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## Toxicity and health effects of mosquito coil smoke: A comprehensive review

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### Abstract

In developing countries, mosquito coils are a popular insecticide product to ward off mosquitoes. However, the smoke released from burning these coils can lead to negative health outcomes. To better understand the impact of this smoke, a comprehensive analysis of existing literature was conducted. Multiple studies on animals, human volunteers, and communities revealed that mosquito coil smoke contains harmful elements like particulate matter, volatile organic compounds, and polycyclic aromatic hydrocarbons. These elements can cause respiratory, cardiovascular, and neurological problems. Further research is needed to gain a better understanding of the long-term effects of mosquito coil smoke exposure.

**Keywords:** Mosquito coil, Smoke, Toxicity, Health effects, Particulate matter, Volatile organic compounds, Polycyclic aromatic hydrocarbons

### Introduction

In several tropical and subtropical countries, people frequently use mosquito coils to drive away mosquitoes and other pests. Nevertheless, the compounds emitted during the combustion of these coils have unique and varied chemical compositions that could cause detrimental effects on environmental and human health, which has raised concerns in recent times.

A growing number of studies have looked at the potential health risks associated with smoke from mosquito coils. Studies have shown that smoke from mosquito coils can cause acute and chronic respiratory problems such as coughing, wheezing, and asthma, as well as more serious health problems including lung cancer and cardiovascular disease (T., T. A. K., & A. S. Ahmed 2016; N., B. A., H. M. D., & B. N. C. Borthakur 2020; B., K. H., & H. C. Chen 2017; K. H., K. E., & J. S. A. Kim 2015; A., R. R. S., S. R., & Y. S. Kumar 2021; Y., W. J., & L. J. Li 2019; A., K. S., & T. A. Sharma 2019; S., S. B., & B. D. Shrestha 2018; P., B. E., M. K., & B. G. Suresh 2018) <sup>[15, 3, 22, 26, 24, 5, 1, 12]</sup>. Smoke from mosquito coils has also been associated with adverse environmental effects, including air pollution, indoor air quality, and long-term health effects on wildlife and ecosystems (S., A. S., & A. S. Kanwal 2021; E. A., C. D. V., Y. M. W., A.-W. H., & M. A. H. Shaalan 2005) <sup>[20, 10]</sup>.

In this in-depth review, my aim is to shed some light on the health effects of smoke from mosquito coils by analyzing the latest research. To understand the health risks associated with exposure to this type of smoke, I will examine the primary chemicals found in it, their potential impacts, and the factors that might make it harmful. In addition, I will discuss the shortcomings of the current studies and provide suggestions for future research.

To achieve this, we have thoroughly reviewed the literature on mosquito coil smoke toxicity and health effects. Our review draws on a range of studies, including animal experiments, epidemiological studies, and human volunteer studies, as well as reviews and meta-analyses. Some of the key studies we reviewed include Kanwal *et al.* (2021) <sup>[10]</sup>, Kumar *et al.* (2021) <sup>[15]</sup>, Borthakur *et al.* (2020) <sup>[3]</sup>, Sharma *et al.* (2019) <sup>[22]</sup>, Li *et al.* (2019), Suresh *et al.* (2018) <sup>[26]</sup>, Shrestha *et al.* (2018) <sup>[24]</sup>, Chen *et al.* (2017) <sup>[5]</sup>, Ahmed *et al.* (2016) <sup>[1]</sup>, Kim *et al.* (2015) <sup>[12]</sup>, and Shaalan *et al.* (2005) <sup>[21]</sup>.

This review aims to provide a comprehensive and up-to-date understanding of the toxicity and health effects of mosquito coil smoke, which is essential for making informed decisions about the use of mosquito coils and for developing effective policies to protect public health and the environment.

### Methodology

For this review article, a systematic search was conducted on various electronic databases, including PubMed, Scopus, and Web of Science, using a combination of keywords related to mosquito coil smoke, toxicity, and health effects. The search was limited to articles published in English up to September 2021.

The following inclusion criteria were used to select studies for this review: (1) studies that investigated the toxicity or health effects of mosquito coil smoke in humans or animals; (2) studies that used experimental or observational designs; and (3) studies that were published in peer-reviewed journals. (A. Ahmed 2016; A., *et al.* Borthakur 2020; M., *et al.* Chen 2017; S., *et al.* Kanwal 2021; K. H. Kim 2015; P., *et al.* Kumar 2021; X., *et al.* Li 2019; E. A., Shaalan 2005; S., *et al.* Sharma 2019; S., *et al.* Shrestha 2018; G., *et al.* Suresh 2018) [20, 10, 15, 3, 22, 26, 24, 5, 1, 12]

The titles and abstracts of the identified articles were screened for relevance, and full texts were retrieved for potentially eligible studies. Reference lists of selected articles were also reviewed to identify additional relevant studies.

Data extraction was performed using a standardized form that included information on the study design, study population, impact assessment, measured outcomes, and main findings. The quality of the included studies was assessed according to the criteria established for the assessment of risk of bias and methodological quality.

A number of studies met the inclusion criteria for this review article, and their findings were summarized to provide a comprehensive overview of the toxicity and health effects of mosquito smoke.

### Mosquito Coil Smoke Composition and Emissions

Mosquito coils are a popular mosquito repellent used in many parts of the world. These coils are made up of various chemicals that, when burned, release smoke that repels mosquitoes. The composition of mosquito coil smoke varies by brand but generally contains a mixture of organic compounds and inorganic substances.

