

The Possible Harms of Tobacco Use on the Reproductive System: A review

Mudather Elnoor Younis, Alnazeer Omer Yagoup

Faculty of medical laboratory science, El-Daein University

mudthereelnoo@yahoo.com

Abstract: *This review aims to quantify the possible harm that tobacco use may do to one's reproductive system. A comprehensive literature search was conducted using the Google Scholar, Pub Med, Research Gate, Frontiers, and Scopus databases; studies that could be pertinent to this review were discovered. We chose studies that illustrated how smoking tobacco might affect one's ability to conceive. The use of tobacco is still prevalent in Sudan in a variety of forms, primarily as smokeless tobacco and cigarette smoking. Toombak dipping, shisha, and cigarette smoking are all patterns of tobacco utilization, as well as combined patterns. The prevalence of tobacco use among adolescents and adults is between 1-25% and 10-47.5 percent, respectively, indicating the need for intervention programs to enhance decreasing this high prevalence. Numerous studies have reported that the contents of cigarette smoke negatively affect sperm parameters, seminal plasma. However, it's unclear how smoking actually affects male fertility. Based on the well-established scientific observation that smoking increases the presence of reactive oxygen species, which in turn causes oxidative stress (OS), smoking has an effect on semen parameters. Male fertility is decreased by OS because it damages sperm characteristics like viability and morphology and inhibits sperm function. According to a meta-analysis, Sudan's pooled prevalence rates for primary, secondary, and overall infertility were 13%, 65%, and 35%, respectively. Infertility in Sudan was mostly caused by female factors. The findings also show that there are many unaccounted-for influences. In Sudan, Polycystic ovary syndrome (PCOS) and azoospermia are the most common causes of infertility in women and men, respectively.*

Introduction:

In order to taste and absorb the smoke into one's bloodstream, smoking involves burning a material and then inhaling the ensuing smoke. The material most frequently used is dried tobacco leaves, which are rolled into an extended cylinder known as a cigarette using a tiny piece of paper. ^[1] Using a bong or a smoking pipe are examples of alternative smoking methods. With the tobacco pandemic killing approximately 8 million people year worldwide, it is one of the worst risks to public health that the world has ever faced. Of those deaths, almost 7 million are directly related to tobacco use, and about 1.3 million are related to non-smokers being exposed to. ^[2] There is no safe amount of tobacco exposure, and all tobacco usage is dangerous. In the world, smoking cigarettes is the most prevalent way to use tobacco. Cigars, cigarillos, hot tobacco, roll-your-own tobacco, pipe tobacco, bidis and kreteks, and smokeless tobacco products are examples of further tobacco products. The majority of the 1.3 billion tobacco users globally—about 80%—live in low- and middle-income nations, which bear the brunt of the disease and mortality caused by tobacco use. Because tobacco smoking takes money away from fundamental necessities like food and shelter, it contributes to poverty. Because tobacco is so addicting, it is tough to stop this spending behavior.

The economic consequences of tobacco use are enormous and include high medical expenses for treating the diseases brought on by tobacco use as well as the lost human capital as a result of morbidity and death linked to tobacco use. ^[2] The WHO global report on trends in prevalence of tobacco use 2000–2025, third edition, states that overall global tobacco usage has decreased over the nearly two decades, from 1.397 billion in 2000 to 1.337 billion in 2018, or by around 60 million individuals. ^[3] In 2020, 18.6% of people in the Eastern Mediterranean Region will have used tobacco, with 33.3% of men and 3.9% of women using tobacco, respectively. ^[4,5] Therefore, as recommended by the Framework Convention on Tobacco Control, preventive measures should be implemented. ^[6] Smoking tobacco cigarettes has a harmful impact on the body's vital metabolic processes. ^[7] When tobacco is burned at the tip, heated air passes through unburned tobacco, releasing nicotine and other substances that are known to be cytotoxic, antigenic, mutagenic, or carcinogenic. These substances include tobacco glycoprotein, polycyclic aromatic hydrocarbons, and certain metals. The smoker inhales these particles, which quickly deposit and absorb into the bloodstream. ^[8,9] Smoking tobacco cigarettes has a harmful impact on the body's vital metabolic processes. ^[8] When tobacco is burned at the tip, heated air passes through unburned tobacco, releasing nicotine and other substances that are known to be cytotoxic, antigenic, mutagenic, or carcinogenic. These substances include tobacco glycoprotein, polycyclic aromatic hydrocarbons, and certain metals. The smoker inhales these particles, which quickly deposit and absorb into the bloodstream. ^[9-10] Snuffing smokeless tobacco primarily increases the risk of mouth cancer and cavity inflammation. ^[9] Cigarette smoking (CS) is regarded as a leading preventable cause of morbidity and mortality worldwide [8]. the primary modifiable risk factor for the development of cardiovascular disease, respiratory disorders, periodontal diseases, and several forms of cancer. ^[11] The majority of research on the role that tobacco use plays in the pathophysiology of numerous systemic illnesses, including immune system, cardiovascular, respiratory, and various cancers, has been done on smokers. ^[9] Before 1940, smoking was uncommon in Sudan; it only started to gain popularity in the 1990s. ^[12] Africa's two countries with the highest cigarette consumption between the middle of the 1960s and the middle of the 1970s were Sudan and Somalia, whereas Britain is the world's top cigarette

