Advances in Reproductive Sciences, 2026, 14(4), 189-197
https://www.scirp.org/journal/arsci
ISSN Online: 2330-0752
ISSN Print: 2330-0744

Index of Sperm DNA Fragmentation in Men Seeking Treatment for Infertility through Assisted Reproductive Technology at the Mere Enfant Hospital in Bingerville, Ivory Coast

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How to cite this paper: Tuo-Benie, W.-T.A., Yaude, S.A., Goulai Bi, Y.B.E., Oka, K.H., Touré, I., Kourouma, N., Coulibaly, Q.D., Agossou, P.I., Bouatinin, M.O. and Yao, G.V. (2026) Index of Sperm DNA Fragmentation in Men Seeking Treatment for Infertility through Assisted Reproductive Technology at the Mere Enfant Hospital in Bingerville, Ivory Coast. *Advances in Reproductive Sciences*, **14**, 189-197.
https://doi.org/10.4236/arsci.2026.144018

Received: September 10, 2026
Accepted: October 31, 2026
Published: November 3, 2026

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Abstract

Background: Infertility is a public health issue that affects 14% of the Ivorian population. Male infertility accounts for one-third of the causes of infertility in couples. Routine diagnosis relies on a semen analysis, which alone appears insufficient to determine the genetic causes. Thus, the use of much more sensitive tests, such as the sperm DNA fragmentation test, allows for the assessment of sperm DNA integrity, especially in men over the age of 40. **The objective** of this study is to determine the level of sperm DNA fragmentation in men undergoing assisted reproductive technology (ART) and to evaluate the correlation between sperm DNA fragmentation and the sperm parameters of these men. **Methodology:** A prospective, descriptive, and analytical study was conducted over a 10-month period from February 3 to December 5, 2025, involving all men enrolled in an assisted reproductive technology (ART) program at the time of our study at the fertility center of the Bingerville Mother and Child Hospital. Semen analysis was performed according to the 2021 WHO recommendations. Sperm DNA fragmentation was assessed using the SCD test with the Halosperm kit. As a reference, fragmentation indices below 15% are considered normal, rates between 15% and 30% are considered moderate, and those above 30% are considered severe. **Results:** The study included a total of 132 patients with a mean age of 47.31 ± 8.9 years. The high mean age

in this cohort could be explained by the fact that patients were recruited through assisted reproductive technology (ART) programs, which require substantial financial resources, thereby limiting access for less affluent individuals—who are often younger. Urogenital infections accounted for infertility in 39.39% of cases, in addition to factors related to tobacco use (22%) and alcohol consumption (14.54%). Morphological abnormalities were primarily characterized by teratozoospermia in 49% of cases. Regarding the fragmentation rate, 22.73% of patients had severe DNA fragmentation (>30%). Furthermore, 32.58% had moderate fragmentation (15% - 30%). However, a significant association was observed between progressive motility, severe abnormalities in the sperm cytogram, and the rate of sperm DNA fragmentation, with various p-values < 0.05. **Conclusion:** A semen analysis/sperm cytogram alone is insufficient to determine the etiology of male infertility. Sperm DNA fragmentation may negatively impact fertilization.

Keywords

Male Infertility, Semen Analysis, Sperm Morphology Analysis, SCD Test, Sperm DNA Fragmentation, Medically Assisted Reproduction, Ivory Coast

1. Introduction

Male infertility is a major cause for concern, as male factors account for approximately 50% of cases among the 15% of infertile couples of reproductive age [1]. In Africa, the prevalence varies from one region to another and is estimated to range between 15 and 30% [2]. In Côte d'Ivoire, it is estimated to be around 14% [3].

The frequency of infertility among couples, as well as its effects on quality of life, makes it a genuine public health problem affecting both men and women. Many couples facing this challenge turn to assisted reproductive technologies (ART). However, the increasing failure rate of these ART techniques suggests the presence of molecular abnormalities.

Indeed, a defect in DNA condensation during spermatogenesis, as well as high levels of sperm DNA fragmentation (SDF), contributes significantly to male infertility [4]. The limitations of conventional methods particularly the semen analysis in predicting pregnancy outcomes following assisted reproductive technology (ART) necessitate the use of other diagnostic tools for determining the underlying cause of cases not identified by semen analysis, namely cases of unexplained or idiopathic infertility. It is in this context that the sperm DNA fragmentation test is essential to address the limitations of the semen analysis, particularly in the context of assisted reproductive technology. This test provides information on the quality of sperm DNA. It has significant diagnostic and prognostic value in the management of male infertility [5].

