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A Comparative Study of Respiratory Quality of Life among Firefighters, Traffic Police and Other Occupations in Malaysia

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Abstract

Background: Despite its excellent psychometric properties, St George's Respiratory Questionnaire (SGRQ) has not been previously used in measuring respiratory quality of life (RQoL) among traffic police and firefighters who are at risk of poor respiratory health by virtue of their occupations.

Objective: To assess and compare the RQoL of the occupationally exposed (firefighters and traffic police) and the occupationally unexposed populations in Penang, Malaysia.

Methods: We recruited male traffic police and firefighters from 5 districts of Penang by convenient sampling during June to September 2018. Participants completed the SGRQ. Scores (symptoms, activity, impacts, total) were derived using a scoring calculator. Higher scores indicate poorer RQoL. Univariate and multivariate linear regression models were fitted to explore the relationship of the independent predictive factors with participants' RQoL.

Results: We recruited 706 participants—211 firefighters, 198 traffic police, and 297 from general population. Smokers had significantly higher scores than non-smokers in all SGRQ domains. Regardless of smoking status, the "occupationally exposed group" had higher symptoms score than the "occupationally unexposed group," who had higher activity and impact scores. Smoking status, comorbidity status and monthly income were significant independent predictors of SGRQ total score.

Conclusion: In comparison with the general population, firefighters and traffic police reported poorer RQoL; smoking further deteriorated their respiratory health. There is a need to strengthen preventive health measures against occupational disease and smoking cessation among firefighters and traffic police.

Keywords: Firefighters; Police; Malaysia; Occupational exposures; Smoking; Respiratory system; Quality of life; Health promotion

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Introduction

In the last two decades, climate change, natural disasters (wildfires, infernos) and catastrophic events such as the New York City World Trade Center (WTC) fire and collapse continue to generate discussions among clinicians and researchers about the need for focused evaluation of Respiratory Quality of Life (RQoL) among

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specific disease and occupational groups as well as the general population. In particular, the respiratory health and QoL of WTC-exposed firefighters has been the focus of several previous studies.[1-3]

Firefighters and traffic police face significant occupational health hazards to their respiratory health.[4] Both occupational groups are regularly exposed to a substantial amount of hazardous materials, such as carbon monoxide, benzene, sulfur dioxide, hydrogen cyanide, lead, nitrogen oxide, and particulates.[5,6] Traffic police officers are continuously exposed to traffic-related atmospheric pollutants from vehicular emissions. On the other hand, firefighters attend to all forms of emergencies like fire attack, search and rescue, chemical and oil spills and are at risk of suffocating, respiratory damage, and burns.[7]

Adverse respiratory health effects of ambient air pollution are dose and exposure-time dependent.[8] There are substantial and consistent evidence showing that traffic police have decreased lung function and increased respiratory morbidity. For example, studies conducted in Bangkok, Thailand,[9] Patiala, India,[10] and Italian cities[11] are unanimous with regards to their findings on such trends. Nevertheless, the trend in the respiratory function and symptoms reported by the firefighters is variable. For example, a South Korean study reports decreased lung functions among firefighters.[12] An Australian[13] study reveals that 10% of their metropolitan firefighters had some forms of chronic respiratory problems, but interestingly, those aged <45 years showed an increasing lung function over time. In addition, a systematic review[14] has failed to show consistent association between the occupation of firefighters and non-cancer disease and ill-health consequences. Many of the previous studies did not assess the extent of smoking effect on their respiratory health independent of occupational exposure. We intend to address this gap in this study.

