Respiratory Symptoms and Pulmonary Function of Traffic Policemen in Thonburi†

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Abstract

A cross-sectional study was conducted to assess whether traffic policemen working in Thonburi district of Bangkok had poorer respiratory health than the normal Thai population. The benefits of wearing masks as a preventative measure against the respiratory hazards of air pollution were assessed. Traffic policemen (n=629) who had worked in Thonburi and male subjects (n=303, the control group) were evaluated for respiratory symptoms using the British Medical Research Council questionnaire. Their pulmonary function was measured by spirometry. Only non-smokers were included in the final analysis and it was found that traffic policemen (n=242) suffered significantly more cough or phlegm (18.6% *vs* 7.8%, P=0.005) and more rhinitis symptoms (17.8% *vs* 7.8%, P=0.009) than the control subjects (n=129). The traffic policemen also had a significantly higher prevalence of abnormal air flow (FEV1<80% predicted) than the control group (21.1% *vs* 12.4%, P=0.04). The mean values of FEV1 and FVC of the traffic policemen were significantly lower than the control group (3.29 ± 0.5 L *vs* 3.43 ± 0.5 L, P=0.01 for FEV1 and 3.86 ± 0.5 L *vs* 3.98 ± 0.6 L, P=0.047 for FVC). Traffic policemen who did not use protective masks had not only a significantly higher prevalence of abnormal FEV1 but also a significantly higher prevalence of abnormal FVC than the control group (35% *vs* 14%, P=0.046). They also had higher relative risks of abnormal FEV1 (2.76 *vs* 1.63) and FVC (2.51 *vs* 1.23) than those who used protective masks. Multivariate analyses with controlling for age, height, and pack-years of cigarette smoking, revealed that the traffic policemen were significantly and independently associated with lower FEV1 and FVC.

In conclusion, the traffic policemen who work in Thonburi have more cough and rhinitis symptoms and lower FEV1 and FVC than the normal Thai population. Traffic policemen who do not use protective masks have higher relative risks of abnormal FEV1 and FVC than those who use them.

Key word : Respiratory Symptoms, Pulmonary Function, Traffic Policemen, Thonburi

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A large and growing body of literature has documented the detrimental effects of outdoor air pollution on respiratory health, both from acute and long term exposure. These effects include increased risks of respiratory symptoms[1-3], decreased lung function[4,5], an increased daily admission of patients to hospital with cardiorespiratory diseases[6], as well as increasing mortality in some population groups[7].

The main pollutants in ambient air are ozone, nitrogen dioxide, particulate matter, sulfur dioxide, and acid aerosols. All have various impacts on respiratory health. Some reports show that fine particulate matter is associated with the worst respiratory effects[5,7,8].

Ambient air pollution results from the combustion of fossil fuels and one of the main sources is vehicle exhausts. As Bangkok is a city plagued by traffic woes, it is to be expected that vehicle exhausts lead to high levels of air pollutants. The annual reports of the Pollution Control Department in 1993, 1994 and 1995[9] showed that the annual mean concentration and the average of maximum levels reached during a 24 hour period of both total suspended particulate matter and PM10 (inhalable particles <10 um diameter) recorded at roadside air-monitoring stations in different areas of Bangkok and Thonburi exceeded the constituting quality air.

This raised the awareness of the authorities that there may be respiratory health hazards from air pollution for people living in Bangkok. One of the population groups most at risk is traffic policemen. This group could serve as a significant model of people experiencing long term exposure to air pollution. There have been very few studies of the respiratory health of traffic policemen in Bangkok. In 1990, Aekplakorn et al[10] compared the respiratory health of Bangkok traffic policemen and members of the police force in other departments. They reported that traffic policemen had more cough and phlegm than their colleagues, but there was no significant difference in their lung function parameters. However, in that study after adjusting for smoking habits, the populations were too small to have detected significant differences in lung function parameters between the two groups.

In 1997, Chaipiyaporn et al[11] compared the pulmonary function of Bangkok traffic policemen who worked in highly polluted areas and that of policemen who worked in areas with little pollution. This study showed that those who worked in highly polluted areas had a lower vital capacity and chest expansion than those who worked in areas with less pollution. Nevertheless, that study did not take into account smoking which is a significant confounding factor. The results of both these studies were controversial and did not answer the question whether Thai traffic policemen had poorer respiratory health than the general population, or not.

