PARTICULATE MATTER RELATED TO RESPIRATORY SYMPTOMS IN LIBRARY STAFF AND ADMINISTRATIVE OFFICERS AT CHULALONGKORN UNIVERSITY, BANGKOK, THAILAND

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ABSTRACT:

Background: Poor indoor air quality is known to cause to health issues such as chronic obstructive pulmonary disease (COPD), ischemic heart disease, acute lower respiratory disease, lung cancer. The indicators for indoor air quality include particulate matter (PM), carbon dioxide (CO_2), carbon monoxide (CO), fungi or other gas. With regard to indoor particulate matter, libraries are commonly known to have high PM values due to a large volume of old and new books. The purpose of this study was to identify association between the level of particulate matter diameter less than 10 micrometer (PM_{10}) and respiratory symptoms among library staff and administrative officers at Chulalongkorn University, Bangkok, Thailand.

Methods: This study was a cross-sectional survey. The participants were 119 library staff (exposure group) and 74 administrative officers (unexposed group). The data collection was done by face-to-face interview with structure questionnaire and personal particulate matter measurement (PM_{10} measurement). Analyzed data with statistics including Chi-square test, Fisher's exact test and logistic regression to identify association between particulate matter (PM_{10}) and respiratory symptoms.

Results: The PM_{10} exposure in library staff was significantly higher than in administrative officers ($p< 0.05$) but the PM_{10} exposure did not exceed the standard of the Occupational Safety and Health Administration (OSHA = 5000 μg/m^3). The prevalence of respiratory symptoms in library staff was not significantly higher than administrative officers (OR > 1.0, $p> 0.05$). However PM_{10} was significantly associated only with wheezing (OR=1.005, p=0.05).

Conclusions: The PM_{10} exposure in library staff was higher than administrative officers but it was associated only with wheezing symptoms. Moreover, besides the PM_{10} concentration there were other factors with positive significant association with the symptoms such as respiratory and allergic disease also with daily smoke exposure from open burning. The factors which negative significant association with the symptoms were gender, renovation of workplace by re-painting and daily smoke exposure from incent.

Keywords: Particulate matter, Respiratory symptoms, Library staff, Administrative officers, Thailand

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INTRODUCTION

In 2012, World Health Organization (WHO) established that poor indoor air quality can lead to disease such as stoke (34%), COPD (26%), ischemic heart disease (22%), acute lower respiratory disease (12%) or lung cancer (6%). These diseases are often caused by household pollutants including cooking in the house without chimney [1]. Dust, CO_2, CO or VOCs from the charcoal fuel or wood is circulated in the house and causes health problem [2]. Nevertheless besides the household there are many other places where poor indoor air quality can be an issue, for example, offices, restaurant, food court, hospital, school and university. According to Daisey et al. [3], CO_2, fungi, bacteria, VOCs and formaldehyde

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were contaminated in the classroom and caused to asthma, respiratory and allergic symptoms in students. Libraries are also a possible venue to have a problem from poor indoor air quality because there are numerous books accumulated in all areas of the place. The study of Wlazlo et al. [4] and Lloyd [5] found that books and documents, especially the old ones, lead to high concentration of dust. The dust will contaminate library air and with high temperature and humidity, the rate of accumulation of dust may be higher. As described above, there were only few studies related to particulate matter (PM) association with respiratory symptoms in libraries. For Thailand, this paper is the first to explore particulate matters exposure and compare its association to the symptoms of workers who working in the library and administrative office. The objective of this study was to measure the concentration of PM_{10} and identify association between PM_{10} and respiratory symptoms among library staff and administrative officers.

METHODOLOGY

Questionnaire

This study was cross-sectional survey with 193 participants from Chulalongkorn university separated into 2 group including 119 library staff (exposed group) from 6 libraries and 74 administrative officers (unexposed group) from 4 offices. We used face-to-face interview with structure questionnaire and standard questionnaire for respiratory symptoms developed from the British Medical Research council (BMRC) and Epidemiology Standardization project [6]. The questionnaire contains questions about socio-demographic (sex, age, respiratory and allergic disease and smoke behavior), daily behavior (work transportation, daily dust exposure and pesticide used), work characteristic (period time to work, work history with exposure to dust and pesticide and period of work per day), workplace characteristic (structure of workplace, type of floor and wall, type of ventilation, clean schedule and renew workplace), respiratory symptoms.