Over 90% of air pollution-related deaths happen in low- and middle-income countries, predominantly in Asia and Africa.[15] Malaysia experienced haze from Indonesian forest fires in recent years. Malaysia statistics in year 2017 showed that 70.4% of atmospheric pollutants came from motor vehicle emission, and there were 29 356 fire incidents reported.[16] It is important to note that the traffic police in Malaysia do not wear any protective mask while on duty. There is a paucity of information on the respiratory health status of the firefighters and the general population when compared with that of traffic police in Malaysia. In addition, there has been no study that used St George's Respiratory Questionnaire (SGRQ) to measure the RQoL among firefighters and traffic police. Unlike pulmonary function test, SGRQ is able to capture the subjective perception and assessment of patients' well-being in multiple dimensions.[17] Quality of life measures is important in health care decision making.[18]

This study aimed to assess and compare the RQoL of the occupational exposed (firefighters and traffic policemen) and occupational unexposed (the general public) populations in Penang, Malaysia. We also studied the extent to which smoking, independent of their occupational exposure, affects the respiratory health status of the participants.

Materials and Methods

This comparative, analytical cross-sectional study was conducted in the state of Penang, Malaysia, during June to September 2018. Traffic police officers and firefighters from five districts of Penang were recruited. Study sites were busy urban areas with moderate-to-heavy traffic flow. For the purpose of this study, we labeled traf-

fic police officers and firefighters as "occupationally exposed group" implying occupational exposure to strong chemicals, petroleum fumes and air pollution by virtue of their occupation. The "occupationally unexposed group," served as a comparison group, was the general population (without reference to any specific characteristics or jobs) who did not have similar occupational exposure.

Given that over 95% of firefighters and traffic police in Malaysia are males, so we recruited only adult (aged 18–60 years) male firefighters and traffic police who were currently serving active duty and matched them with control subjects from the general population, for age and smoking status. Participants with known lung disease, including asthma and chronic obstructive pulmonary disease (COPD), were excluded from the study.

Sampling Strategy

This study utilized a convenient sampling approach to select consenting adults from the eligible population. Male traffic firefighters and police officers were recruited from their respective district headquarters. The respective district/command heads were approached, and served as the nexus of recruitment of officers within their command/districts. For the occupational unexposed group, eligible male participants were approached on an individual basis in health centers, medical schools and homes. Informed written consent was obtained from eligible participants after adequate explanation of the purpose and process of the study.

We found no previous study from Malaysia exploring the respiratory health status of firefighters and traffic police. The minimum sample size was calculated with Stata® ver 13.0 assuming an acceptable type I error of 0.05, a minimum study power of 0.8, an estimated mean SGRQ score of 8.60 in the exposed group (the mean overall SGRQ scale score among the general population of men aged 40–69 years in a 2002 study conducted by Ferrer, *et al*[19]), an estimated mean SGRQ score of 6.60 in unexposed group (the mean overall SGRQ scale score among general population [including police and firefighters] in Malaysia), and a pooled SD of SGRQ score of 7.20.

Based on the above presumptions, we came to a minimum sample size of 204 per group. Therefore, for the three study groups, a minimum sample size of 612 was required. We adjusted the value for a 30% non-response rate (based on Ferrer, *et al*[19]), and arrived at a total sample size of 796.

Data Collection

Participants filled out a structured, prevalidated questionnaire which consisted of two sections: (a) socio-demographic characteristics, including age, race, marital status, education, income, occupation, duration of outdoor work, smoking history, and morbidity status; and (b) SGRQ in English, Malay and Chinese Mandarin. Approval to use the questionnaire was obtained from The St. George's University of London Medical School.

St George's Respiratory Questionnaire (SGRQ)

Quantifying subjective morbidity is often a significant challenge in many studies. Therefore, to improve the internal and external validity of our study, the SGRQ was chosen. The SGRQ is an established assessment tool to measure the RQoL.[17] Part 1 (Questions 1–8) of the questionnaire produces symptoms score. This part addresses the frequency of respiratory symptoms such as cough, dyspnea and wheezing. Part 2 of the questionnaire (Questions 9–16) measures disturbances to patients daily physical activity (activity score) and disturbances of psycho-social function

(impact scores).[20] Lastly, total score is calculated by summing the weights of all the positive responses.