The objective of this study is to determine the level of sperm DNA fragmentation in men undergoing ART and to evaluate the correlation between sperm DNA

fragmentation and the sperm parameters of these men.

2. Methodology

This was a prospective, descriptive, and analytical study conducted over a 10-month period from February to December 2025 at the Bingerville Mother and Child Hospital.

Convenience sampling was used, resulting in the initial selection of 205 patients. Included in this study were patients aged 30 years and older who provided their free and informed consent and had a semen analysis result that allowed for the fragmentation test to be performed. Those who did not participate in this study (47 patients) as well as patients with semen analysis results that precluded the fragmentation test (26 patients), (azoospermia, severe cryptozoospermia, or severe oligozoospermia) were not included in this study. This allowed us to select 132 men consecutively enrolled in assisted reproductive technology (ART) cycles. They presented with at least one of the following factors:

- Unexplained infertility
- Varicocele
- Recurrent miscarriages
- Unexplained ART failure,
- Men aged 30 years and older,
- Suspected environmental factors (alcohol, tobacco, etc.)

2.1. Laboratory Procedure

Semen collection was performed after 2 to 5 days of sexual abstinence via masturbation in the laboratory.

The semen analysis was performed according to 2021 WHO standards. Concentration and motility were assessed using a Makler counting chamber (Sefi Medical Instruments, Haifa, Israel).

The sperm cytogram was obtained using the RAL kit for the study of sperm morphology, according to the strict Kruger criteria [6].

Sperm DNA fragmentation was determined using the chromatin dispersion test, abbreviated as SCD (Sperm Chromatin Dispersion), also known as the halo test. Fragmentation indices below 15% are considered normal; rates between 15 and 30% are considered moderate; and those above 30% are considered severe. This technique is easy to use, inexpensive, and does not require heavy laboratory equipment. It allows for the analysis of chromatin dispersion under a bright-field optical microscope.

2.2. Data Analysis

The data were entered using Microsoft Excel 2007. Data analysis was performed using EpiInfo 7.2. Qualitative variables were compared using the chi-square test, and quantitative variables were compared using the Mann-Whitney test. A multivariate binary logistic regression was performed to identify factors associated

with high (moderate to severe: >15%) sperm DNA fragmentation. Adjusted odds ratios (OR) were estimated along with their 95% confidence intervals, and statistical significance was assessed using the chi-square test.

2.3. Ethical Considerations

We obtained approval from the administrative authorities of the healthcare facility (Authorization No. 03/09/2025), as well as informed consent from the participants, strictly ensuring anonymity.

3. Results

3.1. Epidemiological and Clinical Profile of Patients

In our study, the most represented age group was between 40 and 50 years, with a mean age of 47.31 years and a range from 30 to 70 years.

Medical history was characterized by urogenital infections (39%), followed by tobacco use (22%) and alcohol consumption (14.54%). For 53.71% of the participants, the desire to become a father had been present for more than two years.

3.2. Semen Analysis Profile of Patients

Abnormalities in the semen analysis primarily involved ejaculate volume and motility, particularly progressive motility, in 81% and 52% of cases, respectively. The sperm cytogram was abnormal in 72% of cases. Morphological abnormalities were predominantly characterized by teratozoospermia in 49% of cases, followed by asthenoteratozoospermia (8%), oligoasthenozoospermia (5%), and asthenozoospermia (4%) (Table 1).

Table 1. Breakdown of patients according to semen analysis/sperm cytogram parameters.

Semen analysis parameters	Headcount (n)	Percentage
Normal	**37**	**28**
Tératozoospermia	**65**	**49**
Asthénotératozoospermia	11	8
Oligoasthénotératozoospermia	6	5
Asthénozoospermia	5	4
Nécrozoospermia	5	4
Oligozoospermia	3	2
Total	132	100

3.3. Factors Associated with High Sperm DNA Fragmentation in Patients

Regarding the sperm DNA fragmentation index, 74 patients had a high fragmen-

tation index that is, moderate to severe fragmentation (>15%) representing 55.31% of the patients. These patients were distributed as follows: 22.73% of patients had severe DNA fragmentation (>30%). Additionally, 32.58% had moderate fragmentation (15% - 30%) (Figure 1).