A great many traffic policemen, in one way or another, have been encouraged to wear masks to protect themselves from the polluted air. But how effective these masks are is yet to be investigated as no information on this aspect is available.

Because air pollution is a product of the way that society has chosen to live, obtaining an accurate picture of the extent which current levels of air pollution contribute to poor health is imperative. An opportunity to do this occurred in 1996 when the Police Department sent all the traffic policemen working in Thonburi to undergo an annual check-up at Siriraj Hospital. One part of this schedule was an evaluation of their pulmonary function at our respiratory division. We then performed a study with the objective of assessing whether traffic policemen did indeed have poorer respiratory health concerning respiratory symptoms and pulmonary function than the normal Thai population. We also took a particular interest in determining the benefits of wearing masks as a preventative measure against the respiratory hazards from air pollution.

METHOD

A cross-sectional study was conducted in 1996-1997. The subjects of the study were 629 traffic policemen who were sent for their annual check-up at our respiratory division. All were enrolled in this study. They worked in different areas in the Thonburi district of Bangkok.

The control group included males aged between 20-60 years selected randomly from students, government officers, and workers who had come to Siriraj Hospital for a health evaluation in preparation for going abroad. All were in good health with no history of occupational exposure to air pollution or any substance that has been proved to have adverse respiratory health effects. These people were representative of the normal Thai population who have not had any long term exposure to air pollution. From calculation, the number of subjects in the control group had to be more than 300, and finally, a total of 303 controls were recruited to this study.

Respiratory health evaluation

Respiratory health was evaluated by means of a questionnaire on respiratory symptoms and by performing lung function tests. The questionnaire was a modified Thai version of the British Medical Research Council Questionnaire on Respiratory Symptoms[12] and the subjects were interviewed by trained respiratory technicians. This questionnaire was used to assess the presence of chronic respiratory symptoms and was composed of four subgroups of questions about cough and phlegm, dyspnic symptoms, asthmatic symptoms, and atopic status. Additional questions helped to collect demographic data and document any history of cigarette smoking. Information on how long each traffic policeman had worked in this job, and if he wore a protective mask, was also collected.

Lung function tests through spirometric measurement were performed using a PFT Horizon System Five spirometer (Sensormedics, California) which is a rolling-seal type spirometer with characteristics which meet the recommendations of the American Thoracic Society (ATS). All spirometric measures were performed in accordance with ATS guidelines[13].

Characterization of smoking history

Subjects were classified as non-smokers (total smoking of less than 0.5 pack-year in the past, and no smoking within the last six months) and smokers (including both former smokers and current smokers). In the classification of pack-years of cigarette smoking, non-smokers were classified as having 0 pack-years of cigarette smoking.

Statistical analyses

Only the non-smoking subjects in both the traffic policemen and control groups were chosen for the analysis. Statistical analyses were carried out with SPSS statistical software. The prevalence of respiratory symptoms and abnormal lung function parameters (FEV1<80% predicted, FVC <80% predicted, FEV1/FVC <70%, FEF 25-75<65% predicted) in traffic policemen and controls were compared using Chi-square analysis and relative risk estimation. Multivariate analysis was used to describe and estimate the magnitude of the relationship between the lung function parameters and the subject's occupation as a traffic policeman.

RESULTS

Characteristics of all study subjects

A total of 629 traffic policemen were studied, together with 303 subjects in the control group. The demographic characteristics of both groups are shown in Table 1. The mean age and mean height of both groups were found to be simi-

Table 1. Demographic characteristics of all study subjects.

	Traffic policemen (n=629)	Control (n=303)
Age (year)	35.9±6.5	34.3±9.7
Height (cm)	168.4±4.8	166.6±6.1
Smoking history		
Non smokers	242(38.5%)	129(42.6%)
<20 pack-years	364(57.9%)	161(53.1%)
≥20 pack-years	23(3.6%)	13(4.3%)
Non smokers age (year)	34.5±6.4	32.2±9.5
Non smokers height (cm)	168.1±5	166.8±5.6

Table 2. Duration of work and the use of protective masks of traffic policemen.

	Number (total = 629)	%
Duration of works in traffic		
<5 years	257	40.8
5-10 years	137	21.8
>10 years	235	37.4
use of protective masks		
without masks	57	9.1
use cloth surgical masks	275	43.7
use particulate respirators	297	47.2

Table 3. Resident areas and occupations of control subjects.