Particulate matters measurement

Particulate matters exposure was measured in two groups, 72 library staff (exposed group) and 35 administrative officers (unexposed group). The measurement of particulate matters diameter less than 10 micrometer (PM_{10}) is conducted by a protocol of the National Institute for Occupational Safety and Health (NIOSH) method number 0600 [7] that including personal pump with flow calibration, Polyvinyl Chloride filter (PVC filter) size 37 millimeter and personal impaction sampling device for PM_{10} (PEM). Calculated PM_{10} concentration by pre-post weight difference with current flow rate of personal pump over volume of air intake per routine of the officer worked (about 8 hours).

Data analysis

Data analysis was done using SPSS version 22.0 (Chulalongkorn University licensed). Chi-square and Fisher's Exact test (Statistic significant at $p < 0.05$) for descriptive independents of socio-demographic, daily behavior, work characteristic, workplace characteristic also compared prevalence of respiratory symptoms difference between groups of dust exposure. Independent sample t-test is employed to compare the mean of PM_{10} concentration between library staff and administrative officers (Statistic significant at $p < 0.05$). The PM_{10} concentration was compared to regulation from OSHA that established standard value of respirable dust in Time Wight Average (TWA) is less than 5000 $\mu g/m^3$. The respiratory symptoms were classified the symptoms by guideline modified from previous studied of Ahmed and Abdullah [8]. Logistic regression was used to analyze association between PM_{10} with respiratory symptoms (Statistic significant at $p < 0.05$).

RESULTS

Socio-demographic

This study has 193 participants separated in 119 exposed groups (library staff) and 74 unexposed groups (administrative officers). The library staff and administrative officers mostly are women. The mean of age in library staff was positive significantly higher than administrative officers, 45 and 37 years old respectively ($p < 0.0001$). Most of worker both in library staff (89.9%) and administrative officers (89.2%) do not have respiratory and allergic diseases. 96.6% and 87.8% of library staff administrative officers respectively did not smoke. Library staff used pesticide in household positive insignificantly higher than administrative offers, 42.9% and 37.8% respectively ($p = 0.490$) (Table 1).

Work characteristic

About 74.3 % of administrative officers and 41.2% of library staff was working in their current position less than 10 years ($p < 0.001$). Historical of dust exposed in the past, found that library staff had positive significantly lower than administrative officers, 3.4% and 12.2% respectively ($p = 0.034$). The example of historical worked which exposed to

Table 1 Demographic in library staff compared with administrative officers

Characteristics	Library staff (n= 119)	Administrative officers (n= 74)	*p-value*
Age (year), mean(SD)	44.9 (10.61)	37.3 (9.73)	<0.001[a]
Sex (%)			
Male	24 (20.2)	30 (40.5)	0.002[b]
Female	95 (79.8)	44 (59.5)	
Respiratory and allergic disease (%)			
Yes	12 (10.1)	8 (10.8)	0.872[b]
No	107 (89.9)	66 (89.2)	
Smoke behavior (%)			
Never smoke	115 (96.6)	65 (87.8)	0.034[f]
Smoke : current and Ex-smoke	4 (3.4)	9 (12.2)	
Pesticide used in household (%)			
Yes	51 (42.9)	28 (37.8)	0.490[b]
No	68 (57.1)	46 (62.2)	

[a] Independent sample t-test, [b] Chi-square test

[b] Chi-square test, [f] Fisher's Exact test

Table 2 Work characteristic in library staff compared with administrative officers

Characteristics	Library staff (n= 119)	Administrative officers (n= 74)	*p-value*
Period time of work (%)			
Less than 10 years	49 (41.2)	55 (74.3)	<0.001[b]
11 - 20 years	27 (22.7)	7 (9.5)	
21 - 30 years	22 (18.5)	7 (9.5)	
More than 30	21 (17.6)	5 (6.8)	
Work history with exposure to dust (%)			
Yes	4 (3.4)	9 (12.2)	0.034[f]
No	115 (96.6)	65 (87.8)	
Period of work per days (%)			
5 - 7 hours	13 (10.9)	11 (14.9)	0.581[b]
More than 7 - 8 hours	55 (46.2)	36 (48.6)	
More than 8 hours	51 (42.9)	27 (36.5)	

[b] Chi-square test, [f] Fisher's exact test

dust in library staff was building construction, medicine processing, accumulated of paper's room and wood decoration. On the other hands, the example for administrative officers were farmer, building construction, engine maintenance, herb processing, packaging, wood decoration and private company. Most of library staff and administrative officers has been working in their workplace between 7 – 8 hours per day also administrative officers positive insignificantly higher in period of work per day than library staff, 48.6% and 46.2% respectively (p = 0.581) (Table 2).