The Mann-Whitney test was used to compare age with different values of the fragmentation index. Patients older than 50 years had a mean fragmentation index of 33.7%. Thus, age was associated with a high risk of DNA fragmentation, with p = 0.03 (Table 2).

Patients with abnormal semen analysis results had a high (severe or moderate) fragmentation index in 77% of cases. Table 3 shows a comparison between semen analysis parameters, sperm cytogram findings, and sperm DNA fragmentation.

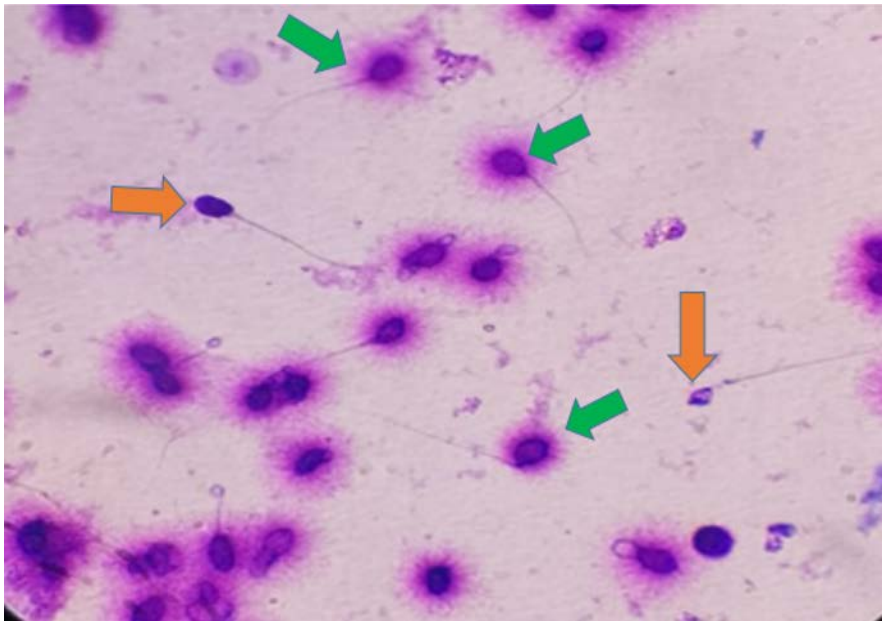


Figure 1. Halosperm, Halotech DNA, SL, Madrid, Spain/SCD: spermatozoa with intact DNA, indicated by green arrows. Orange arrows: spermatozoa with fragmented DNA.

Table 2. Correlation between age and sperm DNA fragmentation.

	DNA fragmentation range			
AGE GROUP	<15 (NORMAL)	15% - 30% (MODERATE)	>30 (SEVERE)	p
>=70	0	0	1	
30 - 39	10	14	4	
40 - 49	30	12	9	0.03
50 - 59	16	14	10	
60 - 69	3	3	6	
TOTAL	59	43	30	

Table 3. Comparative table of factors associated with high (moderate to severe: >15%) sperm DNA fragmentation.

Sperm DNA fragmentation (>15%)			
Variable	**Adjusted OR**	**CI 95%**	**p-value**
Sperm concentration			
B N ≥ 15,000,000	0.72	0.22 - 2.35	0.60
Gradual mobility			
<32% (Asthenozoospermia)	2.85	1.10 - 7.20	**0.03**
Semen analysis			
Pathological	1.70	0.75 - 3.90	0.19
Sperm cytogram			
Teratozoospermia	2.40	0.90 - 6.30	0.07
Asthenozoospermia	3.10	1.05 - 9.10	**0.04**
Asthenoteratozoospermia	3.80	1.10 - 13.0	**0.03**
Necrozoospermia	4.20	1.20 - 14.5	**0.02**

$p < 0.05$: significative.