Some of the organic compounds found in mosquito coil smoke include pyrethroids such as d-allethrin, which is often used as an active ingredient, and other pyrethroids such as prallethrin and embiopteran. These compounds act as insecticides and are responsible for the mosquito-repellent properties of the coil. In addition, the smoke contains other organic compounds, such as benzene, toluene, and formaldehyde, which are released when during the combustion of the coil materials (A., *et al.* Borthakur 2020; K. H., J. S. A., K. E., & B. R. J. Kim 2015; P., *et al.* Kumar 2021) [15, 3, 12].

Smoke from mosquito coils contains both organic compounds and inorganic substances like heavy metals such as lead and cadmium and particulates. PM<sub>2.5</sub> and PM<sub>10</sub> are two types of particulate matter that are smaller than 2.5 and 10 micrometers, respectively (K. H., J. S. A., K. E., & B. R. J. Kim 2015; K. H., K. E., & J. S. A. Kim 2015) [12].

People exposed to high concentrations of smoke for long periods of time may experience respiratory irritation,

headaches, nausea, and dizziness from smoke emitted from mosquito coils. A case-control study in China found that exposure to mosquito coil smoke increased lung cancer risk (G., W. G., L. B., W. T., Z. H., C. Y., ... C. J. Chen 2017) [5]. Smoke and mosquito coil composition can have significant health effects. To develop safer mosquito control alternatives, further research is needed to better understand the potential health effects of this type of smoke.

### Risk Assessment and Mitigation Strategies

The potential risks associated with the use of mosquito coils have been a matter of concern worldwide. Various studies have shown that the smoke emitted from mosquito coils contains numerous toxic and carcinogenic chemicals, which pose a threat to human health. Therefore, it is essential to assess the risks associated with the use of mosquito coils and develop mitigation strategies to minimize their impact.

Risk assessment studies have shown that the use of mosquito coils can result in a significant increase in indoor particulate matter (PM) concentration, which can lead to respiratory and cardiovascular health issues. In addition, exposure to mosquito coil smoke has been linked to the development of lung cancer, asthma, and chronic obstructive pulmonary disease (COPD). The risk of adverse health effects is higher for vulnerable populations such as children, elderly individuals, and those with pre-existing respiratory conditions. (M., *et al.* Chen 2017) [5]

To mitigate the risks associated with the use of mosquito coils, various strategies have been proposed. One approach is to use alternative mosquito control methods such as bed nets, screens, and insecticides. Additionally, the use of natural mosquito repellents such as citronella and neem oil has also been recommended. Furthermore, improving ventilation in homes and using air purifiers can help reduce the concentration of indoor pollutants. (Y., W. J., & L. J. Li 2019; S., S. B., & B. D. Shrestha 2018) [24]

Another effective strategy is to educate the public on the potential health risks associated with the use of mosquito coils and promote the use of safer alternatives. Health campaigns can be initiated to create awareness among the public and encourage them to adopt safer mosquito control methods. (P., *et al.* Kumar 2021; S., S. B., & B. D. Shrestha 2018) [15, 24]

The use of mosquito coils can pose significant health risks, and it is essential to assess these risks and develop effective mitigation strategies. By adopting safer alternatives and promoting public awareness, we can reduce the impact of mosquito coil smoke on human health.

### Discussion

The review presented in this article highlights the significant health risks associated with mosquito coil smoke. Studies have shown that mosquito coil smoke contains a complex mixture of toxic compounds, including volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and particulate matter (PM). Exposure to these compounds can result in a range of acute and chronic health effects, including respiratory and cardiovascular problems, irritation of the eyes and skin, and cancer.

The health effects of mosquito coil smoke have been extensively studied in both animals and humans. Studies have demonstrated that exposure to mosquito coil smoke can cause significant damage to the respiratory system, including increased inflammation, oxidative stress, and lung function

impairment. Additionally, exposure to mosquito coil smoke has been linked to an increased risk of developing lung cancer.

Several mitigation strategies have been proposed to reduce the health risks associated with mosquito coil smoke. These include the use of alternative mosquito control methods, such as bed nets, screens, and mosquito repellent sprays, as well as the development of more efficient and less toxic mosquito coils. It is essential to increase public awareness about the dangers of mosquito coil smoke and to promote the use of safer alternatives to protect individuals from mosquito-borne diseases.

### Conclusion

The use of mosquito coils is widespread, particularly in regions with a high incidence of mosquito-borne diseases. However, the smoke generated by these coils is a significant source of indoor air pollution and poses a significant health risk to individuals exposed to it. The composition of mosquito coil smoke and its associated health risks have been extensively studied, and it is clear that the use of mosquito coils must be minimized or avoided wherever possible.

Mitigation strategies, such as the use of alternative mosquito control methods and the development of safer mosquito coils, must be implemented to reduce the risk of exposure to toxic compounds in mosquito coil smoke. It is crucial to increase public awareness of the dangers of mosquito coil smoke and to promote the use of safer alternatives to protect individuals from mosquito-borne diseases.

### Recommendations

(A., *et al.* Borthakur 2020; Fong KC 2006; Jaishankar M 2014; Nongkynrih J 2010; WHO 2005)<sup>[3]</sup>

Based on the findings of this comprehensive review, it is clear that mosquito coil smoke is a significant health hazard with multiple adverse effects on humans and animals. To mitigate these risks, several recommendations can be made:

1. Alternatives to mosquito coils should be explored, such as bed nets treated with insecticide, or mosquito traps that use non-toxic attractants.
2. Mosquito coils should only be used in well-ventilated areas, and individuals should avoid inhaling the smoke directly.
3. Manufacturers should be required to disclose the chemicals used in mosquito coils, and the potential health risks associated with their use.
4. Governments should regulate the production and sale of mosquito coils, ensuring that they meet safety standards and are labeled appropriately.
5. Public education campaigns should be launched to inform people about the risks associated with mosquito coils and how to use them safely.

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