Although the SGRQ was originally written to assess the respiratory health status of patients with asthma and COPD,[20] it had also been studied and applied to non-COPD patients such as those with sarcoidosis,[20] bronchiectasis,[21] cystic fibrosis,[20] kyphoscoliosis,[20] and the healthy population[19]. Literature concerning the use of SGRQ is abundant. The SGRQ significantly correlates with spirometry, 6-min walking distance (6-MWD), The Medical Research Council Questionnaire (MRCQ) on respiratory symptoms, Sickness Impact Profile (SIP), and Short Form-36 (SF36).[22]

Ethics

This study was strictly conducted according to the Declaration of Helsinki. Ethical approval of this study was obtained from Medical Research and Ethics Committee, Ministry of Health Malaysia. Informed written consent was obtained from all individual participants included in the study.

Statistical Analysis

Data was entered into an electronic copy of an MS Excel-based scoring calculator, which was supplied by the questionnaire producers and was pre-programmed with formulae to calculate scores in three domains (Symptoms, Activity, and Impacts) and a total score calculated thereof.

Each question response has a unique empirically derived "weight,"[20] the lowest possible score is zero; the highest, 100. Higher scores indicate poorer respiratory QoL. The minimal important clinical difference (MID) in the SGRQ is "four units."[22]

Data exploration and analysis was conducted using SPSS® for Windows® ver 23. Test of normality was conducted on the QoL scores to ascertain suitability of parametric statistical tests or otherwise. Descriptive statistics of numerical variables were presented as mean (or median) and SD (or IQR) while frequency distribution tables were presented for categorical variables. The comparison of the scores (overall and sub-unit scores) by study groups and socio-demographic profiles was done using one-way ANOVA and *Student's t* tests or the corresponding non-parametric options. Univariate and multivariate linear regression models were fitted to explore the relationship of the independent predictive factors with respondents' respiratory health status. A p value <0.05 was considered statistically significant.

TAKE-HOME MESSAGE

- Firefighters and traffic policemen face significant occupational health hazards to their respiratory health.
- St George's Respiratory Questionnaire (SGRQ) measures the respiratory quality of life and it has not been used among firefighters and traffic policemen.
- In comparison with the general population, firefighters and traffic police have poorer respiratory quality of life, and smoking further worsens their respiratory health.

Results

We successfully recruited 706 male participants (88.6% response rate) (Table 1) categorized as occupationally exposed group consisting of firefighters (n=211) and traffic police (n=198); and occupationally unexposed group comprising participants from the general population (n=297). The mean age of firefighters, traffic police, and general population was 37.5 (SD 8.3), 41.2 (10.5), and 37.5 (9.6) years, respectively.

About half of the participants in both firefighters and occupationally unexposed group aged between 30 and 39 years. Traffic police were evenly distributed across the age groups. Slightly more than half the

firefighters were current smokers. Current smokers were defined as those who smoked at least 100 cigarettes, including rolled cigarettes, pipes and cigars in their lifetime and who, at the time of study, smoked either every day or on some days.[23] About 60% of traffic police and 66% of occupationally unexposed group were non-smokers. The majority of occupationally exposed group were Malays as compared to half of the occupationally unexposed group who were Malays. More than 80% of the participants in each group completed secondary form 5 or higher in education (Form 1 to 3 are lower secondary and form 4–5 are upper secondary equivalent). About one-quarter of firefighters and traffic police compared to 20% of the occupationally unexposed group spent at least 30 hours/week outdoor for work purpose. The majority of the participants earned less than US$ 1200 (RM 5000) per month. Although the majority of the participants had no comorbidity, the occupationally unexposed group had about 3 times higher prevalence of comorbidity. The comorbidities include hypertension, diabetes, hypercholesterolemia, ischemic heart disease, peptic ulcer disease, renal failure, psoriasis, eczema, malignancies, epilepsy, arthritis, schizophrenia, renal calculi, and autoimmune diseases.

Smokers had higher scores for all SGRQ domains than non-smokers (Table 2). Among firefighters and traffic police, those who smoke had higher mean symptoms score (23.98 and 24.99, respectively) than their non-smoking counterparts (20.97 and 19.05, respectively). This difference was statistically significant among the traffic police (p=0.005). Similarly, among the occupationally unexposed group, smokers had significantly higher symptoms score than non-smokers (14.34 *vs* 8.66, p=0.03).

