THE AWARENESS OF ATMOSPHERIC PATICULATE MATTER TOWARDS HEALTH THREATS: A CASE STUDY IN BANGKOK METROPOLITAN, THAILAND

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ABSTRACT

This research aims to study the awareness of particulate matter ($PM_{2.5}$) towards health threats: a case study in Bangkok metropolitan also emphasizes efforts initiated by respondents to reduce the related health threats consequences and suggest particulate matter ($PM_{2.5}$) control for relevant agency. The questionnaire was disseminated to the public and received 172 responses. Descriptive statistics, which include frequency and percentage of respondents were calculated. The Independent Samples t-test, a one-way analysis of variance (ANOVA), and the Chi-Square test were employed to identify variables associated with the public's awareness and practices with regard to $PM_{2.5}$ in Bangkok metropolitan area. A p-value less than 0.05 was considered as a statistically significant. A large number of the respondents were unaware of $PM_{2.5}$, how widespread it is in Bangkok metropolitan area, and to what extent it has been monitored. However, the majority of respondents indicated respiratory issues and adopted self-protective measures when the air quality was unfavorable. There were significant differences in the implementation of preventative measures, which was widespread amongst individuals who suffered from respiratory problems. Approximately 38% of respondents expressed an interest in getting information on Bangkok's air quality index through social and mass media. The findings suggested that there is a need to increase public awareness of airborne contaminants, particulate matter ($PM_{2.5}$) and the negative health consequences. Furthermore, epidemiological research should be done to increase the awareness of how particulate matter is associated to morbidity and mortality in Bangkok metropolitan area respectively.

Keywords: Awareness, Health Threats, Metropolitan area, Particulate Matter ($PM_{2.5}$).

INTRODUCTION

The quality of the air we breathe possesses a significant impact on our health and well-being, as particulate matter (PM) emerging as an important environmental concern internationally. According to Ali, M. U & et, al., (2019), atmospheric particulate matter, or PM, is a complex combination of solid and liquid particles hanging in the air, varied in size, content, and source. Regarding to Rönkkö, T. J & et, al., (2018), particulate matter of a diameter of 2.5 micrometers or smaller ($PM_{2.5}$) has attracted particular consideration because of its propensity to penetrate deep into the respiratory system and pose significant risks to health. As urbanization and industrialization expand across the world, the increasing incidence of $PM_{2.5}$ pollution has become a major public health concern, contributing to a variety of negative health effects such as respiratory ailments, cardiovascular problems, and even early death. In addition to Wang, Q. & et, al (2019) indicated that industrialization has a strong link with $PM_{2.5}$ concentrations, but the severity of its effect differs between groupings of nations with varying socioeconomic characteristics. Therefore, Al-Shidi, H. K., & et.al., (2021), given to these issues, promoting knowledge about the health risks associated with atmospheric particulate matter (PM) is critical to protecting public health and encouraging informed

decision-making at the individual, community, and policy levels. Therefore, the researcher is interesting in investigating the awareness of fine particulate matter ($PM_{2.5}$) in Bangkok metropolitan area and provide recommendations for particulate matter mitigation respectively.

OBJECTIVES

This research investigates the relationship between atmospheric particulate matter and health threats with an emphasis on public awareness, and attitudes toward air quality issues by examining existing literature, empirical studies, and public health initiatives accordingly.

LITERATURE REVIEWS

Particulate matter

According to Seinfeld, J.; Pandis, S (1998), particulate matter (PM) are microscopic solid particles that travel through the air. This happens when objects are smashed, struck, and crushed until they are broken into small particles. When blown by the wind, it diffuses in the air before dropping to the ground. Particle can be classified into two categories based on size: Coarse particles are particulate matter (PM) that exceeds 2.5 microns (µm) up to 10 microns (µm) (PM_{10}), while fine particles are smaller than 2.5 microns (µm) ($PM_{2.5}$). Ultrafine particles have sizes up to 100 nanometers (nm) ($PM_{0.1}$). In addition, in Thailand, the Pollution Control Department announced a new air quality index for particulate matter (PM), mandating a 24-hour average of no more than 37.5 micrograms per cubic meter (µg/m³).