airlifter. ^[13] Sudanese people consume tobacco in the form of cigarettes, water pipes (Shisha), and Toombak, a smokeless variety of tobacco that is made locally from moistened fermented tobacco leaves combined with sodium carbonate. ^[14] The literature on the possible harms of tobacco use to reproductive health is reviewed in this paper.

The dangers of smoking during pregnancy

The health of both the mother and the unborn child is at risk due to maternal smoking and secondhand smoke exposure. Because their moms smoke, over 400,000 newborns in the US are exposed to cigarette smoke's harmful ingredients before to delivery each year. Since the first Surgeon General's Report on smoking and health was published in 1964, exposure to the harmful compounds in tobacco smoke has resulted in 100,000 baby deaths from SIDS, preterm, low birth weight, and other issues. The following are some of the ways that smoking impacts a pregnancy's health and fertility. ^[15] When a couple engages in regular unprotected intercourse yet is unable to conceive, this condition is known as infertility. The global impact of not being able to have children is felt by both men and women. In addition to prejudice and exclusion, infertility can result in anguish and sadness. The existence of both male and female components complicates any approximation that may solely address the woman and the outcome of a pregnancy diagnosis or live delivery, making it difficult to determine universal infertility prevalence statistics. In a recent study, 60.84% of the participants were primary infertile women from Sudanese women with infertility issues who visited the Banoon Center of Obstetrics and Gynecology for assisted reproduction. ^[16]