In terms of activity score, we observed marginally higher mean score among smokers than non-smokers across all

Table 1: Frequency of socio-demographic and clinical characteristics of participants. Values are n (%).

Variable	Firefighters	Traffic police	Comparison group
Age group (yrs)	n=211	n=198	n=297
<20	0 (0.0)	2 (1.0)	3 (1.0)
20–24	11 (5.2)	8 (4.0)	18 (6.1)
25–29	21 (10.0)	23 (11.6)	40 (13.5)
30–34	44 (20.9)	26 (13.1)	58 (19.5)
35–39	64 (30.3)	30 (15.2)	76 (25.6)
40–44	29 (13.7)	29 (14.6)	28 (9.4)
45–49	21 (10.0)	23 (11.6)	30 (10.1)
50–54	12 (5.7)	34 (17.2)	28 (9.4)
55–59	9 (4.3)	23 (11.6)	16 (5.4)
Smoking status	n=205	n=193	n=297
Current smoker	109 (53.2)	77 (38.9)	100 (33.7)
Non-smoker	96 (46.8)	116 (58.6)	197 (66.3)
Ethnicity	n=211	n=198	n=297
Malay	205 (97.2)	178 (89.9)	150 (50.5)
Chinese	1 (0.5)	4 (2.0)	98 (33.0)
Indian	4 (1.9)	9 (4.5)	45 (15.2)
Others	1 (0.5)	4 (2.0)	4 (1.3)
Marital status	n=211	n=198	n=297
Single	27 (12.8)	27 (13.6)	82 (27.6)
Married	181 (85.8)	158 (79.8)	208 (70.0)
Divorced	3 (1.4)	8 (4.0)	4 (1.3)
Widowed	0 (0.0)	1 (0.5)	3 (1.0)
Level of education	n=209	n=194	n=297
No formal education	0 (0.0)	0 (0.0)	4 (1.3)
Primary	1 (0.5)	0 (0.0)	11 (3.7)
Secondary Form 3	12 (5.7)	3 (1.5)	45 (15.2)
Secondary Form 5	160 (75.8)	137 (69.2)	101 (34.0)
Tertiary	36 (17.1)	54 (27.3)	136 (45.8)

Continued

Table 1: Frequency of socio-demographic and clinical characteristics of participants. Values are n (%).

Variable	Firefighters	Traffic police	Comparison group
Hours spent outdoor during work/week	n=201	n=192	n=291
0–10	61 (28.9)	66 (33.3)	163 (54.9)
11–20	61 (28.9)	45 (22.7)	52 (17.5)
21–30	22 (10.4)	28 (14.1)	18 (6.1)
31–40	16 (7.6)	15 (7.6)	13 (4.4)
>40	41 (19.4)	38 (19.2)	45 (15.2)
Monthly income (RM)	n=206	n=194	n=289
<1000	30 (14.2)	14 (7.1)	45 (15.2)
1001–5000	175 (82.9)	158 (79.8)	205 (69.0)
5001–10 000	1 (0.5)	22 (11.1)	28 (9.4)
>10 000	0 (0.0)	0 (0.0)	9 (3.0)
Comorbidity status	n=211	n=198	n=297
With	18 (8.5)	22 (11.1)	100 (28.3)
Without	193 (91.5)	176 (88.9)	213 (71.7)

participant groups. However, this difference was not statistically significant. In all participant groups, smokers had about 4 points higher impact score than non-smokers ($p<0.024$).

Furthermore, we combined firefighters and traffic police as occupationally exposed group to examine the potential impact of the participants' occupation on the SGRQ scores having sub-grouped them by smoking status (Table 3). Regardless of their smoking status, the occupationally exposed group had on average about 10 units higher mean symptoms score than the occupationally unexposed group ($p<0.001$). In contrast, occupationally unexposed group had on average a minimum of 4 and 2 units higher activity and impact score, respectively, than the occupationally exposed group. There appeared to be a marginal difference in the total score between occupationally exposed group and occupationally unexposed group by smoking status; the difference was not significant.

