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EDITORIAL

Particulate Matter 2.5 and Obstetric Complications

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ABSTRACT

Particulate matter (PM) is microscopic solid or liquid matter suspended in the atmosphere of Earth. The sources of PM can be natural or anthropogenic. The most common used for classification of PM is the size of PM. PM 2.5 influences general health problems. Inhalation of PM 2.5 also causes obstetric complications such as low birth weight, preterm delivery and stillbirth. Thus, pregnant women should avoid the exposure to PM 2.5 for prevention of these obstetric complications.

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Introduction

Particulate matter (PM) is microscopic solid or liquid matter suspended in the atmosphere of Earth[1, 2]. There have been many classifications of PM. The most common used for classification of PM is the size of PM.

PM 10 is defined as particles which pass through a size-selective inlet with a 50% efficiency cut-off at 10 µm aerodynamic diameter. PM10 corresponds to the "thoracic convention"[3].

PM 2.5 is defined as particles which pass through a size-selective inlet with a 50% efficiency cut-off at 2.5 µm aerodynamic diameter. PM 2.5 corresponds to the "high-risk respirable convention"[3].

The size of PM is very important. Only PM smaller than 10 µm can reach the alveoli. Larger PM are deposited higher up in the respiratory system and removed on the mucocilliary escalator, but may then be swallowed and subsequently absorbed through the gastrointestinal tract[2].

Sources of PM

Sources of PM can be natural or anthropogenic[1]. Natural sources include PM originating from volcanoes, dust storms, forest and grassland fires, living vegetation and sea spray. Anthropogenic sources include combustion within car engines, solid-fuel combustion in households, industrial activities (such as building, mining, manufacturing of cement, ceramics and bricks, and smelting), quarrying and mining[1].

Regulation

Due to the highly toxic health effects of particulate matter, most governments have created regulations. Each country has set standards for PM

10 and PM 2.5 concentrations. For example, United States has set standards for PM 2.5 concentrations: 35 μg/m^3 for daily average and 12 μg/m^3 for yearly average[4]. WHO has set standards for PM 2.5 concentrations: 25 μg/m^3 for daily average and 10 μg/m^3 for yearly average[5]. In Thailand, the standards for PM 2.5 concentrations are 50 μg/m^3 for daily average and 25 μg/m^3 for yearly average[6].

An air quality index (AQI) is used to communicate to the public how polluted the air currently is or how polluted it is forecast to become. As the AQI increases, an increasingly large percentage of the population is likely to experience increasingly severe adverse health effects[7].

The Air Quality Health Index or (AQHI) is a scale designed to help understand the impact of air quality on health. It has been used in Canada. It is a health protection tool used to make decisions to reduce short-term exposure to air pollution by adjusting activity levels during increased levels of air pollution. The AQHI also provides advice on how to improve air quality by proposing behavioural change to reduce the environmental footprint. The AQHI provides a number from 1 to 10$^+$ to indicate the level of health risk associated with local air quality. On occasion, when the amount of air pollution is abnormally high, the number may exceed 10[8]. Table 1 shows the AQHI Health Risk Categories[8].

Table 1. The AQHI Health Risk Categories[8].

Health Risk	AQHI	Health Messages	
		At Risk population*	General Population
Low	1–3	Enjoy your usual outdoor activities.	Ideal air quality for outdoor activities
Moderate	4–6	Consider reducing or rescheduling strenuous activities outdoors if you are experiencing symptoms.	No need to modify your usual outdoor activities unless you experience symptoms such as coughing and throat irritation.
High	7–10	Reduce or reschedule strenuous activities outdoors. Children and the elderly should also take it easy.	Consider reducing or rescheduling strenuous activities outdoors if you experience symptoms such as coughing and throat irritation.
Very high	Above 10	Avoid strenuous activities outdoors. Children and the elderly should also avoid outdoor physical exertion.	Reduce or reschedule strenuous activities outdoors, especially if you experience symptoms such as coughing and throat irritation.

* People with heart or breathing problems are at greater risk.