Workplace characteristic

The structure of workplace, mostly both of library staff and administrative officers worked in cement construction workplace and floor of workplace in both groups made from cement, rubber and other material: wood, laminate or carpet respectively (p = 0.536). The ventilation process of library staff was air conditioners positive significantly higher than administrative officers (p = 0.012). The libraries cleaned floor nearly every day positive significantly higher than administrative offices (p<0.0001) and similarly to air conditioner clean schedule most of libraries cleaned air conditioners 1 times per month (69.7%) while administrative offices cleaned their air conditioner about 4 times per year (p<0.0001). More than this, last year the workplace of library staff (82.4%) had been renovated positive significantly higher than administrative officers (64.9%) (p = 0.006) for example including changed floor, set up wallpaper, decoration areas, polish floor and painted. The firstly type of renewed workplace in both 2 groups was polished floor, library staff (64.7%) had polished floor in workplace positive significantly higher than administrative officers (47.3%) (p = 0.017) (Table 3).

Particulate matters exposure

This study was measurement particulate matters

Table 3 Workplace characteristic in libraries compared with administrative offices

Characteristics	Library staff (n= 119)	Administrative officers (n= 74)	*p-value*
Ventilation material (%)			
Air conditioner	116 (97.5)	65 (87.8)	0.012[f]
Other : Fan Natural ventilation	3 (2.5)	9 (12.2)	
Floor cleaned (%)			
Everyday	115 (96.6)	53 (71.6)	<0.001[b]
Not more than 3 times/week	4 (3.4)	21 (28.4)	
Air conditioner cleaned (%)			
Never	12 (10.1)	9 (12.2)	
Everyday	3 (2.5)	6 (8.1)	<0.001[b]
1 times per month	83 (69.7)	29 (39.2)	
Other: 1-4 times per years	21 (17.6)	30 (40.5)	
Renew workplace (%)			
Yes	98 (82.4)	48 (64.9)	0.006[b]
No	21 (17.6)	26 (35.1)	
Type of renew workplace (%)			
Floor renew	51 (42.9)	10 (13.5)	<0.001[b]
Set up wallpaper	7 (5.9)	1 (1.4)	0.157[f]
Renovated areas	48 (40.3)	6 (8.1)	<0.001[b]
Polished floor	77 (64.7)	35 (47.3)	0.017[b]
Re-paint	54 (45.4)	12 (16.2)	<0.001[b]

[b] Chi-square test, [f] Fisher's Exact test

Table 4 PM_{10} exposure of library staff compared with administrative officers

Characteristics	Library staff (n= 119)	Administrative officers (n= 74)	*p-value*
1. PM_{10} ($\mu g/m^3$)**:** Mean (SD)	202.81(176.9)	102.95(69.5)	**<0.001[a]**
2. PM_{10} ($\mu g/m^3$)**:**			
- Minimum	9.89	9.88	
- Maximum	1298.7	515.53	

[a] Independent sample t-test.

Table 5 Unadjusted prevalence of respiratory symptoms in library staff compared with administrative officers

Characteristics	Total prevalence (n=193)	Libraries staff (n= 119)	Administrative officers (n= 74)	OR[b]	*p-value*[b]
Respiratory symptoms (%)					
Cough	30 (15.5)	21 (17.6)	9 (12.2)	1.55	0.307
Phlegm	28 (14.5)	14 (11.8)	4 (5.4)	2.33	0.140
Wheezing	35 (18.1)	22 (18.5)	13 (17.6)	1.06	0.872
Shortness of breath	64 (33.2)	45 (37.8)	19(25.7)	1.76	0.082

[b] Chi-square test.

diameter less than 10 micrometer (PM_{10}). The results show that library staff exposed to PM_{10} positive significantly higher than administrative officers including 202.81 and 102.95 $\mu g/m^3$ respectively ($p < 0.0001$). Range of PM_{10} exposure in library staff was 72.52 – 370.60 $\mu g/m^3$ while in administrative officers was 42.89 – 140.12 $\mu g/m^3$ (Table 4).