Smoking and Semen Quality

Of all the World Health Organization (WHO) regions, Europe has the highest tobacco usage rate at 37% of men who are of reproductive age. The formation and function of sperm may be impacted by tobacco smoke toxins, which could have a detrimental impact on semen parameters. Considering the high rate of smoking and the most recent modifications to the WHO laboratory protocols for the analysis of human semen. ^[17] About 4000 chemical compounds are produced when tobacco is burned, and smokers breathe in a variety of carcinogens such as nicotine, carbon monoxide, cadmium, and other mutagenic substances that may be harmful to male germ cells. ^[18] Toxins from cigarette smoke can alter the chromatin structure and reduce the mitochondrial activity of human sperm, which can hinder fertilization in vitro and in vivo. ^[19, 20] The characteristics of sperm that are most commonly utilized in clinical settings to evaluate fertility—motility, concentration, and morphology—have been linked to a decline in quality when smoking cigarettes. ^[21–23] Nevertheless, there is conflicting data, with other research finding no impact on semen quality. ^[24–26] In Sudan, the combined prevalence of infertility factors was 41%, 27%, 16%, and 17% for female, male, combined factors, and unexplained factors, respectively. The pooled prevalence of overall infertility, primary infertility, and secondary infertility were 13% (I² ¼ 96.45, p, 0.001), 65% (I² ¼ 98.5, p, 0.001), and 35% (I² ¼ 98.5, p, 0.001), respectively. Ovulatory disorders (polycystic ovarian syndrome, 38%) and ovulatory factors (36%) accounted for 36% of the infertile women in the sample. In contrast, the primary causes of male infertility were spermatid abnormalities, specifically azoospermia (37%), oligozoospermia (30%), and asthenozoospermia (30%). ^[27, 28, 29] Compared to secondary infertility, primary infertility is more common in Sudan. According to this study, a significant frequency of unexplained variables contributed to infertility in Sudan, with female factors being the most common causes. In Sudan, azoospermia and polycystic ovarian disease were the most frequent causes of infertility in men and women, respectively. There is significant heterogeneity among the included research, which should be taken into account when interpreting these results. ^[30] Moreover, smoking contributes to erectile dysfunction (ED), a disorder that now affects 18 million males in the United States over the age of 20. The inability to sustain an erection strong enough for satisfying sexual performance is known as ED, and it can have an impact on reproduction. Smoking interferes with the normal function of blood vessels in erectile tissue and changes the blood flow required for an erection. While the precise number of smokers who may experience reproductive difficulties as a result of their smoking is unknown, smoking can be harmful to one's capacity to conceive, to a safe and healthy pregnancy, and to the health of both the mother and the child. Your reproductive health can improve if you stop smoking. ^[31] Three studies on semen volume. ^[32–34] assessed the impact of smoking on semen volume. Volume was shown to be lower in heavy smokers (REM MD: 0.77 ml; 95% CI, 0.96 to 0.58; p < 0.001) and moderate smokers (REM MD: 0.32 ml; 95% CI, 0.62 to 0.02; p = 0.04) compared to nonsmokers, according to pooled data. Supplementary Fig. 10 revealed that light smokers had greater volumes than moderate and heavy smokers (p = 0.001). 3.3.2. Four studies on sperm counts. ^[32–35] compared the effects of cigarette consumption on sperm count. The pooled results showed that counts were significantly lower in moderate smokers (REM MD: -9.93; 95% CI, 18.04 to 1.82; p = 0.02) and heavy smokers (REM MD: 28.06; 95% CI, 42.27 to 8.86; p = 0.004) than in nonsmokers. The effect size was more pronounced in heavy smokers than in moderate smokers (p = 0.0003). 3.3.3. Sperm motility three studies. ^[33–35] reported the effects of cigarette consumption on sperm motility. The pooled results indicated that motility was decreased by moderate smoking (REM MD: 3.98%; 95% CI, 6.84 to 1.11; p < 0.006) and heavy smoking (REM MD: 4.62%; 95% CI, 11.08 to 1.84), albeit not significantly different in the latter. Sperm motility was higher in mild smokers than in moderate and heavy smokers (REM MD: 4.14%; 95% CI, 1.03–7.25; p < 0.01). 3.3.4. Sperm morphology two studies. ^[33, 34] reported the effects of cigarette consumption on sperm morphology. The pooled results showed that morphology was decreased by mild smoking (FEM MD: 0.9%; 95% CI, 1.68 to 0.12; p = 0.02), moderate smoking (MD: 2.47%; 95% CI, 3.31 to 1.64; p < 0.001), and heavy smoking (MD: 4.24%; 95% CI, 5.02 to 3.46; p < 0.001). The higher the cigarette consumption, the higher the magnitude of the effect size (p < 0.0001). Overall, these

findings suggest that female smokers may have lower amounts of antimullerian hormone and higher levels of progesterone when compared to their friends who do not smoke. Estradiol levels appeared to be related to weight, menopausal state, and smoking status; premenopausal smokers had much lower levels, while overweight postmenopausal smokers had significantly greater levels when compared to non-smokers. Thankfully, sex hormones can quickly revert to levels seen in never-smokers: research showed no variations in sex hormone levels between never-smokers and former smokers as little as a year after quitting. ^[36]

Method

A comprehensive literature search was conducted using the Google Scholar, Pub Med, Research Gate, Frontiers, and Scopus databases; studies that could be pertinent to this review were discovered. We chose studies that illustrated how smoking tobacco might affect one's ability to conceive.