	Number (total =303)	%
Resident areas		
Bangkok	70	23.1
Other provinces	233	76.9
Occupation		
Farmers and gardener	105	34.6
Government officers	103	34.0
Office workers	56	18.6
Self-employed	31	10.2
Students	8	2.6

lar. The mean age and mean height of both groups were also similar when only the non-smokers were considered.

Most of the traffic policemen (90.9%) wore protective masks while working. Cloth surgical masks and particulate respirators were used equally. The length of time that these traffic policemen had spent in this job is shown in Table 2. Most of the control subjects (76.9%) lived in provinces outside Bangkok. Their occupations are shown in Table 3.

Prevalence of respiratory symptoms

The prevalence of respiratory symptoms of the non-smokers in both groups were compared with

Table 4. Prevalence of respiratory symptoms in non-smoking traffic policemen and control subjects.

Respiratory symptoms	Traffic policemen (n=242)	Control (n=129)	RR (95% CI)	P-value
Cough or Phlegm	45(18.6%)	10 (7.8%)	2.4 (1.25-4.6)	0.005*
Dyspnea	45(18.6%)	14(10.8%)	1.71(0.98-3.0)	0.05
Rhinitis symptoms	43(17.8%)	10 (7.8%)	2.29(1.19-4.41)	0.009*
Chronic bronchitis	5 (2.1%)	3 (2.3%)	0.89(0.22-3.66)	0.9
Asthmatic symptoms	5 (2.1%)	3 (2.3%)	0.89(0.22-3.66)	0.9

*Statistically significant difference

Table 5. Relationship between duration of work amidst the traffic and respiratory symptoms in non-smoking traffic policemen.

Duration of work amidst traffic	Cough			Rhinitis		
	n	RR (95%CI)	P-value	n	RR (95% CI)	P-value
>10 years (n=86)	16(18.6%)	1.28(0.69-2.39)	0.5	19(22.1%)	1.53(0.83-2.83)	0.4
5-10 years (n=52)	12(23.1%)	1.5 (0.77-2.93)		9(17.3%)	1.2 (0.56-2.56)	
<5 years (n=104)	16(15.4%)	1			15(14.4%)	1

Table 6. Prevalence of respiratory symptoms in non-smoking traffic policemen who had and had not used protective masks.

Respiratory symptoms	Protective masks used (n=222)	Protective masks not used (n=20)	RR (95% CI)	P-value
Cough or Phlegm	42(18.9%)	3(15%)	0.79(0.27-2.33)	0.7
Rhinitis	40(18%)	3(15%)	0.83(0.28-2.45)	0.7

Table 7. Prevalence of abnormal spirometry in non-smoking traffic policemen and control subjects.

Abnormal spirometry	Traffic policemen (n=242)	Control (n=129)	RR (95% CI)	P-value
FEV1 <80% predicted	51(21.1%)	16(12.4%)	1.7 (1.01-2.86)	0.04*
FVC <80% predicted	45(18.6%)	18(13.9%)	1.33(0.81-2.2)	0.26
FEV1/FVC <70%	2 (0.8%)	1 (0.8%)	1.07 (0.1-11.65)	0.96
FEF25-75 <65% predicted	60(24.8%)	24(18.6%)	1.33(0.87-2.03)	0.18

* Statistically significant difference

the relative risk (RR) estimation as shown in Table 4. The traffic policemen suffered significantly more cough or phlegm and more rhinitis symptoms than the control group with relative risks of 2.4 and 2.29 respectively. However, both groups had a similar small number of subjects who had symptoms compatible with chronic bronchitis and asthma.

The relationship between the length of time the subjects had worked as traffic policemen and the cough and rhinitis symptoms are shown in Table 5. The traffic policemen who had worked longer amidst the traffic appeared to have a higher relative risk of having cough and rhinitis symptoms. However, these differences were not statistically significant. There was also no significant difference in the prevalence of cough or phlegm and rhinitis symptoms between those traffic policemen who had used protective masks and those who had not (Table 6).

