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Do police officers and firefighters have a higher risk of disease than other public officers? A 13-year nationwide cohort study in South Korea

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ABSTRACT

Objectives The work of public officers involves repeated and long-term exposure to heavy workloads, high job strain and workplace violence, all of which negatively impact physical and mental health. This study aimed to evaluate and compare the incidences of diseases among different categories of public officers in Korea, in order to further understand the health risks associated with these occupations.

Design A cohort study using the National Health Insurance data.

Participants We collated claims data between 2002 and 2014 for 860 221 public officers.

Primary and secondary outcome measures Age-standardised rates were calculated using the direct standardisation method, and HRs were calculated using the Cox proportional hazard regression models.

Results Overall, we found that police officers and firefighters had a higher incidence of a range of diseases when compared with national and regional government officers (NRG). The most prominent HRs were observed among police officers for angina pectoris (HR: 1.52, 95% CI 1.49 to 1.54), acute myocardial infarction (HR: 1.84, 95% CI 1.77 to 1.92) and cerebrovascular disease (HR: 1.36, 95% CI 1.31 to 1.40). Firefighters were more susceptible to physical ailments and were at a significantly higher risk for traumatic stress disorders (HR: 1.40, 95% CI 1.26 to 1.56) than NRGs.

Conclusion Compared withNRGs, police officers had higher HRs for all measured diseases, except for traumatic stress disorders. While firefighters had higher HRs for almost all diseases examined, public education officers had a higher HR for traumatic stress disorders, when compared with NRGs.

Strengths and limitations of this study

- ► This study is the largest cohort study based on nationwide follow-up data including all Korean public officers.
- ► We have included a comprehensive set of various health problems potentially related to job as well as cardiovascular disorders.
- ► A limitation of the study is that incidences of some diseases could have been underestimated or overestimated because our study used claims data.

INTRODUCTION

The broad category of 'public officers' comprises individuals in a range of government-overseen positions and public sector employment. As a percentage of total employment across the Organisation for Economic Co-operation and Development countries, the employment rate for public officers rose slightly between 2009 and 2013, from 21.1% to 21.3%.[1] In Korea and in many developed countries, positions at public offices are regarded as prestigious occupations, although uniquely stressful.[2 3] The work of public officers is fundamental to the maintenance of society, and it is therefore important to understand any afflictions or ailments associated with this category of individuals.

The work of public officers involves repeated and long-term exposure to heavy workloads, high job strain or workplace violence, all of which have a potentially negative impact on physical and mental health. This is particularly true for police officers and firefighters who in addition to workplace stress also deal with physical, chemical, biological and psychological hazards while on duty.[4–8] For example, in the USA in particular, studies have shown police officers to have a shorter life expectancy than the general population.[9] For the reasons above, research shows that firefighters and police officers have higher mortality and morbidity rates compared with the general population, particularly for cardiovascular diseases (CVD). The incidence of cardiovascular diseases has been reported to be higher among police officers than in the general civilian population (31.4% vs 18.4%).[10] Similarly, a study involving American firefighters found that CVD was the primary cause of

death in the line of duty, accounting for approximately 45% of the on-duty fatalities.[11]

Considerable research on the health of public officers has been conducted in many Western countries, focusing mainly on cardiovascular diseases, chronic diseases and mental disorders. However, comparable research in Asian countries is scarce. Using a large, nationwide dataset based on insurance claims, this study aimed to evaluate the differences in the incidence rates of specific diseases among different categories of public officers in Korea, in order to develop an understanding of health risks associated with these occupations.

SUBJECTS AND METHODS

Data source

The study population consisted of public officers, including police officers, firefighters, public educational officers (PEOs), and national and regional government officers (NRGs), with claims data between 2002 and 2014, which were collected from the National Health Insurance Service (NHIS) using their customised database service.

The Korean National Health Insurance programme covers almost 100% of the Korean population and the database contains information on demographic characteristics, hospital admissions, ambulatory care, principal diagnosis, comorbidities (using the International Classification of Disease's, 10th revision (ICD-10)), procedures and prescriptions regarding all inpatients and outpatients. The date of death was ascertained from death certificates collected from the Korean National Statistical Office. Patients who were alive on 31 December 2014 or after were not considered deceased for the purpose of this study.

Study subjects and identification

We identified 860 221 public officers as the study population based on occupation codes. We then collected all patient claims data between 2002 and 2014, and dates of death, through the NHIS customised database service. We defined each disease based on its ICD-10 and procedure codes. We identified patients with alcoholic liver disease (ICD-10 K70), peptic ulcer (K25–K28), dyslipidaemia (E78 with prescription), diabetes mellitus (DM) (E10–E14 with prescription), type 2 DM (E11), hypertension (I10–I15 or I30 with prescription), angina pectoris (I20), acute myocardial infarction (I21), cerebrovascular diseases (I63), admission due to injury (S00-T98 and document code of 'hospital admission'), lower back pain (M543–M545 and document code of 'hospital admission'), lumbar disc herniation (M51), soft tissue diseases in shoulder region (M75), mental illness (F00–F99), mood disorders (F30–F39), sleep disorders (G47 or F51) and traumatic stress disorders (F43.0–F43.1). In order to designate new cases of diseases (incidence), we used a 1-year washout period between 1 January 2002 and 31 December 2002.