Conclusion and Discussion

It has been discovered that tobacco use generally has a detrimental effect on human health. There are scars in Sudan when it comes to data on this topic, and not many studies have been released. It was discovered that smoking cigarettes was a substantial risk factor for lower semen parameters in adult males. It is necessary to conduct studies on subcellular sperm damage, such as oxidative stress markers and sperm DNA integrity, which are not evaluated in traditional semen analysis. This would increase the accuracy of the estimated impact sizes and enable a more accurate assessment of the data's potential therapeutic significance. In Sudan, all forms of tobacco use are practiced, including combination forms such as shisha, Toombak dipping, and cigarette smoking. The prevalence of tobacco use in adults and adolescents ranges between 10–47.5% and 1–25%, respectively, suggesting the need for intervention initiatives to lower this high prevalence. When it comes to the quality and function of semen, smoking affects fertile men more than it does infertile men. A possible explanation for this is compromised semen parameters. ^[37] Moreover, smoking contributes to erectile dysfunction (ED), a disorder that now affects 18 million males in the United States over the age of 20. The inability to sustain an erection strong enough for satisfying sexual performance is known as ED, and it can have an impact on reproduction. Smoking interferes with the normal function of blood vessels in erectile tissue and changes the blood flow required for an erection. ^[31] Compared to men who are subfertile, smokers have a greater detectable impact on the quality and function of their semen. This could be explained by decreased spermatozoa function at the primary level and semen parameters in the infertile population. ^[38] Smoking has a bidirectional interaction with a number of variables (such as mood and sex hormones); these relationships differ according to gender and may eventually make it more difficult for a person to quit smoking. ^[39] According to the findings of a meta-analysis, Sudan had pooled prevalence rates of 13%, 65%, and 35% for overall infertility, primary infertility, and secondary infertility, respectively. Infertility in Sudan was mostly caused by female factors. The findings also show that there are many unaccounted-for influences. In Sudan, polycystic ovary syndrome {PCOS} and azoospermia are the most common causes of infertility in women and men, respectively. ^[30]

References

1. Tobacco [Internet]. Who.int. [cited 2023 Oct 18]. Available from: <https://www.who.int/en/news-room/fact-sheets/detail/>.
2. Tobacco [Internet]. Who.int. [cited 2023 Oct 18]. Available from: <https://www.who.int/news-room/fact-sheets/detail/tobacco>.
3. WHO launches new report on global tobacco use trends [Internet]. Who.int. [cited 2023 Oct 18]. Available from: <https://www.who.int/news/item/19-12-2019-who-launches-new-report-on-global-tobacco-use-trends>
4. Tobacco N. WHO global report on trends in prevalence of tobacco use 2000-2025, fourth edition [Internet]. Who.int. World Health Organization; 2021 [cited 2023 Oct 18]. Available from: <https://www.who.int/publications/i/item/9789240039322>
5. Elgoni HE, Mohammed M. Tobacco use in Sudan: Prevalence, patterns, and determinants – A systematic review. Saudi J Health Syst Res [Internet]. 2021;2(1):1–8. Available from: <http://dx.doi.org/10.1159/000520425>
6. WHO Framework Convention on Tobacco Control overview [Internet]. Who.int. [cited 2023 Oct 18]. Available from: <https://fctc.who.int/who-fctc/overview>.
7. Mohamed Bartal; Tobacco, smoking, smokeless tobacco, health effects, Department of Respiratory Diseases. Casablanca, Morocco; 2001.
8. Home [Internet]. Saudijournals.com. [cited 2023 Oct 18]. Available from: <https://saudijournals.com>
9. van der Vaart H, Postma DS, Timens W, ten Hacken NHT. Acute effects of cigarette smoke on inflammation and oxidative stress: a review. Thorax [Internet]. 2004;59(8):713–21. Available from: <http://dx.doi.org/10.1136/thx.2003.012468>
10. Sopori ML, Razani-Boroujerdi S, Singh SP. Immunomodulatory effects of cigarette smoke/nicotine. In: Infectious Agents and Pathogenesis. New York: Springer-Verlag; 2006. p. 103–9.