Generally speaking, participants with comorbidity had at least 5 and 8 units higher mean symptoms score than those without comorbidity among the occupationally unexposed group, and occupationally exposed group, respectively ($p<0.001$) (Table 4). Conversely, among those with no comorbidity, occupationally unexposed group had slightly higher mean activity score than the occupationally exposed group ($p<0.001$).

We performed simple linear regression analysis to examine the association between socio-demographic and clinical characteristics and the three domains of SGRQ and total scores. We then selected socio-demographic variables that showed a significant ($p<0.05$) bivariate association with SGRQ scores (Table 5) for further analysis in the multivariate model. We also considered the principle of biological plausibility in variable selection into the multivariate model (Table 5).

We fitted a multivariate regression model to identify predictors of SGRQ total score among socio-demographic and clinical factors. We then examined the prediction models using enter, backward and forward methods, and presented results from enter method which provided the most parsimonious model and explained the highest variance in the outcome variable.

The multivariate model was significant ($p<0.001$), explained about 10% of the variance in SGRQ total score observed and produced three significant independent predictors of SGRQ total score. We observed that smokers had on average about 4.2 units higher total score than non-smokers ($p<0.001$), while respon-

Table 2: Comparison of mean (SD) SGRQ scores among firefighters, traffic police, and an occupationally unexposed comparison group according to their smoking status

Occupational Exposure	Symptoms score	p value	Activity score	p value	Impact score	p value	Total score	p value
Firefighters (n=211)								
Current smoker	23.98 (13.27)	0.127	8.51 (14.37)	0.778	9.27 (14.17)	0.020	11.35 (11.93)	0.091
Non-smoker	20.97 (14.85)		7.92 (15.40)		5.35 (9.43)		8.63 (10.85)	
Traffic police (n=198)								
Current smoker	24.99 (15.37)	0.005	8.90 (17.32)	0.362	10.92 (14.07	0.024	10.92 (14.07)	0.034
Non-smoker	19.05 (11.55)		6.81 (14.28)		6.99 (9.60)		6.99 (9.60)	
Unexposed comparison group (n=297)								
Current smokers	14.34 (17.04)	0.029	15.91 (20.64)	0.058	10.63 (17.13)	0.014	12.90 (16.18)	0.008
Non-smokers	8.66 (11.9)		11.21 (18.87)		6.01 (10.21)		8.06 (11.08)	

dents with comorbidity had an average of 8.6 units higher total score than those with no comorbidity ($p<0.001$). For every unit increase in the monthly income, respondents SGRQ total score decreased significantly by about 3.5 units ($p=0.029$).

Smoking status, comorbidity status and occupation group were significant independent predictors of SGRQ symptoms score, while smoking status and comorbidity status were significant independent predictors of activity and impact scores. Respondent's monthly income was also a significant predictor of SGRQ impact score (Table 5).

Discussion

We found that regardless of smoking status, the occupationally exposed group had higher frequency of respiratory symptoms despite better daily physical activity and psychosocial function (lower activity and impact scores) than the occupation-

Table 3: Comparison of mean (SD) SGRQ scores of current smokers and non-smokers according to their occupational exposure

Smoking status	Occupational exposure	Symptoms score	p value	Activity score	p value	Impact score	p value	Total score	p value
Current	Firefighters and traffic police (n=186)	24.39 (14.15)	0.001	8.67 (15.61)	0.003	8.76 (14.41)	0.331	11.17 (12.82)	0.356
	Comparison group (n=100)	14.34 (17.04)		15.91 (20.64)		10.62 (17.13)		12.90 (16.18)	
Non-smoker	Firefighters and traffic police (n=212)	19.92 (13.15)	0.001	7.31 (14.8)	0.021	4.44 (9.48)	0.109	9.27 (14.17	0.756
	Comparison group (n=197)	8.66 (11.90)		11.21 (18.87)		6.01 (10.21)		8.04 (14.82)	