4. Discussion

The mean age of the patients was 47.31 years, with ages ranging from 30 to 70 years. The high mean age in the study population could be explained by the fact that the patients were all recruited through assisted reproductive technology (ART). Because this treatment requires substantial financial resources, access is limited for less affluent individuals, who are often younger. Indeed, recent studies showing a decline in fertility after age 40 indicate that this age group (40 to 50 years) accounts for 25% of men who undergo assisted reproductive technology (ART) treatments with their partners [7]. Furthermore, patients over the age of 50 have a high fragmentation index (>15%), with an average of 33.7%. Similarly, a significant association was found between age and the DNA fragmentation rate, with $p = 0.03$. This correlation ($p = 0.03$) confirms the decline in semen quality associated with paternal age. Indeed, cellular aging is accompanied by an increase in alterations to sperm chromatin, which can directly impact natural fertility and success rates in assisted reproductive technology (ART). A study conducted in 2023 demonstrates a marked effect of the combination of advanced male age and impaired sperm DNA fragmentation. Indeed, in their study of a sample of 300 individuals, patients over the age of 35 had a significantly higher fragmentation index than the younger group [8]. Urogenital infections (39%), followed by tobacco and alcohol use (36.54%), were the most common factors in these patients' medical histories. These infections, along with environmental factors, are known

to play a role in the mechanisms of sperm DNA fragmentation [9].

4.1. Sperm Analysis Results

Abnormalities in the semen analysis primarily concerned ejaculate volume and motility, particularly progressive motility, in 81% and 52% of cases, respectively. As for the sperm cytogram, it was abnormal in 72% of cases. Morphological abnormalities were predominantly characterized by teratozoospermia in 49% of cases, followed by asthenoteratozoospermia (8%), oligoasthenozoospermia (5%), and asthenozoospermia (4%). Nevertheless, data from the literature suggest that conventional sperm parameters namely, sperm concentration, motility, and morphology—while serving as the primary tools for assessing male fertility, remain limited and insufficient for predicting sperm functional capacity in the context of diagnosing the causes of male infertility [10].

Furthermore, successful reproduction depends on a key factor: the integrity of sperm DNA. This factor influences not only fertilization but also embryonic development and the ability to carry a pregnancy to term [11].

4.2. Sperm DNA Fragmentation Index

Regarding the sperm DNA fragmentation index, 74 patients had moderate to severe fragmentation, representing 55.31% of the patients. Patients with abnormal semen analysis results predominantly had an abnormal fragmentation index, although the association was not statistically significant ($p = 0.19$; **Table 2**). A study conducted in 2026 found similar results, with a significant link between abnormal semen analysis results and impaired sperm DNA in 1784 patients undergoing assisted reproductive technology (ART) [12]. Furthermore, men with oligozoospermia had a significantly higher DNA fragmentation index than those with normozoospermia, according to a study conducted in 2023 [4]. Additionally, according to the author, embryos derived from sperm with a high fragmentation index did not have a favorable outcome.

5. Conclusion

A semen analysis alone is insufficient to determine the cause of male infertility. Sperm DNA fragmentation can have a negative impact on sperm fertility. The sperm DNA fragmentation test revealed sperm DNA alterations even in men with normal semen analysis results. Outcomes related to fertilization, embryonic development, pregnancy, and live births were not measured in this cohort.

Author Contributions

TUO-BENIE Wako-Tianwa Alice, Writing original draft; YAUDE Sadia Alfred data curation, GOULAI BI You Bazago Etienne and TOURE I1, Formal Analysis; KOUROUMA Noumoutie, data curation; OKA Kouassi Hubert, Formal Analysis; COULIBALY Quidana Desiree, Conceptualization; AGOSSOU Philippe Irenee, Conceptualization; BOUATININ Mimbra Olivia, Formal Analysis; YAO Gnan-

goran Victor, Validation and supervision.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Frikh, M., Benaissa, M., Kasouati, J., Benlahlou, Y., Chokairi, O., Barkiyou, M., *et al.* (2021) Prévalence De L'infertilité Masculine Dans Un Hôpital Universitaire Au Maroc. *Pan African Medical Journal*, **38**, Article No. 46. https://doi.org/10.11604/pamj.2021.38.46.19633

[2] Bonnet, D. (2023) Quand La Stérilité Interroge La Nature Des Liens Familiaux. Hommage À Suzanne Lallemand. *Journal des Africanistes*, **93**, 180-203. https://doi.org/10.4000/11tek

[3] Dia, J.M., Yao, I., Guié, P., Bohoussou, E., Nguessan, E., Oyelade, M., Allah, F., *et al.* (2016) Epidemiological and Etiological Aspects of Infertile Couples in Abidjan. *Revue Internationale des Sciences Médicales d' Abidjan*, **18**, 22-26.

