การศึกษาเปรียบเทียบพฤติกรรมการป้องกันและผลกระทบจากฝุ่นละอองขนาดเล็ก (PM2.5) ของนิสิตมหาวิทยาลัยศรีนครินทรวิโรฒ วิทยาเขตประสานมิตรและองครักษ์
A Comparative Study of the Preventive Behavior and Impact of PM2.5 on Students of Srinakharinwirot University Ongkharak and Prasarnmit Campuses

นิพนธ์ต้นฉบับ

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Original Article

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บทคัดย่อ

วัตถุประสงค์: เพื่อศึกษาระดับความรู้ ผลกระทบในด้านต่าง ๆ และพฤติกรรมการป้องกันตนเองกับฝุ่นละอองขนาดเล็ก (PM2.5) นิสิตมหาวิทยาลัยศรีนครินทรวิโรฒ และเปรียบเทียบระหว่างนิสิตในสองวิทยาเขต **วิธีการศึกษา:** การวิจัยเชิงสำรวจ กลุ่มตัวอย่างคือนิสิตมหาวิทยาลัยศรีนครินทรวิโรฒระดับปริญญาตรีทั้งสองวิทยาเขต (องครักษ์และประสานมิตร) จำนวน 330 คน ในช่วงมิถุนายนถึงกรกฎาคม 2019 ใช้แบบสอบถามประเมินความรู้ ผลกระทบ และพฤติกรรมป้องกันตน เปรียบเทียบความแตกต่างระหว่างสองวิทยาเขตโดยใช้ independent t test **ผลการศึกษา:** พบว่านิสิตทั้งสองวิทยาเขตมีความรู้เรื่อง PM2.5 ระดับปานกลาง โดยคะแนนความรู้ของนิสิตวิทยาเขตองครักษ์มากกว่านิสิตวิทยาเขตประสานมิตรเล็กน้อยแต่มีนัยสำคัญทางสถิติ (P-value < 0.01) ทั้งนี้ปริมาณฝุ่น PM2.5 ในช่วง 1 เดือนที่วิจัย พบว่าในพื้นที่องครักษ์มีมากกว่าพื้นที่ประสานมิตรอย่างมีนัยสำคัญทางสถิติ (P-value < 0.001) อย่างไรก็ตาม นิสิตทั้ง 2 พื้นที่คะแนนความเห็นด้านผลกระทบในด้านการเรียน และด้านการใช้ชีวิตประจำวัน และพฤติกรรมการป้องกันตนเองเกี่ยวกับฝุ่น PM2.5 ในระดับสูงและไม่ต่างกัน **สรุป:** ผลการวิจัยในครั้งนี้อาจนำไปเป็นข้อมูลพื้นฐานในการพัฒนาหรือออกแบบโปรแกรมปรับพฤติกรรมการป้องกันตนเองเพื่อลดผลกระทบที่ได้รับจากฝุ่นละอองขนาดเล็กในนิสิตมหาวิทยาลัยศรีนครินทรวิโรฒต่อไป

คำสำคัญ: ฝุ่นละอองขนาดเล็ก; PM2.5; พฤติกรรมการป้องกัน; ความรู้; ผลกระทบ; นิสิต; มหาวิทยาลัย

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Abstract

Objective: To determine levels of knowledge about, impact of and preventive behavior against PM2.5 in undergraduate students of Srinakharinwirot University (SWU) between the two campuses. **Methods:** This survey research in 330 SWU students in Prasarnmit and Ongkharak campuses was conducted from June to July 2022. Questionnaire was used to assess knowledge about, impact of and preventive behavior against PM2.5. Scores of each measure between the two campuses were compared using an independent t test. **Results:** Level of knowledge about PM2.5 in students in both campuses was at a moderate level. Mean score of knowledge in students in Ongkharak campus was slightly higher than that in Prasarnmit campus but with a statistical significance (P-value < 0.01). At the time of survey, PM2.5 level in Ongkharak campus was significantly higher than that in Prasarnmit campus (P-value < 0.001). However, students in both campuses had a high level of impact on learning, impact on daily life and preventive behavior with no difference between the two campuses. **Conclusion:** The findings could be useful in developing program to modify preventive behavior against PM2.5 to reduce its impact on SWU students.

Keywords: particular matter 2.5; PM 2.5; preventive behavior; knowledge; impact; student; university

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Introduction

Particulate matter 2.5 (PM2.5) in the air is the most common problem at the global level with impacts on physical and mental health. Behavioral adaptation to deal with this problem in different ways affect health outcomes. People's behavioral adaptation is therefore of great concern in the PM2.5 hazard.