Prevalence of abnormal spirometry

The lung function parameters of the non-smoking traffic policemen and the control subjects are shown in Table 7. The traffic policemen had a significantly higher prevalence of abnormal air flow (FEV1 <80% predicted) than the control group. The mean values of FEV1 and FVC of the traffic policemen were also significantly lower than the control group as shown in Table 8. However, there was no difference in the prevalence of air flow obstruction (FEV1/FVC <70%) between these two groups. As we were aware that protective masks may have had some protective effects and that this should be considered as a confounding factor in the interpretation of the results, we reanalyzed the lung function parameters of the non-smoking traffic policemen who had not used protective masks. This group of traffic policemen had not only a significantly higher prevalence of abnormal FEV1 but also a higher prevalence of abnormal FVC (FVC<80% predicted) as shown in Table 9. What is more, when compared to the control group, the relative risks of having abnormal FEV1 and FVC of the traffic policemen who had

Table 8. Mean values of FEV1 and FVC in non-smoking traffic policemen and control subjects.

	Traffic policemen	Control	P-value
FEV1(L)	3.29±0.5	3.43±0.5	0.01*
FVC (L)	3.86±0.5	3.98±0.6	0.047*

* Statistically significant difference

Table 9. Prevalence of abnormal spirometry in non-smoking traffic policemen who had not used protective masks and control subjects.

Abnormal spirometry	Traffic policemen (n=20)	Control (n=129)	RR (95% CI)	P-value
FEV1 <80% predicted	6(30%)	16(12.4%)	2.76(1.2-6.35)	0.03*
FVC <80% predicted	7(35%)	18(14%)	2.51(1.2-5.23)	0.046*
FEV1/FVC <70%	0	1(0.8%)	-	-
FEF25-75 <65% predicted	7(35%)	24(18.6%)	1.88(0.94-3.78)	0.13

* Statistically significant difference

Table 10. Prevalence of abnormal spirometry in non-smoking traffic policemen who had used protective masks and control subjects.

Abnormal spirometry	Traffic policemen (n=222)	Control (n=129)	RR (95% CI)	P-value
FEV1 <80% predicted	45 (20.3%)	16 (12.4%)	1.63 (0.96-2.77)	0.06
FVC <80% predicted	38 (17.1%)	18 (14.0%)	1.23 (0.73-2.06)	0.44
FEV1/FVC <70%	2 (0.1%)	1 (0.8%)	1.16 (0.11-12.69)	0.69
FEF25-75 <65% predicted	53 (23.9%)	24 (18.6%)	1.28 (0.83-1.97)	0.25

Table 11. Relationship between abnormal spirometry and the use of protective masks in non-smoking traffic policemen.

Abnormal spirometry	Protective masks		RR (95% CI)	P-value
	used (n=222)	not used (n=20)		
FEV1 <80% predicted	45(20.3%)	6(30%)	1.48(0.72-3.04)	0.22
FVC <80% predicted	38(17.1%)	7(35%)	2.04(1.05-3.97)	0.05
FEV1/FVC <70%	2 (0.9%)	0	-	-
FEF25-75 <65% predicted	53(23.9%)	7(35%)	1.47(0.77-2.79)	0.2

Table 12. Regression coefficients of various independent variables associated with the change in lung function parameters.

Lung functions parameters	Intercept	Age	Height	Traffic policemen	Pack-years of smoking	R^2
FEV1	-2.5	-0.02*	0.04*	-0.14*	-0.002	0.38
FVC	-4.069	-0.02*	0.05*	-0.16*	-0.001	0.44
FEV1/FVC	106.83	-0.27*	-0.08*	-0.14	-0.05*	0.14
FEF25-75	0.95	-0.04*	0.03*	-0.11	-0.01	0.15

* Statistically significant difference

not used protective masks were higher than those who had used them as shown in Table 9 and Table 10. However, there was no statistically significant difference when the prevalence of abnormal spirometry was directly compared in non-smoking traffic policemen who had used protective masks and in those who had not (Table 11).

To identify the independent contribution of working as traffic policemen to the changes in spirometric measures of lung function while taking into account potentially known important factors, multivariate analysis was used. In this multivariate analysis model, we controlled the important variables known to effect spirometric measures of lung function including age, height, and pack-years of cigarette smoking. The regression coefficients indicated that the job of traffic policemen was significantly and independently associated with lower FEV1 and FVC as shown in Table 12.

DISCUSSION

This cross-sectional study was designed to look for differences in the respiratory health status between traffic policemen who were working in Thonburi district and the normal Thai population. Traffic policemen were chosen as a representative group with long term exposure to air pollution in Bangkok. One of the main problems in any cross-sectional study is confounding factors. The major confounding factor with significant effects on respiratory health is smoking. Therefore, only the non-smoking subjects were chosen for the analysis of this study results.