[4] Andrabi, S.W., Ara, A., Saharan, A., Jaffar, M., Gugnani, N. and Esteves, S.C. (2023) Sperm DNA Fragmentation: Causes, Evaluation and Management in Male Infertility. *JBRA Assisted Reproduction*, **28**, 306-319. https://doi.org/10.5935/1518-0557.20230076

[5] Zhang, Z., Zhu, L., Jiang, H., Chen, H., Chen, Y. and Dai, Y. (2015) Sperm DNA Fragmentation Index and Pregnancy Outcome after IVF or ICSI: A Meta-Analysis. *Journal of Assisted Reproduction and Genetics*, **32**, 17-26.

[6] Agarwal, A., Sharma, R., Gupta, S., Finelli, R., Parekh, N., Panner Selvam, M.K., *et al.* (2022) Sperm Morphology Assessment in the Era of Intracytoplasmic Sperm Injection: Reliable Results Require Focus on Standardization, Quality Control, and Training. *The World Journal of Men's Health*, **40**, 347-360. https://doi.org/10.5534/wjmh.210054

[7] Martínez, E., Bezazián, C., Bezazián, A., Lindl, K., Peliquero, A., Cattaneo, A., *et al.* (2021) Sperm DNA Fragmentation and Male Age: Results of *in Vitro* Fertilization Treatments. *JBRA Assisted Reproduction*, **25**, 533-539. https://doi.org/10.5935/1518-0557.20210018

[8] Kaltsas, A., Zikopoulos, A., Vrachnis, D., Skentou, C., Symeonidis, E.N., Dimitriadis, F., *et al.* (2024) Advanced Paternal Age in Focus: Unraveling Its Influence on Assisted Reproductive Technology Outcomes. *Journal of Clinical Medicine*, **13**, Article No. 2731. https://doi.org/10.3390/jcm13102731

[9] Esteves, S.C., Zini, A., Coward, R.M., Evenson, D.P., Gosálvez, J., Lewis, S.E.M., *et al.* (2021) Sperm DNA Fragmentation Testing: Summary Evidence and Clinical Practice Recommendations. *Andrologia*, **53**, Article No. 13874. https://doi.org/10.1111/and.13874

[10] Wan, B., Fu, Y., Ma, N., Zhou, Z. and Lu, W. (2026) Sperm DNA Fragmentation and Assisted Reproduction: An Umbrella Meta-Analysis. *European Journal of Medical Research*, **31**, Article No. 218. https://doi.org/10.1186/s40001-025-03801-y

[11] Borges, E., Zanetti, B.F., Setti, A.S., Braga, D.P.d.A.F., Provenza, R.R. and Iaconelli, A. (2019) Sperm DNA Fragmentation Is Correlated with Poor Embryo Development, Lower Implantation Rate, and Higher Miscarriage Rate in Reproductive Cycles of Non-Male Factor Infertility. *Fertility and Sterility*, **112**, 483-490. https://doi.org/10.1016/j.fertnstert.2019.04.029

[12] Wei, C., Liang, Q., Liu, D., Yu, Y., Wei, Y., Li, Y., *et al.* (2026) Association of Sperm DNA Fragmentation Index with Semen Quality and ART Outcomes: Real-World Evidence from a Retrospective Cohort. *Basic and Clinical Andrology*, **36**, Article No. 9. https://doi.org/10.1186/s12610-026-00308-2

List of Abbreviations

ART	Assisted Reproductive Technology
CI	Confidence Interval
DFI	*DNA Fragmentation Index*
DNA	Deoxyribonucleic Acid
EPHN	Établissement Public Hospitalier National
MAR	Medically Assisted Reproduction
OR	Odds Ratio
WHO	World Health Organization
SCD	Sperm Chromatin Dispersion
SDF	Sperm DNA Fragmentation
UFHB	Felix Houphouët-Boigny University
UFR	Training and Research Unit