In Thailand, this PM2.5 situation has been a key problem caused by El Niño that has resulted in severe drought, forest fires, and smog since the end of 2015. According to data on March 13, 2020, Thailand was ranked number one in the world[1] with an excessive amount of PM2.5 especially in the Bangkok Metropolitan region and several provinces, including Nakhon Nayok province. The mean of PM2.5 between January - March 2020 was 51.88 µg/ m^3, which was higher than the standard mean.[2] Consequently, this particulate matter caused an impact on people's respiratory system, especially those with respiratory diseases, e.g., relapse of asthma that would require more use of insufflation.[3] Acute infectious diseases in the lower respiratory system would also cause problems until the function of the lungs would become worse, which could cause emphysema and lung cancer,[4] affect the cardiovascular system[5] (e.g., cerebrovascular disease and heart attack), and skin irritation.[6,7] Thus, for self-care and protection for safety from PM2.5 in children, parents, and

caretakers, the air quality situation could be monitored in the Air4Thai App, and the information should be provided through different channels. Moreover, children should be instructed to drink eight to ten glasses of clean water every day. Children with underlying diseases should also be under very close care. In case of a frequent cough, dyspnea, suffocation, and angina, they should seek immediate medical assistance. When the level of PM2.5 is green (26 $\mu g/m^3$), children should avoid outdoor activities. Additionally, the elderly should avoid activities that could cause PM2.5, e.g., lighting joss sticks, burning joss paper, grilling, burning leaves, burning garbage, etc. When the level of PM2.5 is orange (51 $\mu g/m^3$), outdoor activities such as outdoor exercise should be reduced, and masks should be worn when going outside.[8]

The study on Thailand's PM2.5 management in 2005 used the management of PM2.5 in Thailand according to the WHO's guidelines and similar implementation in various countries such as China, Japan, and Vietnam.[9] The study suggested that to solve this pollution situation would require various measures. For industry, strict implementation of clean energy policies are needed. For transportation, public mass transport by bicycles or walking would lessen pollution. For energy, grilling food in households should be reduced and renewable energy should be used instead. In energy creation, solar or wind energy should be promoted. For city planning, green spaces and parks should be supported. In agricultural and urban garbage management, the incineration of garbage and amounts of organizational garbage should be reduced.[9] Otherwise, the problem of excessive PM2.5 would remain.[10-12] Problems are of greater concerns for areas with dense occupancies. Among various areas, school and universities are one of the most crowded ones.

Srinakharinwirot University Prasarnmit campus is located in Watthana district, Bangkok, Thailand with a high population density. The population, traffic, construction, and diesel combustion due to traffic congestion are the major causes of more PM2.5 in the country. Moreover, between February 3 - 9, 2021, PM2.5 at 30.7 - 64.8 $\mu g/m^3$ was found on Soi Sukhumvit 63, Watthana district,[2] of which the air quality was good to moderate.

Nakhon Nayok is an agricultural province with 28.75% of all households making a living from agriculture, animal husbandry, and fishery. The total agricultural/farming areas are around 466,161 rai (184,305 acres) (35.15% of the province). The people also make a living from services, commerce, labors, and others. The district with the most agriculturists is Mueang Nakhon Nayok, while Ongkharak district contains the largest areas of in-season and off-season rice fields in the province.[13] Furthermore, from observation, straw bases and garbage were removed by burning. Additionally, because this province is a bypass to the capital city, Bangkok, traffic congestion usually occurs, and there is also a number of factories. As a consequence, all of these factors have increased the amount of PM2.5 in Nakhon Nayok. A study by Srisukho et al (2018) on the association between the particle sizes of PM2.5 and each category of vehicles around the Ongkharak Market found that the categories of vehicles with the amounts of PM2.5 included Category 2, i.e., large trucks with three shafts, and Category 5, i.e., motorcycles and three-wheeled vehicles.[14] Most impacts included eye irritation and allergies (ibid). In examining the data between February 3 - 9, 2020, it was found that PM2.5 was 53.2 – 75.0 $\mu g/m^3$,[2], of which the air quality was moderate.

Previous studies and current published research works have mainly focused on the causes and factors, impacts, and solution measures of PM2.5. A study on the levels of knowledge and preventive practices against PM2.5 was also conducted by the students of the Faculty of Management Science, Nakhon Pathom Rajabhat University, ~~Nakhon~~ Pathom Province. Almost all respondents (96.90%) stated that there was PM2.5 in Nakhon Pathom Rajabhat University. Some of them (31.40%) thought that it was caused by combustion, followed by vehicles (28.20%). For the knowledge and preventive practice assessment, their knowledge and prevention were high, while their health was moderate.

