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Lung Cancer Risks and Prevention for Urban Life in Thailand

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Abstract

Lung cancer is a leading cause of cancer-related mortality worldwide, including in Thailand, where rapid urbanization and industrialization have significantly increased air pollution levels, particularly PM2.5 (particulate matter with a diameter of less than 2.5 microns). This review examines the link between PM2.5 exposure and lung cancer, focusing on the urban context of Thailand. Research consistently shows that PM2.5 exposure substantially raises the risk of lung cancer, exacerbated by Thailand's less stringent air quality regulations. The review also highlights the severe health impacts of PM2.5, which include respiratory and cardiovascular diseases, as well as neurological impairments. Effective prevention strategies are discussed, emphasizing the importance of both individual actions, such as smoking cessation and the use of protective masks, and broader policy measures, including stricter tobacco control, improved air quality standards, and urban planning reforms. The conclusion underscores the need for continued research and policy development to mitigate the risks of PM2.5 exposure and reduce the lung cancer burden in Thailand.

Keywords: Lung Cancer, PM2.5 Pollution, Urban Health, Air Quality Control

Introduction

Lung cancer remains a leading cause of cancer-related deaths globally, including in Thailand. Rapid urbanization and industrial growth, particularly in Bangkok and other major cities, have significantly increased air pollution levels, especially the concentration of PM2.5 (particulate matter with a diameter of less than 2.5 microns). This pollutant poses a substantial risk for developing lung cancer. This article review explores the relationship between PM2.5 exposure and lung cancer in the urban context of Thailand, examining potential prevention strategies. Research has shown that PM2.5 exposure significantly increases the risk of developing lung cancer [1,2]. Globally, cancer incidence has risen sharply, particularly in developed countries [3]. For instance, in the United States, it is estimated that in 2024, about 611,720 people will die from cancer, with lung and bronchus cancers being the leading causes of these deaths [4]. Cancer mortality rates vary by demographic factors, with the highest rates observed among Black men and women in the United States. Age is also a critical factor, with the highest mortality rates found in those aged 65 to 74 years [5].

Health Effects of PM2.5

Exposure to PM2.5, which consists of fine particles with a diameter of 2.5 micrometers or smaller, has severe health impacts. These fine particles can penetrate deep into the lung tissue, causing inflammation and cellular changes that significantly increase the risk of lung cancer, chronic obstructive pulmonary disease (COPD), ischemic heart disease, stroke, and other respiratory conditions like asthma and emphysema. Studies have shown a strong correlation between increased PM2.5 levels and the rise in lung cancer cases in Bangkok [2]. In the United Kingdom, survival rates for lung cancer have improved slightly over the past few decades, yet lung

cancer remains a leading cause of cancer deaths [6]. In Thailand, air pollution is a significant public health concern, particularly in Bangkok and the northern regions, with PM2.5 levels reaching four times higher than WHO standards in April 2022 [1]. PM2.5 is one of the most harmful air pollutants, capable of carrying hazardous substances such as carcinogens and heavy metals into the lungs, leading to long-term health risks, including lung cancer [7].

Definition and Sources of PM2.5

PM2.5 pollution in Thailand originates from various sources, such as vehicle emissions, industrial activities, open burning, construction, and pollution from neighboring countries. Traffic congestion, especially in cities like Bangkok, contributes significantly to PM2.5 levels due to emissions from diesel engines and older vehicles. Factories and industrial processes release substantial pollutants, increasing PM2.5 concentrations. Agricultural practices, like burning crop residues in open fields, further exacerbate the problem, particularly during the dry season. Additionally, pollution from neighboring countries carried by winds also impacts Thailand's air quality. Seasonal changes affect PM2.5 levels, with higher levels during the dry season due to increased burning and less rain, while the rainy season typically sees lower levels as the rain helps clear the air [2,8,9,10]

Epidemiological Studies on PM2.5 and Lung Cancer

Epidemiological studies have consistently shown a significant link between PM2.5 exposure and an increased risk of lung cancer. These studies, conducted across various regions and populations, highlight the ongoing dangers of long-term exposure to PM2.5. The European ESCAPE study, which spanned nine countries, found a clear connection between prolonged PM2.5 exposure and lung cancer, particularly adenocarcinoma [11]. In Canada, the CanCHEC study revealed that non-smokers exposed to high levels of PM2.5 had a significantly increased risk of dying from lung cancer, underscoring the serious threat posed by PM2.5, even in the absence of traditional risk factors like smoking [12]. A 17-year cohort study in the Netherlands also demonstrated a strong relationship between higher air pollution levels and increased lung cancer risk [13]. The American Cancer Society's CPS II study confirmed that both smokers and non-smokers exposed to higher PM2.5 levels face an increased risk of dying from lung cancer [14]. In Thailand, the link between PM2.5 pollution and lung cancer is becoming increasingly evident, with studies showing that fine particles from vehicle emissions, industrial activities, and open burning significantly contribute to lung cancer rates, especially in cities like Bangkok [2,10,15,16,17].