11. He H, Pan Z, Wu J, Hu C, Bai L, Lyu J. Health effects of tobacco at the global, regional, and national levels: Results from the 2019 Global Burden of disease study. *Nicotine Tob Res* [Internet]. 2022;24(6):864–70. Available from: <http://dx.doi.org/10.1093/ntr/ntab265>.
12. Idris AM, Ibrahim YE, Warnakulasuriya KA, Cooper DJ, Johnson NW, Nilsen R. Toombak use and cigarette smoking in the Sudan: estimates of prevalence in the Nile state. *Prev Med* [Internet]. 1998;27(4):597–603. Available from: <http://dx.doi.org/10.1006/pmed.1998.0331>.
13. Taha A, Ball K. Smoking and Africa: the coming epidemic. *Br Med J* [Internet]. 1980;280(6219):991–3. Available from: <http://dx.doi.org/10.1136/bmj.280.6219.991>
14. Idris AM, Ibrahim SO, Vasstrand EN, Johannessen AC, Lillehaug JR, Magnusson B, et al. The Swedish snus and the Sudanese toombak: are they different? *Oral Oncol* [Internet]. 1998;34(6):558–66. Available from: [http://dx.doi.org/10.1016/s1368-8375\(98\)00047-5](http://dx.doi.org/10.1016/s1368-8375(98)00047-5).
15. SMOKING AND REPRODUCTION [Internet]. Cdc.gov. [cited 2023 Oct 18]. Available from: https://www.cdc.gov/tobacco/data_statistics/sgr/50th-anniversary/pdfs/fs_smoking_reproduction_508.pdf
16. Hussein MOMM. I Mohammed A Gafoor A Gadir, I Mosab Nouraldein Mohammed Hamad2 Prevalence of primary infertility among selected group of Sudanese women with infertility disorders. 8:1–2019.
17. Cigarette Smoking and Semen Quality: A New Meta-analysis Examining the Effect of the 2010 World Health Organization Laboratory Methods for the Examination of Human Semen Reecha Sharma a. Avi Harlev b,c , Ashok Agarwal c, *, Sandro C. Esteves d;
18. Zenzes MT. Smoking and reproduction: gene damage to human gametes and embryos. *Hum Reprod Update* [Internet]. 2000;6(2):122–31. Available from: <http://dx.doi.org/10.1093/humupd/6.2.122>
19. Sharma R, Biedenharn KR, Fedor JM, Agarwal A. Lifestyle factors and reproductive health: taking control of your fertility. *Reprod Biol Endocrinol* [Internet]. 2013;11(1):66. Available from: <http://dx.doi.org/10.1186/1477-7827-11-66>.
20. Calogero A, Polosa R, Perdichizzi A, Guarino F, Vignera SL, Scarfia A, et al. Cigarette smoke extract immobilizes human spermatozoa and induces sperm apoptosis. *Reprod Biomed Online* [Internet]. 2009;19(4):564–71. Available from: <http://dx.doi.org/10.1016/j.rbmo.2009.05.004>.
21. Künzle R, Mueller MD, Hänggi W, Birkhäuser MH, Drescher H, Bersinger NA. Semen quality of male smokers and nonsmokers in infertile couples. *Fertil Steril* [Internet]. 2003;79(2):287–91. Available from: [http://dx.doi.org/10.1016/s0015-0282\(02\)04664-2](http://dx.doi.org/10.1016/s0015-0282(02)04664-2).
22. Ozgur K, Isikoglu M, Seleker M, Donmez L. Semen quality of smoking and non-smoking men in infertile couples in a Turkish population. *Arch Gynecol Obstet* [Internet]. 2005;271(2):109–12. Available from: <http://dx.doi.org/10.1007/s00404-003-0572-z>.
23. Al-Matubsi HY, Kanaan RA, Hamdan F, Salim M, Oriquat GA, Al Hanbali OA. Smoking practices in Jordanian people and their impact on semen quality and hormonal levels among adult men. *Cent Eur J Public Health* [Internet]. 2011;19(1):54–9. Available from: <http://dx.doi.org/10.21101/cejph.a3629>
24. Trummer H, Habermann H, Haas J, Pummer K. The impact of cigarette smoking on human semen parameters and hormones. *Hum Reprod* [Internet]. 2002;17(6):1554–9. Available from: <http://dx.doi.org/10.1093/humrep/17.6.1554>
25. Swan SH, Brazil C, Drobnis EZ, Liu F, Kruse RL, Hatch M, et al. Geographic differences in semen quality of fertile U.S. males. *Environ Health Perspect* [Internet]. 2003;111(4):414–20. Available from: <http://dx.doi.org/10.1289/ehp.5927>
26. Li Y, Lin H, Ma M, Li L, Cai M, Zhou N, et al. Semen quality of 1346 healthy men, results from the Chongqing area of southwest China. *Hum Reprod* [Internet]. 2009;24(2):459–69. Available from: <http://dx.doi.org/10.1093/humrep/den399>
27. Infertility [Internet]. nhs.uk. [cited 2023 Oct 18]. Available from: <https://www.nhs.uk/conditions/infertility>
28. Mascarenhas MN, Flaxman SR, Boerma T, Vanderpoel S, Stevens GA. National, regional, and global trends in infertility prevalence since 1990: a systematic analysis of 277 health surveys. *PLoS Med* [Internet]. 2012;9(12):e1001356. Available from: <http://dx.doi.org/10.1371/journal.pmed.1001356>
29. WHO. Global prevalence of infertility, infecundity and childlessness. UK: 2012. 12 p [Internet]. Bing. [cited 2023 Oct 18]. Available from: https://www.bing.com/search?pglt=41&q=29.+WHO.+Global+prevalence+of+infertility%2C+infecundity+and+childlessness.+UK%3A+2012.+12+p.&cvid=20e3edb383e34bf38ec3f6083270ea3e&gs_lcrp=EgZjaHJvbWUyBggAEUYOdIBC DI1ODRqMGoxqAIAaAIA&FORM=ANNTA1&PC=U531
30. Abdullah AA, Ahmed M, Oladokun A. Prevalence of infertility in Sudan: A systematic review and meta-analysis, *Qatar Medical Journal* 2021;47 <http://dx.doi.org/10.5339/qmj.2021.4>
31. CDCTobaccoFree. Tips from former smokers © [Internet]. Centers for Disease Control and Prevention. 2023 [cited 2023 Oct 18]. Available from: <https://www.cdc.gov/tobacco/campaign/tips/index.html>
32. El-Melegy NT, Ali M-EM. Apoptotic markers in semen of infertile men: Association with cigarette smoking. *Int Braz J Urol* [Internet]. 2011;37(4):495–506. Available from: <http://dx.doi.org/10.1590/s1677-55382011000400009>.