Particulate matter and Potential Health Effects

According to Chereminisoff, N.P. (2002) indicated that particulate matter (PM) is the most critical cause for unfavorable health impacts, but coarse particles have less influence due to their relatively large size. Fine Particulates matter (PM) may penetrate the thoracic or lower chambers of the respiratory system, producing asthma and respiratory morbidity. Additionally, Brown, J.S.& et.al, (2013) found that approximately 20% or less of PM_{10} particles penetrate through the extra thoracic airways and into the lower respiratory system. In accordance with Pedersen, M. & et.al (2006) discovered that $PM_{2.5}$ contains additional hazardous chemical species such as Polycyclic Aromatic Hydrocarbons (PAHs) and heavy metals, which have carcinogenic, mutagenic, and/or teratogenic effects. Moreover, Kim et al. (2015) investigated coarse particle and fine particles in terms of composition, common emission sources, life duration, and travel distance and found that $PM_{2.5}$ has varying health consequences based on its chemical and physical components, ranging from minor to severe condition. In addition to this issue, the Pollution Control Department in Thailand has established the AQI (Air Quality Index) or air quality index value which are currently five classifications altogether, as seen in Table 1. below.

Table 1: Thailand Air Quality Index (AQI)

AQI (µg/m³)	Meaning	Warning Color	Description
0-25	Excellent	Blue	Air quality is very good, suitable for outdoor activities and travel
26-50	Satisfactory	Green	Good Air quality, can perform outdoor activities and travel as normal.
51-100	Yellow	Moderate	**General public:** able to perform outdoor activities normally. **People who need special health care:** If there are initial symptoms such as coughing, difficulty

AQI (µg/m³)	Meaning	Warning Color	Description
			breathing, eye irritation, the duration of outdoor activities should be reduced.
101-200	Orange	Unhealthy	**General public:** should be vigilant about their health. If there are preliminary symptoms such as coughing, difficulty breathing, eye irritation, the duration of outdoor activities should be reduced, or use self-protection equipment if necessary. **People who need special health care:** should reduce the duration of outdoor activities, or use self-protection equipment if necessary. If any individual has health signs and symptoms such as coughing, difficulty breathing, eye inflammation, chest tightness, headache, irregular heartbeat, nausea, fatigue, they should consult a doctor.
201 above	Red	Very Unhealthy	Outdoor activities are not recommended. Avoid places with heavy air pollution, or wear self-protection equipment or face mask when in an exposed area, if necessary. If any individual has any health signs and symptoms, they should consult a doctor.

Source: Air Quality and Noise Management Division, Pollution Control Department

METHODOLOGY

Questionnaire Formulation and Dissemination:

Pilot research with 25 participants was carried out initially. Several questions have been amended in response to feedback from these individuals. The questionnaire was produced and delivered to Bangkok residents and non-residents regardless. The questionnaires were disseminated to the public and received 172 responses Descriptive statistics, which include frequency and percentage of participant responds were calculated. To collect a representative sample of the population, the researcher ensures variety in socioeconomic backgrounds, and health statuses, including characteristics such as age, gender, smoking status, and pre-existing health issues respectively. In addition, the researcher used google forms to create a web-based assessment. A convenience sample technique was used, and the link to the questionnaire was distributed via the application and emails to respondents. To maintain respondents' anonymity, no IP addresses were stored, and incomplete questionnaires that were not properly submitted were not recorded accordingly.

Statistical analysis:

The statistical analysis was carried out using SPSS Statistics software. Descriptive statistics, such as frequency and percentage of answers, were calculated. The Independent Samples t-test, a one-way analysis of variance (ANOVA), and the Chi-Square test were employed to identify variables associated with the public's awareness and practices with regard to $PM_{2.5}$ in Bangkok. A p-value of less than 0.05 was considered as a statistically significant.