To be able to promote health prevention practice among students toward PM2.5, understanding of knowledge, understanding and practice of this group of population should be understood. However, the previous study in Nakhon Pathom province was done only in one school of a university with specific environment. The findings could represent only a limited specific university student. Generalization to a broader group of university students could be problematic.

To better represent a broader group of university students with different geographical differences, the study population of those of Srinakharinwirot University (SWU) could be examined for their opinion. In addition, since the difference of the two campuses (main campus and Ongkharak campus) of SWU exists, different opinions and knowledge of students on PM2.5

and preventive practice in the two settings could also be expected. This study aimed to compare knowledge, preventive measures, and impacts of PM2.5 on health, learning, daily living, and environment of SWU students in the two campuses. The findings could be useful in planning preventive measures for SWU students in the two campuses. Specifically, the study aimed to determine levels of knowledge about PM2.5, impact of PM2.5 on learning, impact of PM2.5 on daily life, and preventive behavior against PM2.5 in SWU undergraduate students in the two campuses. In addition, levels of PM2.5 during the time of the survey in the two campuses were determined and compared. The findings could be useful in developing program or campaign to promote preventive behavior against PM2.5.

Methods

In this cross-sectional study, the study population was undergraduate students of Srinakharinwirot University at Ongkharak campus and Prasarnmit campus, in the academic year of 2021. The sample size calculation was based on a power analysis of 80% for a comparison of two means using the Glass' formula. [15] In this research, the effect size was calculated from the levels of knowledge and practices against PM2.5 in the students at the Faculty of Management Science, Nakhon Pathom Rajabhat University with means in the experimental and control groups of 3.65 and 3.46, respectively.[16] The standard deviation (SD) in the control group was 0.738.[16] According to the calculation, the effect size was 0.30 which was a small one. The sample size was estimated from the sample size as a one-way hypothesis for a type I error of 5% and a power of 80%.[15] There were 138 participants required per group. However, to compensate for missing data, 20% of participants were added (i.e., 27 participants per group). Thus, this study included 165 participants per group with a total of 330 participants in both groups.

Participant selection

The study participants were recruited from undergraduate students of SWU at Ongkharak campus and Prasarnmit campus using multistage sampling. Eight of 17 faculties at Prasarnmit campus and 4 of 8 faculties at Ongkharak campus were randomly selected. At Prasarnmit campus, for each faculty selected, 20 - 22 students were selected with 5 - 6 students for each academic year of study. At Ongkharak campus, 41 - 42 students were selected with 10 to 11 students for each academic year of study. Each student was random selection without replacement. The number of students selected was proportional to the number of students in each academic year of study. A total number of 165 students for each campus were recruited.

Data collection procedure

To all prospective participants, the researchers provided them with objectives, process, and voluntary nature of the study. The participants were required to complete the questionnaire for this study on their own and could not discuss the contents with each other. Upon completing the questionnaire via Google Forms, the participants were asked to check whether they had completed all the questions. When they submitted it to the researchers, the researchers checked the filled questionnaire. If incomplete, the participants were asked to answer the missed items. It took about 15 - 20 minutes to complete the questionnaire. The researchers collected 330 completed questionnaires from June to July 2022.

Ethical considerations

This study was approved by the Ethics Committee for Human Study of Srinakharinwirot University (approval number: SWUEC/E-170/2564). Participants could withdraw from the study at any time with no negative consequences on their study from the university.

Research instruments

This research used a questionnaire about the preventive behavior and impacts of PM2.5 on Srinakharinwirot University students at the Prasarnmit and Ongkharak campuses. The researchers modified some questions from all questionnaires of Inttarakamhang (2020).[12]

The question consisted of 4 parts. The first part collected demographic characteristics of the participants including age, sex, year of study, and faculty of study. The **second part** assessed levels of knowledge about PM2.5. Of the 10 questions, 4 and 6 items were worded with positive and negative statements, respectively. The response was a 3-point rating scale ranging from 1-No, to 2-Not sure, and 3-Yes. With a possible total score of 1 – 3 points, levels of knowledge

about PM2.5 were categorized as low, moderate and high (1.00 - 1.67, 1.68 - 2.35, and 2.36 - 3.00 points, respectively).