Table 4: Comparison of mean (SD) SGRQ scores of firefighters, traffic police and the occupational unexposed comparison group according to their comorbidity status

Comorbidity status	Occupational exposure	Symptoms score	p value	Activity score	p value	Impact score	p value	Total score	p value
With	Firefighters and traffic police (n=40, 9.8%)	29.60 (17.57)	0.001	18.03 (20.96)	0.635	14.36 (19.24)	0.347	17.29 (17.28)	0.329
	Comparison group (n=100, 28.3%)	14.54 (18.58)		20.19 (24.89)		11.17 (16.78)		14.55 (17.87)	
Without	Firefighters and traffic police (n=369, 90.2%)	21.07 (12.89)	0.001	6.61 (13.84)	0.011	5.41 (10.73)	0.435	8.22 (10.29)	0.616
	Comparison group (n=213, 71.7%)	9.01 (11.53)		9.87 (16.19)		6.14 (11.08)		7.77 (10.24)	

ally unexposed group. Moreover, smokers had higher scores than non-smokers in all SGRQ domains regardless of their occupations. In summary, the RQoL of firefighters and traffic police was poorer than that of the general population and this was made worse if they smoked.

The age, ethnicity, income distribution, and smoking status of traffic police reported in this study was consistent with findings from previous studies conducted elsewhere in Malaysia.[20,22] To date, most Malaysian studies have focused more on exploring the effect of long hours of outdoor work and lung function of traffic police. There seems to be disproportionate attention in exploring the health status of other occupation groups such as firefighters (with potentially similar occupational exposure to dust, fumes, and smoke) and the general population. This is a major gap that the current study aimed to fill.

In recent years, air pollution has become a major public health challenge in Malaysia, and this is attributable to factors such as rapid industrialization, increased traffic volume, a high prevalence of smoking among the population and haze.[27-29] The prevalence of smoking among respondents in the current study averaged 40%, and this was consistent with, albeit lower than the prevalence reported among adult male Malaysians (61.7%) from previous studies.[30] Such a high smoking prevalence, particularly in public places, has necessitated research and discussions around the potential risks and effect of passive smoking on the health of the general population, and now a basis of recent public policies on tobacco regulation and control in Malaysia.[31]

We found in the current study that smokers had higher SGRQ symptoms, activity, impact, and total scores than non-smokers. There is rich literature evidence on the negative impacts of smoking on health-related quality of life (HRQoL);[32-36] this has been established in various studies using a wide variety of study designs and HRQoL instruments. The findings

Table 5: Results of simple and multiple linear regression of socio-demographic and clinical characteristics on SGRQ score

	Simple linear regression		Multiple linear regression
Variables	**Unstandardized β**	**p value**	**Unstandardized β (95% CI)**
SGRQ Symptoms			
Current smokers	6.384	0.001	4.193 (2.195 to 6.191)
Malay	7.371	0.001	0.993 (-1.818 to 3.804)
Hours spent outdoor during work	4.278	0.001	1.940 (-0.236 to 4.117)
Monthly income	-5.266	0.009	-2.094 (-5.751 to 1.563)
With comorbidity	2.738	0.063	7.421 (4.632 to 10.210)
Occupationally exposed group	11.334	0.001	1.462 (9.027 to 13.897)
SGRQ Activity			
Current smokers	2.012	0.133	3.635 (1.213 to 6.056)
Malay	-5.571	0.000	-3.048 (-6.444 to 0.347)
Level of education	-5.129	0.014	-0.748 (-.939 to 3.443)
With comorbidity	11.689	0.001	10.217 (6.844 to 13.691)
SGRQ Impacts			
Current smokers	4.215	0.001	4.582 (2.815 to 6.349)
Monthly income	-4.111	0.024	-3.900 (-7.166 to -0.634)
With comorbidity	6.517	0.001	7.136 (4.658 to 9.612)
Occupationally exposed group	1.276	0.572	-0.656 (-2.568 to 1.257)
SGRQ Total			
Current smokers	3.888	0.001	4.242 (2.534 to 5.950)
Monthly income	-3.760	0.016	-3.512 (6.196 to 10.983)
With comorbidity	7.568	0.001	8.589 (-6.669 to -0.356)
Occupationally exposed group	-0.528	0.182	0.396 (-1.453 to 2.245)