RESEARCH RESULTS

The results of this study indicated significant differences among respondents in regards to the preventive measures they implemented against airborne contaminants quality or particulate matter ($PM_{2.5}$), which were based on a variety of reasons. There were statistically significant

differences in the use of face coverings or face mask and reducing outdoor activities during high level of particulate matter ($PM_{2.5}$) based on participants' awareness ($p<0.05$), beliefs that the $PM_{2.5}$ concentration in Bangkok is relatively high ($p<0.001$), and that $PM_{2.5}$ affects human health ($p<0.001$), existing respiratory problems ($p<0.01$), and the belief that $PM_{2.5}$ is causally linked to respiratory problems ($p<0.001$). There were statistically significant differences in the utilization of home air purifiers based on respondents' beliefs that high concentrations of $PM_{2.5}$ affect human health ($p<0.001$) and lead to the necessity for medical treatment in hospitals. The majority of the respondents consider transportation in Bangkok (69.4%) as the primary sources of $PM_{2.5}$, followed by construction and reclamation (52.8%), industries (41.4%), and agricultural burning (38.6%). The respondents said $PM_{2.5}$ had respiratory (92.8%) and cardiovascular (56.2%). For health consequences, most of respondents mentioned that $PM_{2.5}$ in Bangkok metropolitan area is associated with health problems, such as neurological and dermatological issues. Furthermore, 78.2% of respondents considered the $PM_{2.5}$ in Bangkok metropolitan area had a negative impact on the environment. The majority of respondents said it was the responsibility of industries (89.6%) and the government (88.7%) to improve air quality, while minority of respondents indicating that it was the responsibility of individuals (62.8%) and non-governmental organizations (NGOs) (52.4%). However, Patel, S. & et.al., (2020), said that it is critical that we enhance our understanding of particulate matter ($PM_{2.5}$) exposure in residential areas because it is the correlated with health hazards. Daily activities like cooking, cleaning, and opening doors and windows may regulate indoor the chemical process. Moreover, approximately 89.5% of respondents envisioned to be aware of Bangkok's air quality index, and 83.1% preferred Instagram, application as a social media source of information. Other kinds of media were less popular, with a considerable number of individuals showing a preference for television (31.1%) and radio (22.4%) respectively.

RESEARCH CONCLUSIONS

This study is an investigation on $PM_{2.5}$ in Bangkok metropolitan area. The data indicated that while a large percentage of participants were unaware of $PM_{2.5}$, the assumption that it had negative consequences on human health was prevalent. It is essential to raise public awareness, particularly among those who are unaware or previously suffer from respiratory problems. In order to encourage citizens to take preventative measures before developing any of these health issues. Furthermore, an attitude of shared responsibility and raising public awareness about how to contribute to reduce particulate matter ($PM_{2.5}$) should be addressed. Although a large number of respondents were eager to help reduce particulate matter ($PM_{2.5}$), the public's efforts through lower power consumption and reduce using private transportation and consider using public transportation or using a car-pool concept must be highlighted to the public.

RECOMMENDATION

The researcher recommends that an extensive questionnaire could be carried out throughout Thailand to identify possible areas of collaboration with various agencies. The second recommendation is to perform epidemiological research to gain a better knowledge of the reliable interconnected link between particulate matter ($PM_{2.5}$) and health problems in Thailand in general and compare to Bangkok particularly. Additionally, Charernnit, K. & et, al. (2023) stated that in the midst of the 4^{th} industrial revolution particularly after COVID-19, all types of businesses and industries have to adjust their operation which are getting more challenging. Therefore, for future research, the researcher recommends to study the economic consequences of particulate matter ($PM_{2.5}$) impacts by emphasizing on economic impact, investment, public health and wellbeing, in order to anticipate policymakers regarding the relevance of the

connections between economics, investment, wellness and environmental sustainability associated with green energy as well as study the innovation and technology of green energy for home-use appliances that can becoming economical enough to be utilized for home uses and reduce house-hold particulate matter (PM) accordingly.

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