Previous Research Findings

Recent research underscores the severe health risks of PM2.5 pollution. These fine particles penetrate deep into the lungs, causing cellular damage and inflammation, leading to lung cancer. Urban areas with heavy traffic and industrial activities show higher PM2.5 levels, correlating with increased lung cancer rates. Developing countries, including Thailand, face greater risks due to less stringent air quality regulations. In Thailand, lung cancer rates are rising rapidly among both men and women, driven by worsening air pollution from changes in lifestyle, population growth, and increased industrial activity. Vehicle emissions, weak fuel standards, and poor enforcement of air quality laws contribute significantly to the problem [18].

Northern Thailand has faced severe air pollution for over 15 years, with PM2.5 levels exceeding WHO standards, particularly in Chiang Mai and Chiang Rai. Agricultural burning, forest fires, and open waste burning are major contributors to this issue, significantly impacting health, especially in vulnerable groups [19,20].

Radon gas is another significant lung cancer risk, particularly in areas with high uranium content, such as northern Yala. Radon exposure, along with chemical disasters and pollutants like Polycyclic Aromatic Hydrocarbons (PAHs), further exacerbates the risk of lung cancer [21,22].

Smoking remains a leading cause of lung cancer, responsible for 30-40% of cancer deaths. A 1950s U.S. study found that 597 out of 605 male lung cancer patients were smokers, with smokers being ten times more likely to develop lung cancer. Even non-smokers exposed to secondhand smoke face significant risks [23,24].

Common Cancers in Thailand

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In 2023, the most common cancers in men were colorectal cancer (20.7%), liver and bile duct cancer (19.0%), and lung and bronchus cancer (12.9%). In women, the most common cancers were breast cancer (39.8%), colorectal cancer (12.2%), cervical cancer (11.1%), and lung and bronchus cancer (6.9%) [25].

By 2025, the most common cancers in men remained colorectal cancer (21.0%), liver and bile duct cancer (18.2%), and lung and bronchus cancer (12.8%). In women, breast cancer increased to 41.7%, followed by cervical cancer (13.1%), colorectal cancer (10.7%), and lung and bronchus cancer (5.6%) [25].

The 2025 cancer statistics from the National Cancer Institute of Thailand show the most frequent cancers among new patients as colorectal cancer (474 cases), liver and bile duct cancer (320 cases), lung cancer (273 cases), breast cancer (792 cases), and cervical cancer (249 cases). Lung cancer predominantly affects those aged 50-70, with a higher incidence in men (60.8%) compared to women (39.2%) [26].

Lung Cancer and PM2.5: Preventive Measures

Lung cancer is a deadly disease linked to PM2.5, fine particulate matter from various sources. Research indicates that PM2.5 significantly increases the risk of lung cancer, particularly in populations with low to moderate health literacy, which may be influenced by parental education levels. PM2.5 affects both short-term and long-term health, especially in children, leading to chronic respiratory inflammation, reduced lung function, emphysema, gene mutations, and increased cancer risk. It also impacts neurological development, potentially causing early dementia, delayed development, and ADHD [27,28].

Preventive measures, such as wearing N95 masks, are crucial, as these masks can filter up to 80% of PM2.5 particles. Government actions, including restricting truck traffic during rush hours, adopting cleaner fuel standards, and enforcing bans on agricultural burning, aim to reduce PM2.5 levels. However, some measures, like street cleaning and misting buildings, have limited effectiveness. The economic impact of PM2.5 includes healthcare costs and reduced workforce productivity, prompting the government to consider fiscal incentives, such as tax reductions for importing anti-pollution equipment and promoting the use of clean agricultural technologies [29,30].

Choosing to live away from construction sites is also recommended, as construction activities, especially tile cutting and plastering, generate significant dust that poses health risks [31,32].

Prevention of Lung Cancer Risks

At the individual level, preventing lung cancer involves avoiding risk factors and maintaining good health. The most effective measures include not smoking or quitting if you do, avoiding secondhand smoke and pollution, maintaining a healthy weight through a balanced diet and regular exercise, getting vaccinated against pneumonia, and having regular health check-ups. Those in high-risk groups should also consider lung cancer screening [33,34].

At the policy level, lung cancer prevention requires strict tobacco control measures, such as increasing tobacco taxes, creating smoke-free areas, and supporting smoking cessation programs. Ensuring air quality through stringent emission standards is also crucial [35] , along with promoting clean energy and implementing effective urban planning [36]. Additionally, workplace safety, lung cancer screening programs [37] , health awareness initiatives, and improving pollution control laws are essential [38].

Conclusion

Lung cancer remains a significant public health issue in Thailand, exacerbated by the high levels of PM2.5 pollution, particularly in urban areas like Bangkok. The evidence strongly links PM2.5 exposure to an increased risk of lung cancer, alongside other serious health conditions such as COPD, cardiovascular diseases, and neurological impairments. While individual preventive measures, such as avoiding smoking and using protective masks, are crucial, broader policy interventions are equally important. These include stricter tobacco control, enhanced air quality standards, and comprehensive urban planning to reduce pollution sources. Future research and policy reforms should focus on developing and enforcing effective strategies to reduce PM2.5 exposure, protect public health, and ultimately decrease the burden of lung cancer in Thailand. Addressing these challenges through a combination of individual action and strong policy measures is essential for safeguarding the health of Thailand's population and improving overall health outcomes.

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