The **third part** assessed the opinions about the impact of PM2.5 on learning and daily life. Of the total of 17 items, 7 assessed the impact on learning and 10 on daily life. The response was a 5-point rating scale ranging from 1-lowest, to 2-low, 3-moderate, 4-high, and 5-highest. With a possible total score of 1 – 5 points, levels of perceived impact were categorized as lowest, low, moderate, high, and highest (1.00 - 1.49, 1.50-2.49, 2.50 - 3.49, 3.50 - 4.49, and 4.50 - 5.00 points, respectively).

The **fourth part** assessed preventive behavior against PM2.5. The 23 questions had a response of a 5 five-point rating scale ranging from 1-lowest, to 2-low, 3-moderate, 4-high, and 5-highest. With a possible total score of 1 – 5 points, levels of preventive behavior were lowest, low, moderate, high, and highest (1.00 - 1.49, 1.50 - 2.49, 2.50 - 3.49, 3.50 - 4.49, and 4.50 - 5.00 points, respectively).

In addition, to show air quality around the time of the study conduct (from June to July 2022), PM2.5 levels around the two campuses were acquired from the website of Air4Thai (Regional weather reports). The levels of air quality were classified as very good, good, moderate, starting to affect health, and affecting health (0 – 25, 26 – 50, 51 - 100, 101-200, and 201 ug/m^3 or higher, respectively). [2]

Quality assurance of the instrument

Since the questionnaire was from the work of Inttarakamhang (2020)[12] and the researchers modified some of the questions, questionnaire in our study was subject to content validity and reliability testing. Three parts of the questionnaire (i.e., knowledge about, impact on and preventive behavior against PM2.5) were tested for content validity by three university instructors specifically two experts who were specialized in community nursing and one in community health. The questionnaire was found to have an acceptable content validity with the content validity index (CVI) of 1.00 for all items.

The internal consistency reliability was tested in 30 individuals with characteristics comparable to the participants. Questions of knowledge about, impact on and preventive behavior against PM2.5 were found to have a high internal consistency reliability with Cronbach's alpha coefficients of 0.86, 0.89, and 0.88, respectively.

Data analysis

Descriptive statistics including mean with standard deviation and frequency with percentage were used to summarize the participants' demographic characteristics and study variables. To compare scores of knowledges about, impact of and preventive behavior against PM2.5 between the two campuses, independent t test or Mann-Witney U test was used as appropriate. Statistical significance level was set at a type I error of 5% (i.e., P-value < 0.05). All statistical analyses were performed using the SPSS version 20.

Results

Of the 330 participants, 165 from each campus, he majority were female (211 or 62.9 %). Their age was from 18 - 25 years old with a mean of 20.64 years. The number of students from each year of study was 25%.

The level of PM2.5 in Prasarnmit campus was 24.33 ± 6.03 ug/m^3 (a very good level) which was significantly lower than that in Ongkharak campus (32.73 ± 10.63 ug/m^3, good level) (P-value = 0.001, independent t test).

Knowledge about PM2.5 was at moderate level in students in both campuses (Table 1). Even with a very small difference, the knowledge of students at Ongkharak campus (2.30 points) was significantly higher than that at the Prasarnmit campus (2.21 points) (P-value = 0.005). For impacts on learning, impacts on daily life, and preventive behavior, all were at a moderate level in students at both campuses and there was no significant difference between the two campuses for each of all measures (Table 1).

Table 1 Levels of knowledge about, impacts of and preventive behavior against PM2.5 (N = 330).

Study variables	Prasarnmit campus (n = 165)			Ongkharak campus (n = 165)			t	P-value
	mean	S.D.	Level	mean	S.D.	Level		
Knowledge about PM2.5	2.21	0.29	Moderate	2.30	0.26	Moderate	2.825	0.005
Impacts on learning	3.75	0.72	High	3.76	0.71	High	-0.110	0.912
Impacts on daily life	3.80	0.67	High	3.79	0.62	High	0.077	0.939
Preventive behavior	3.91	0.57	High	3.90	0.49	High	0.203	0.839

Discussions and Conclusion

This research was a comparative study of the preventive behavior and impact of PM2.5 on the students of Srinakharinwirot University's Ongkharak and Prasarnmit campuses. The objectives were to compare the amount of PM2.5, and levels of knowledge about, impacts on learning

and daily life, and preventive behavior against PM2.5 between the two campuses. However, there were few previous studies comparing the prevention measures and effects of PM2.5 on students. Our findings add more to the literature and certain aspects are discussed as follows.

