	5	16.7
Oligoasthenospermia	15	50.0
Azoospermia	4	13.3

Table 4: Distribution of patients according to number of packs consumed and spermogram

Packs/year	Frequency	Azoospermia	Asthenospermia	Oligoasthenospermia	Normal
1 – 5	15	2	1	8	4
6 – 10	7	1	3	2	1
11 – 15	6	1	1	3	1
16 – 20	2	0	0	2	0
Total	30	4	5	15	6

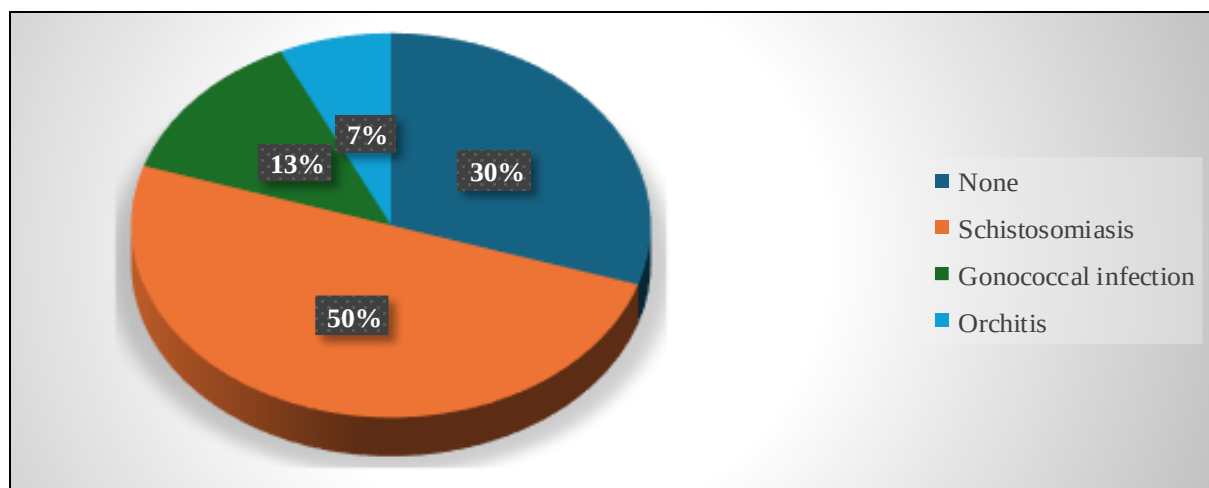


Fig 1: Répartition des patients selon les antécédents infectieux

Discussion

In our study conducted between January 1 and August 31, 2023, a total of 195 patients underwent semen analysis, of whom 50 were smokers, representing a prevalence of 25.64 %. This rate is lower than that reported by Saleh in the United States [3]. Such differences may be explained by lifestyle variations between countries. The mean age of our patients was 41 years, ranging from 23 to 58 years. The most represented age group was 32–41 years (50 %), which is comparable to the findings of Benabbou A. in Algeria in 2013, who reported 56.25 % of cases within this age group [4]. The relatively young age profile of our cohort reflects the demographic structure of Mali, where 70% of the population is under 35 years [5]. In urban and educated settings, the average age at first marriage among men ranges between 30 and 40 years [5]. This delay is generally attributed to prolonged schooling and the increasing unemployment rate among young adults. As infertility consultations usually take place after marriage, women are often the first to undergo investigations, while men tend to delay medical evaluation as long as their sexual potency remains intact. Furthermore, many patients initially turn to traditional medicine before consulting a physician. A history of schistosomiasis was reported in 68% of our patients. This high proportion can be explained by the endemic nature of the disease in Mali, where many cities are located along the Niger River, favoring transmission. Civil servants represented 40 % of the study population. This may be due to their greater awareness of male involvement in infertility and their relatively stable financial status, enabling them to bear the costs of medical evaluation. Monogamous marital status predominated (78 %), consistent with the general distribution of marital arrangements in Mali [5]. In our study, 80 % of semen analyses were abnormal. The deleterious effects of smoking on male fertility have been well documented for several decades. Tobacco smoking is a major source of exposure to toxic heavy metals such as lead and cadmium [6] as well as arsenic [7], all of which have been associated with an increased risk of male infertility [7, 8]. Zhang *et al.* [9] demonstrated that the incidence of oligo-asthenozoospermia was significantly higher among heavy smokers compared with light and moderate smokers. Similarly, the American Society for Reproductive Medicine declared in 2012 that “sperm parameters and sperm function test outcomes are 22% poorer in smokers than in non-smokers, and the effects are dose-dependent” [10]. Smoking has been shown to reduce both the quality and the quantity of spermatozoa [11]. Jeremy *et al.* [12] reported that 66% of young male smokers aged 30–40 years with erectile dysfunction were heavy smokers. Tobacco

use has thus also been implicated in male sexual dysfunction [12]. In our cohort, no normal semen analysis was observed beyond a threshold of 16 pack-years, suggesting a dose–response relationship. This finding is close to that of Sterzik *et al.* [13] in Denmark, who found that men smoking 1–10 cigarettes per day predominantly presented with normozoospermia, followed by oligozoospermia and asthenozoospermia. The mechanisms underlying tobacco-related impairment of sperm quality have been explored in several studies. Ultrastructural abnormalities, particularly involving the sperm flagellum, have been reported among heavy smokers [14, 15]. In addition, defects in the acrosome reaction [16] and capacitation [17] have been observed, both of which are crucial steps in the fertilization process. These data confirm that tobacco smoking is a major contributor to male infertility, with effects that are clearly dose-dependent.

Conclusion

The role of smoking in impairing spermatogenesis is well established, making smoking cessation one of the key lifestyle modification measures. The greater the number of cigarettes consumed and the longer the duration of smoking, the more severe the alterations in semen parameters. Our findings highlight the necessity of complete smoking cessation before any parental project.

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Conflict of Interest

Not available

Financial Support

Not available

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