of the current study were consistent with similar evidence emerged from recent interventional studies that examined the effect of smoking cessation interventions on SGRQ scores.[37-39] Our findings provided a further addition to the current knowledge in this area, in that, we demonstrated clinically significant poorer respiratory health status among traffic policemen and the firefighters who were smokers. This can provide a valuable basis for targeted high risk behavioral modification and occupation health promotion interventions in the target population.

Both firefighters and traffic police have been documented in literature to be at

higher risk of respiratory diseases due to occupational exposure to dust, smoke, and fumes.[12,40,41] The findings of the current study further extended this understanding. We found that regardless of smoking and co-morbidity status, firefighters and traffic policemen had a significantly higher symptoms score (indicating higher frequency and severity of respiratory symptoms, and poorer respiratory health status) than the general population. This is not surprising, given that a decline in pulmonary function from smoke inhalation (from fire, vehicle and industrial emissions, cigarettes, *etc*) has been shown to be a direct correlate of the content and characteristics of the noxious agents in the smoke, the duration of exposure, and underlying immunity and sensitivity of individuals.[42,43] This is further supported by our finding in the current study that about 40% of the firefighters and traffic policemen spent at least half of their weekly working hours (20 hours) outdoors, thereby significantly increasing their exposure to these noxious agents and pollutants. Given this background, it is therefore reasonable to expect that the presence of any underlying comorbidity would further result in higher symptom score, and poorer respiratory health as observed in the current study. This information should be of keen interest to the firefighter and traffic police authorities in Malaysia, perhaps for better workforce planning—such as capping the number of weekly hours spent on outdoor work by firefighters and traffic policemen, training and retraining, and provision, enforcement and monitoring of compliance with the use of personal protective equipment during outdoor work.

We also found that smoking, comorbidity status, and monthly income were significant independent predictors of SGRQ total score. Smoking and the presence of comorbidity place an immense burden on the immune system and therefore potentiate poor respiratory health in the presence of other risk factors, regardless of their own independent effect on the respiratory system. Our finding that higher monthly income predicted better respiratory health status was probably explained by the established fact that higher income is a correlate of better health-seeking behavior, particularly among the local population in Penang, Malaysia.[44] Although health care costs is reasonably subsidized for all Malaysians by the government, the relationship between income and health is complex, and low income has been shown to affect health risk perception, awareness, and an individual's capacity to take better responsibility for their own health.[45]

To the best of our knowledge, this is the first study to assess, to compare, and to report the RQoL of firefighters, traffic police, and the general population in Penang, Malaysia. The relatively large sample size and the use of internationally acclaimed and widely validated SGRQ instrument ensured that our findings were not only internally valid, but also improved the external validity and generalizability of our results. However, our study has notable limitations. Given the exploratory nature of this study, we have used a convenient sampling strategy to select participants from the eligible population. Whereas this was seemingly the most practical approach in our setting, it is possible that our sample did not achieve the best representativeness of the target population, which a probability sampling technique could have better achieved. Nonetheless, we matched respondents by age and smoking status in an attempt to minimize such gaps. We did not conduct spirometry to examine the lung function of the respondents, which would have provided an objective clinical measure of the respiratory health status of the respondents over and above the robust information that the SGRQ provides.

In conclusion, by virtue of their oc-

cupation, firefighters and traffic police in our study had clinically significant poorer RQoL than the general population. Public health specialists, respiratory physicians, traffic police and firefighters authorities in Malaysia should strengthen their strategies in both occupational disease prevention and smoking cessation among firefighters and traffic police.

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