Effect of PM on health problems

The effects of inhaling PM that has been widely studied in humans and animals include respiratory diseases, cardiovascular disease, and obstetric problems. PM has an effect on health problems either acute or chronic effects. Acute health problems include lung inflammatory reactions, respiratory symptoms, adverse effects on the cardiovascular system, increased in hospital admissions, increased in mortality and increased in medication usage. Chronic health problems include increased in lower respiratory symptoms, reduction in lung function in children, increased in chronic obstructive pulmonary disease, reduction in lung function in adults, and reduction in life expectancy[9].

Effect of PM 2.5 on obstetric problems

There have been many studies regarding PM 2.5 and obstetric problems. Previous study showed that oxidative stress, deoxyribonucleic acid (DNA) methylation, mitochondrial DNA content alteration, and endocrine disruptions may all play an important role in PM 2.5 induced adverse effects to pregnant women and fetuses. In addition, PM 2.5 exposure can cause male reproductive toxicity, leading to associated adverse pregnancy outcomes[10]. Research evidence indicates that PM 2.5 has a potential to induce low birth weight (LBW), preterm birth (PTB), and stillbirth[10].

- ***Low birth weight***

Exposure to PM 2.5 during pregnancy may affect the growth and development of infants[11]. One study found that exposure to specific constituents of PM 2.5, especially traffic-related particles, sulphur constituents, and metals was associated with decreased birth weight. Inhalation of PM can trigger maternal oxidative stress, damage cells, cause inflammation and changes in the blood system, decrease placental blood flow, disrupt transplacental oxygenation, leading to poor growth of the fetus[12]. Previous studies found that exposure to PM 2.5 during pregnancy increased low birth weight infants[10, 13, 14]. Stieb DM, et al demonstrated pooled odds ratios for low birth weight ranged from 1.05 (0.99-1.12) per 10 μg/m^3 PM 2.5 to 1.10 (1.05-1.15) per 20 μg/m^3 PM 10 based on entire pregnancy exposure[15].

- ***Preterm delivery***

Previous studies demonstrated that exposure to PM 2.5 during pregnancy was associated with preterm delivery[10, 13, 14, 16, 17]. DeFranco E et al demonstrated that exposure to high levels of particulate air pollution, PM 2.5, in pregnancy is associated with a 19% increased risk of PTB; with greatest risk with high third trimester exposure[17]. Meta-analytic study found that the pooled odds ratio (OR) for PM 2.5 exposure (per 10 μg/m^3 increment) during the entire pregnancy on preterm birth was 1.13 (95 % CI 1.03-1.24) in 13 studies with a significant heterogeneity ($Q = 80.51$, $p < 0.001$). The pooled ORs of PM 2.5 exposure in the first, second and third trimester were 1.08 (95 % CI 0.92-1.26), 1.09 (95 % CI 0.82-1.44) and 1.08 (95 % CI 0.99-1.17), respectively[18].

- ***Stillbirth***

Some studies found that exposure to PM 2.5 during pregnancy was associated with stillbirth[10, 19]. DeFranco E et al found that exposure to high levels of PM 2.5 in the third trimester of pregnancy was associated with 42% increased stillbirth risk, aOR 1.42 (95% CI 1.06,1.91)[19].

Prevention of health problems from PM 2.5

The prevention of health problems from PM2.5 include minimizing the releasing of PM 2.5 especially from anthropogenic sources and avoiding the inhalation of PM 2.5.

Risk reduction behaviors of PM 2.5 include minimizing the times for opening windows in order to reduce the PM 2.5 exposure from outside, adjusting time of day or frequency that the physical exercise was done according to AQI, adjusting the physical exercise styles or amounts in relation to the AQI, wearing face masks when going outside in the haze, cleaning the mouths and noses after outdoor activities and using air purifiers when airing the room[20].

In conclusion, PM 2.5 can increase obstetric complications such as low birth weight, preterm delivery and stillbirth. Obstetric complications increase when exposure to PM 2.5 during pregnancy, the best way is prevention from PM 2.5 exposure. Pregnant women should avoid the exposure to PM 2.5 for prevention of these obstetric complications

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