33. Joo KJ, Kwon YW, Myung SC, Kim TH. The effects of smoking and alcohol intake on sperm quality: light and transmission electron microscopy findings. *J Int Med Res* [Internet]. 2012;40(6):2327–35. Available from: <http://dx.doi.org/10.1177/030006051204000631>.
34. Anifandis G, Bounartzi T, Messini CI, Dafopoulos K, Sotiriou S, Messinis IE. The impact of cigarette smoking and alcohol consumption on sperm parameters and sperm DNA fragmentation (SDF) measured by Halosperm(®). *Arch Gynecol Obstet* [Internet]. 2014;290(4):777–82. Available from: <http://dx.doi.org/10.1007/s00404-014-3281-x>
35. Vine MF, Margolin BH, Morrison HI, Hulka BS. Cigarette smoking and sperm density: a meta-analysis. *Fertil Steril*. 1994;61(1):35–43.
36. Gu F, Caporaso NE, Schairer C, Fortner RT, Xu X, Hankinson SE, et al. Urinary concentrations of estrogens and estrogen metabolites and smoking in caucasian women. *Cancer Epidemiol Biomarkers Prev* [Internet]. 2013;22(1):58–68. Available from: <http://dx.doi.org/10.1158/1055-9965.EPI-12-0909>
37. Fréour T, Dessolle L, Lammers J, Lattes S, Barrière P. Comparison of embryo morphokinetics after in vitro fertilization-intracytoplasmic sperm injection in smoking and nonsmoking women. *Fertil Steril* [Internet]. 2013;99(7):1944–50. Available from: <http://dx.doi.org/10.1016/j.fertnstert.2013.01.136>
38. Harlev A, Agarwal A, Gunes SO, Shetty A, du Plessis SS. Smoking and male infertility: An evidence-based review. *World J Mens Health* [Internet]. 2015;33(3):143. Available from: <http://dx.doi.org/10.5534/wjmh.2015.33.3.143>
39. Allen AM, Oncken C, Hatsukami DK. Women and smoking: The effect of gender on the epidemiology, health effects, and cessation of smoking. *Current Addiction Reports* [Internet]. 2014 Jan 10;1(1):53–60. Available from: <https://doi.org/10.1007/s40429-013-0003-6>