Respiratory symptoms

Total prevalence of respiratory symptoms in the worker both with library staff and administrative officers showed that shortness of breath (33.2%) was the highest prevalence. The library staff had risk to be respiratory symptoms positive insignificant higher than administrative officers for cough (OR = 1.55, $p = 0.307$), phlegm (OR = 2.33, $p = 0.307$), wheezing (OR = 1.06, $p = 0.307$) and shortness of breath (OR = 1.76, $p = 0.307$) (Table 5).

Other factors associated to respiratory symptoms.

The study showed that PM_{10} was not strong association to respiratory symptoms any more. It was possible that there were other factors that

Table 6 Independent variables statistically significantly associated with respiratory prevalence

No.	Symptoms	Other factors	OR	*p-value*
1	Cough	Respiratory and allergic disease	3.358	0.03
2	Phlegm from chest	1. libraries group	4.702	0.046
		2. Sex (Female vs. male)	0.218	0.008
		3. Re-painting workplace	0.172	0.017
3	Wheezing	1. PM_{10} exposure	1.005	0.050
		2. Respiratory and allergic disease	3.928	0.020
		3. Sex (Female vs. male)	0.398	0.043
		4. Incent smoke exposed	0.060	0.015
4	Shortness of breath	Smoke from open burning exposed	3.464	0.010

related or causes to both symptoms in library staff and administrative officers such as sex in term of female to male, respiratory and allergic disease, exposed to smoke from incent, traffic or open burning etc. we can explain like Table 6.

DISCUSSION AND CONCLUSION

This was the first study in Thailand on the association of particulate matters and respiratory symptoms among workers at libraries and offices. The results show that the socio-demographic of the library staff mostly difference from administrative officers ($p < 0.05$). Library staffs mostly were woman and had worked for more than 10 years. This finding is consistent with the work of Sanwa [9] and Maitawthong [10] about age of librarians mostly more than 51 years old. There were similarly socio-demographic of respiratory disease history, pesticide used and period of worked per day ($p > 0.05$). Nevertheless, the result shown that the libraries had concentration of PM_{10} higher than administrative offices so the library staff were exposed to PM_{10} than administrative officers, this result was similarly with result of Thepaksorn et al. [11]. This consistent to previous studied of Lloyd [5] who found that dust in libraries could increase and strict on the books, shelf, and gap of books depend on increasing of humidity level and temperature in the room. More than this, the library staff had prevalence of respiratory symptoms higher than administrative officers but we found that the particulate matters (PM_{10}) association only with wheezing ($p < 0.05$) which consistent to The study of Bakke et al. [12] about dust association with wheezing and rash symptoms respectively. It was possible that PM_{10} exposure in libraries and administrative offices rarely low (It was not exceed to the standard (OSHA= 5000 $\mu g/m^3$) [13]. However there were any respiratory symptoms which were not significantly associated with PM_{10} exposure such as cough, phlegm from chest and shortness of breath, it was possible that they were associated to other factors which promotes the symptoms such as respiratory and allergic disease history, gender, daily smoke exposure from incent smoke and open burning also with renew workplace by re-painting. More than this, in generally the symptoms in the worker possible came from dust mite allergen, microorganism such as fungi, virus or bacteria, Carbon dioxide (CO_2), Nitrogen dioxide (NO_2), Volatile Organic Compounds (VOCs), Benzene, Formaldehyde and Polycyclic Aromatic Hydrocarbons (PAHs) in the air that consisted to WHO indoor air quality guideline [14] also the previous studied of Leartkankasuk et al. [15], Wlazlo et al. [4] and Daisey et al. [3].

However in the future should to have study about the other factors which associated to respiratory symptoms in the libraries such as fungi, bacteria or any chemicals for prediction the symptoms which can be occur in the workplace. The recommendation to prevent workers from symptoms is health promotion for them by dissemination knowledge on personal health care such as 6 steps of hand washing or the people who were respiratory disease should to use masks when they arrange or keep books on the shelves for decrease risk of symptoms from particulate matter.

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