The situation of PM2.5 in SWU was not bad with a very good level in Prasarnmit campus (24.33 $\pm$ 6.03 ug/m^3) and a good level in Ongkharak campus (32.73 $\pm$ 10.63 ug/m^3). The WHO set a pollution control limit of PM2.5 in the air at no more than 25 ug/m^3, which is considered hazardous to health. However, in Thailand, the danger limit of PM2.5 dust is 50 ug/m^3. Hence, these PM2.5 levels were congruent with the study of Kliengchuay et al (2022).[17]

They evaluated the rural area of Ratchaburi province that had the highest concentration of 136.42 μg/m^3 and the lowest of 2.33 μg/m^3. The annual average of PM2.5 in Ratchaburi was 26.86 μg/m^3, which could be observed as exceeding the standard in some periods of the year but extremely exceeding the WHO's guidelines. Additionally, Chansuebsri et al (2022) studied the urban atmosphere of northern Thailand and found that the source identification of PM2.5 by cluster analysis during the burning season in rural sites was higher than in urban sites from burning, traffic, and transboundary pollution.[18]

It was found that the score of knowledge about PM2.5 in students at Ongkharak campus (2.30 points) even though was significantly higher than those at Prasarnmit campus (2.21 points) (P-value < 0.01), scores of knowledge in both campuses were at a moderate level. The small difference between the two campuses could be viewed as no practical difference. This research congruent with the study of Yuhe Z et al (2021), that student behavior was recognized as an important influential factor in indoor air quality.[19] Student behavior was recognized as an important influential factor in indoor air quality.[19]

The knowledge about PM2.5 of the students at Ongkharak campus (provincial area) was significantly higher than that at Prasarnmit campus (city area). With higher PM2.5 level in Ongkharak campus, students in provincial areas at risk from PM2.5 dust would have better protection and pollution health concerns than students in cities. Our finding is consistent with the work of Reames and Bravo (2018).[20] However, people in the Bangkok Metropolitan Region had a high level of attitude to avoid the risk from the PM2.5 problem (84.1%), followed by risk perception (81.5%), and knowledge (62.1%).[21]

It was found that the impacts on learning and daily life, and preventive behavior against PM2.5 were all at high level and not different between the two campuses. These results were consistent with the study of Weng et al. (2021).[22] They studied about population aging and air pollution as global concerns. The results showed similar mean score of PM2.5 preventive behavioral intention among the elderly with and without chronic diseases. Furthermore, the research of Pimkot et al (2021).[23] They study about the preventive behavior against PM.2.5 in Bachelor's degree students of Dusit district, Bangkok and found that the self-practice of the participants was comparable regardless of sex, age, and education level.

The study of Kim and Ha (2020) investigated the predictors of behavior related to particulate matter in nursing students. The level of knowledge, attitude and behavior were relatively high. The significant predictors of the behavior were attitude. They suggested educational programs to enhance nursing students' health promoting behaviors against particulate matter and must be focused on attitude change.[24]

The knowledge about PM2.5 in Srinakharinwirot University students at the Ongkharak campus was significantly higher than those at the Prasarnmit campus (P-value < 0.01). This could correspond to the amount of PM2.5 at the Ongkharak campus that was significantly higher than that at Prasarnmit campus (P-value < 0.001). Even though statistically significant, such slightly higher knowledge score found in students at Ongkharak campus would hardly show practical difference. This could also indicate why the scores of behavior between the two campuses were not different even though we did not prove this association statistically.

The students' preventive behavior against PM2.5 in the two groups was not different. Therefore, from the implication of the study, a self-protection behavior program should be implemented to prevent the impact of PM2.5 on Srinakharinwirot University students. These results showed that health education regarding the threat of PM2.5 on the health of the students should be strengthened, so to enhance their knowledge, preventive attitude, and preventive behavioral intention toward PM2.5.[25] For this reason, the results could be used as basic data to develop or design a self-protection behavior program to prevent the impact of PM2.5 on Srinakharinwirot University students and affected people. Furthermore, capacity building and networking through all the relevant organizations should be conducted in

the risk areas to reduce the influencing factors affecting the human health risks due to PM2.5 in the future.

The present study has certain limitations. The sample was undergraduate students of Srinakharinwirot University. Generalization to individuals of other age or other levels of education could be limited. Since our study was cross-sectional in design, the cause-effect relationship could not be tested. Further studies with longitudinal design with a wider groups of university students and students at other types of institutions should be conducted.

The findings could be useful in developing a campaign or program to promote health behavioral changes related to PM2.5 prevention. Public awareness campaigns should be combined with education to enhance the perception that the public could protect themselves and be tailored explicitly for all target populations.

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