Statistical analysis

The demographic characteristics of the study subjects were expressed as means and SD for continuous variables, or as percentages for categorical variables. Age-standardised rates (ASRs) were calculated by the direct standardisation method, using the person-years of NRG officers as the standard population. We calculated person-years as the time after the 1-year washout period, 1 January 2003 to the end of observation or death. In order to calculate person-years by age group (10-year intervals), we divided each individual's person-years by age group and then summed up all person-years for each respective age group.

We calculated HRs using the Cox proportional hazards regression models with adjustments for age and sex. All analyses were performed using the SAS Enterprise Guide V.9.4 (SAS Institute, Cary, NC, USA). The results were considered statistically significant when the P value was less than 0.05.

RESULTS

Study population

A total of 860 221 public officers were included in this study and were followed up for a total of 10 017 374 person-years. The overall mean length of follow-up was 11.6 years, and the mean age was 39.55±9.06 years. The total proportion of male to female public officers was 63.7% to 36.3%, respectively. The proportions of different public officers were as follows: police officers, 10.8% (1073 302 person-years); firefighters, 2.7% (272 189 person-years); PEOs, 39.4% (3973 058 person-years); and NRG officers, 47.1% (4698 825 person-years) (table 1).

Incidence rate

ASRs broken down by sex and public officer type are shown in table 2. Among men with the alcoholic liver disease, NRG officers showed the highest ASR for incidence with 1180.0 cases per 100 000 person-years, followed by police officers (1177.1), PEOs (1060.1) and firefighters (857.8). Among women with the alcoholic liver disease, firefighters showed the highest ASR with 164.9 cases per

Table 1 Characteristics of public officers

Characteristics	All officers	Person-year
Total, n (%)	860 221	10 017 374
Men	547 808 (63.7)	6315 940
Women	312 413 (36.3)	3701 434
Age, mean±SD, years	39.55±9.06	10 017 374
Type of public officers, n (%)		
Police officer	92 545 (10.8)	1073 302
Firefighter	23 356 (2.7)	272 189
Public educational officer	338 857 (39.4)	3973 058
National and regional government officer	405 463 (47.1)	4698 825

Table 2 Age-standardised cause-specific incidence rate by public officers

	Men (per 100 000 person-years)					Women (per 100 000 person-years)				
	Police	Firefighter	PEO	NRG	IRD	Police	Firefighter	PEO	NRG	IRD
Alcoholic liver disease	1177.1	857.8	1060.1	1180.8	−3.7	161.5	164.9	141.7	163.9	−2.4
Peptic ulcer	5166.8	4869.6	5245.8	5090.6	76.2	4598.4	4852.4	4804.4	4847.5	−249.1
Dyslipidaemia	2673.1	1955.5	2207.8	2358.9	314.2	1115.1	1087.6	995.3	1030.1	85.0
Diabetes mellitus	915.2	699.4	821.2	942.0	−26.8	237.3	254.9	171.0	233.9	3.4
Type 2 diabetes mellitus	918.5	703.0	822.5	943.2	−24.7	238.1	254.9	170.2	233.1	5.0
Hypertension	2329.6	1924.2	2401.6	2457.8	−128.2	875.0	742.0	753.8	846.8	28.2
Angina pectoris	1648.3	1186.5	1251.5	1256.7	391.6	673.5	668.5	549.1	557.0	116.5
Acute myocardial infarction	342.2	216.8	200.6	208.1	134.1	87.6	98.9	63.8	70.7	16.9
Cerebrovascular diseases	530.5	431.4	477.8	496.7	33.8	239.3	209.5	184.3	213.1	26.2
Admission due to injury	1714.2	1854.2	1322.7	1323.3	390.9	1008.9	1508.6	743.8	854.1	154.8
Lower back pain	377.3	383.4	248.4	249.4	127.9	322.6	446.6	215.7	250.0	72.6
Lumbar disc herniation	2358.1	2552.2	2208.6	2111.6	246.5	2113.3	2662.5	1970.3	1986.8	126.5
Soft tissue diseases in shoulder region*	3061.6	2987.1	2928.5	2724.8	336.8	2250.8	2761.2	2201.7	2263.3	−12.5
Mental illness	3569.1	3543.4	3627.4	3571.8	−2.7	3648.5	3860.0	3883.7	3828.7	−180.2
Mood disorder	1273.3	1339.2	1215.6	1262.0	11.3	1378.6	1618.9	1375.2	1390.8	−12.2
Sleep disorder	1362.5	1328.0	1285.8	1350.0	12.5	1312.1	1540.7	1275.3	1319.5	−7.4
Traumatic stress disorder	95.1	132.6	98.6	98.5	−3.4	141.6	244.3	169.6	140.0	1.6

*Shoulder disease including adhesive capsulitis of shoulder, rotator cuff syndrome, bicipital tendinitis, calcific tendinitis of shoulder, impingement syndrome of shoulder, bursitis of shoulder and so on.
IRD, incidence rate difference between police and national or regional government officer; NRG, national and regional government officer; PEO, public educational officer.