The study showed that traffic policemen had significantly more cough or phlegm (18.6%) and rhinitis symptoms (18.6%) than the control group. This is in accordance with the results of a previous study by Aekplakorn et al[10] on the respiratory health of traffic policemen in Bangkok. In that study, traffic policemen also had significantly more cough and phlegm than ordinary policemen. Most of the studies on the effects of outdoor air pollution have shown that people who live in areas with high levels of air pollutants have more respiratory symptoms than those who live in other areas [1,2,14,15]. Data from both experimental animal researches, and from chamber studies in humans, have shown that exposure to oxidant air pollutants may lead to injury and inflammation of the airways [16-18] which may be associated with these symptoms. However, the magnitude of the contribution of chronic air pollutant exposure to the development of chronic respiratory symptoms is unknown. The most reported symptoms are cough or phlegm. Neverthe-

less, in agreement with the results of this study, the symptoms were rarely severe enough to meet the criteria of chronic bronchitis. This study also showed that traffic policemen had more rhinitis symptoms than the control group. The association of air pollution with upper respiratory symptoms is less well documented than it is with lower respiratory symptoms. However, from controlled exposure studies and occasional case reports, the nasal cavity appears to be a target for injury from the oxidant gases in air pollution[16,19,20].

Though traffic policemen who had worked longer tended to have higher relative risks of developing cough and rhinitis, the differences were not statistically significant. The definite reason for this is not clear. Possible explanations are that levels of air pollutants may have been lower in the past and had not affected the respiratory health of these traffic policemen in their early working periods. It is possible too that traffic policemen who had contracted respiratory symptoms then changed their job before the study period. In this case the traffic policemen who had worked longer might be those who were in fact less predisposed towards respiratory symptoms. There may also be adaptive or compensatory changes after prolonged exposure to air pollution[16].

Of more concern than the subjective respiratory symptoms are the results of lung function tests. This study shows that traffic policemen have lower FEV1 and FVC than the general population. FEV1 is a lung function parameter that is easy to measure and has very good reproducibility[21]. It is the most widely used and quoted lung function test in clinical practice. Chronically reduced FEV1 is a predictor of increased risk of mortality. Hence, a statistically significant increase in the number of persons with FEV1 below normal limits indicates an increase in the number of persons with respiratory impairment in the population. In the guidelines of the American Thoracic Society, this is considered to be an adverse respiratory health effect of air pollution[22]. Although there were many variables which had significant effects on lung function parameters, it was confirmed in the multiple variate analysis that, when adjusted for age, height and pack-years of smoking, the job of a traffic policemen had a negative association with FEV1 and FVC.

This study also revealed the protective effects of wearing masks as the traffic policemen who had not worn protective masks had higher relative risk of abnormal FEV1 and FVC than those who had used them. This has not been reported before and may be a neglected confounding factor in many previous studies regarding the relationship between the health of traffic policemen and air pollution. Although in the direct comparison between the traffic policemen who had used, and those who had not used, protective masks, there was no statistically significant difference in the prevalence of abnormal spirometry, this may be because of the too small number of subjects in the latter group.

Besides smoking, there are other uncontrolled confounding factors which may have effects on lung function parameters and which should be considered in the interpretation of the results of this study. These include airway hyperresponsiveness [23], atopy[23], childhood respiratory infections[24], and socioeconomic status[25]. However, the traffic policemen were government officers and, in general, had better socioeconomic status than most of the controls who were farmers and gardener. In addition, related to their profession, traffic policemen, by and large, were physically trained and had better average lung function parameters than the general population[26]. Thus, it exaggeratedly supported that the traffic policemen had lower lung functions than the general population. Although there were many confounding factors, the results which showed that the traffic policemen who had not used protective masks had a higher relative risk of abnormal lung function than those who had used masks, actually suggested that the main factor which had a deleterious effect on their lung functions lies in the air they breathe.

This study used traffic policemen as a model of people with long term exposure to air pollution. Though the symptoms and the changes of lung function parameters were subtle, it should be emphasized that these traffic policemen were young with an average age of only 36 years. When they are older with the decline of their lung function; if they continue to be exposed to air pollution and if, especially, they continue to smoke, what will their destiny be? Therefore, we are of the opinion that all traffic policemen should wear protective masks during their work to protect themselves, at least in part, from the deleterious effects of air pollution.

In conclusion, at the current level of air pollution, after adjustment for smoking habits, the traffic policemen who worked in Thonburi district

of Bangkok had more cough or phlegm, more rhinitis symptoms and lower FEV1 and FVC than the normal Thai population. The traffic policemen who had not used protective masks had a higher relative risk of abnormal FEV1 and FVC than those who had used them. All traffic policemen should wear protective masks during their working hours.

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อาการผิดปกติทางระบบการหายใจและสมรรถภาพปอดของตำรวจจราจรในเขตธนบุรี

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คณะผู้วิจัยได้ทำการศึกษาเพื่อเปรียบเทียบความชุกของอาการผิดปกติทางระบบการหายใจและสมรรถภาพปอดของตำรวจจราจรในเขตธนบุรีกับประชากรทั่วไป รวมทั้งได้ศึกษาถึงผลของการใส่เครื่องป้องกันมลพิษอากาศขณะปฏิบัติงานในตำรวจจราจรเหล่านี้ด้วย โดยทำการศึกษาแบบ cross-section ในตำรวจจราจรซึ่งปฏิบัติงานในเขตธนบุรี จำนวน 629 ราย และกลุ่มควบคุม ซึ่งเป็นประชากรทั่วไป จำนวน 303 ราย หาความชุกของอาการผิดปกติทางระบบการหายใจโดยใช้แบบสอบถามที่ปรับมาจากแบบสอบถามมาตรฐานที่ใช้ในการสอบถามอาการทางระบบการหายใจของ British Medical Research Council และตรวจสมรรถภาพปอด โดยวิธี spirometry

เมื่อเลือกเฉพาะผู้ที่ไม่สูบบุหรี่มาวิเคราะห์ ผลการศึกษาพบว่าตำรวจจราจร (จำนวน 242 ราย) มีอาการไอหรือมีเสมหะ (18.6% *vs* 7.8%, P=0.005) และอาการ rhinitis (17.8% *vs* 7.8%, P=0.009) มากกว่ากลุ่มควบคุม (จำนวน 129 ราย) พบตำรวจจราจรที่มีความผิดปกติของ air flow (FEV1<80% predicted) มากกว่ากลุ่มควบคุม (21.1% *vs* 12.4%, P=0.04) อย่างมีนัยสำคัญทางสถิติ ค่าเฉลี่ยของ FEV1 และ FVC ของตำรวจจราจรต่ำกว่ากลุ่มควบคุม (FEV1 3.29±0.5 *vs* 3.43 ± 0.5 ลิตร, P=0.01; FVC 3.86 ± 0.5 *vs* 3.98 ± 0.6 ลิตร, P=0.047) นอกจากความผิดปกติของ FEV1 แล้ว ตำรวจจราจรที่ไม่ใส่เครื่องป้องกันมลพิษอากาศ ยังพบมีความผิดปกติของ FVC (FVC<80% predicted) มากกว่ากลุ่มควบคุม (35% *vs* 14%, P=0.046) และมี relative risk ของความผิดปกติของ FEV1 และ FVC มากกว่าตำรวจจราจรที่ใส่เครื่องป้องกันมลพิษอากาศ (FEV1 2.76 *vs* 1.63, FVC 2.51 *vs* 1.23) เมื่อทำการวิเคราะห์ด้วยวิธี multivariate โดยควบคุมตัวแปร อายุ ความสูง และจำนวนบุหรี่ที่สูบ พบว่าอาชีพตำรวจจราจรเป็นตัวแปรอิสระที่มีความสัมพันธ์กับการลดลงของ FEV1 และ FVC

โดยสรุป ตำรวจจราจรที่ปฏิบัติงานในเขตธนบุรี มีอาการไอ และ rhinitis มากกว่า และมีค่า FEV1 และ FVC ต่ำกว่าประชากรไทยทั่วไป ตำรวจจราจรที่ไม่ได้ใส่เครื่องป้องกันมลพิษอากาศในขณะปฏิบัติงานมี relative risk ของการลดลงของ FEV1 และ FVC สูงกว่าตำรวจจราจรที่ใส่เครื่องป้องกันมลพิษอากาศ

คำสำคัญ : อาการผิดปกติทางระบบการหายใจ, สมรรถภาพปอด, ตำรวจจราจร, ธนบุรี

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