100 000 person-years. Among men with peptic ulcers, the highest ASR was for PEOs (5245.8), followed by police officers (5166.8); among women with peptic ulcers, firefighters showed the highest ASR (4852.4), followed by NRG officers (4847.5).

The highest incidence of dyslipidaemia in both sexes was found among police officers (men: 2673.1, women: 1115.1), while the lowest incidence was seen in firefighters among men (1955.5) and PEOs among women (995.3). Among men, the incidence rates for DM and type 2 DM were highest among NRGs (942.0 and 943.2, respectively), followed by police officers. Among women, DM and type 2 DM rates were highest among firefighters, followed by police officers. Hypertension rates in men were highest among NRGs (2457.8) and lowest among firefighters (1924.2), while in women they were highest among police officers (875.0) and lowest among firefighters (742.0).

For both sexes, angina pectoris and cerebrovascular diseases were highest among police officers. Acute myocardial infarction in men was highest among police officers, followed by firefighters, while in women the highest rates were observed among firefighters, followed by police officers. Admission due to injury, lower back pain and lumbar disc herniation were highest among firefighters for both sexes, followed by police officers (both sexes). For both sexes, PEOs had the highest rate of mental illness. Finally, for both sexes, firefighters and PEOs had the highest rates of traumatic stress disorders, while firefighters and police officers had the highest rates of mood and sleep disorders.

Differences in HRs for incident diseases by public officer type

To investigate the difference in HRs for each incident disease by the type of public officer, we conducted a survival analysis using a Cox proportional model adjusted

Table 3 Differences in HRs for incident diseases by public officer type

	HR (95% CI)			
	NRG	Police	Firefighter	PEO
Alcoholic liver disease	1(ref.)	1.10 (1.07 to 1.12)	0.80 (0.76 to 0.83)	0.82 (0.81 to 0.83)
Peptic ulcer	1(ref.)	1.19 (1.18 to 1.20)	1.13 (1.11 to 1.15)	0.97 (0.96 to 0.98)
Dyslipidaemia	1(ref.)	1.25 (1.23 to 1.27)	0.89 (0.86 to 0.92)	0.89 (0.88 to 0.90)
Diabetes mellitus	1(ref.)	1.05 (1.02 to 1.08)	0.73 (0.69 to 0.77)	0.77 (0.75 to 0.78)
Type 2 diabetes mellitus	1(ref.)	1.05 (1.03 to 1.07)	0.85 (0.82 to 0.88)	0.85 (0.85 to 0.86)
Hypertension	1(ref.)	1.05 (1.03 to 1.07)	0.85 (0.82 to 0.88)	0.85 (0.85 to 0.86)
Angina pectoris	1(ref.)	1.52 (1.49 to 1.54)	1.06 (1.02 to 1.10)	0.93 (0.92 to 0.94)
Acute myocardial infarction	1(ref.)	1.84 (1.77 to 1.92)	1.21 (1.10 to 1.32)	0.89 (0.86 to 0.92)
Cerebrovascular diseases	1(ref.)	1.36 (1.31 to 1.40)	0.97 (0.90 to 1.04)	0.87 (0.85 to 0.89)
Admission due to injury	1(ref.)	1.41 (1.39 to 1.43)	1.58 (1.53 to 1.63)	0.95 (0.93 to 0.96)
Lower back pain	1(ref.)	1.47 (1.41 to 1.52)	1.52 (1.43 to 1.63)	0.96 (0.93 to 0.99)
Lumbar disc herniation	1(ref.)	1.20 (1.18 to 1.22)	1.43 (1.39 to 1.46)	1.00 (0.99 to 1.01)
Soft tissue diseases in shoulder region	1(ref.)	1.20 (1.18 to 1.21)	1.26 (1.24 to 1.29)	1.00 (0.99 to 1.01)
Mental illness	1(ref.)	1.07 (1.06 to 1.09)	1.11 (1.08 to 1.13)	0.98 (0.98 to 0.99)
Mood disorder	1(ref.)	1.03 (1.01 to 1.05)	1.12 (1.08 to 1.16)	0.96 (0.95 to 0.97)
Sleep disorder	1(ref.)	1.06 (1.04 to 1.08)	1.04 (1.01 to 1.08)	0.94 (0.92 to 0.95)
Traumatic stress disorder	1(ref.)	1.00 (0.93 to 1.07)	1.40 (1.26 to 1.56)	1.11 (1.07 to 1.15)

All models adjusted for age and sex.
NRG, national and regional government officer; PEO, public educational officer; ref, reference.

for age and sex. The results of this analysis are shown in table 3.

The following results were statistically significant: police officers (HR: 1.25, 95% CI 1.23 to 1.27) had a greater risk of dyslipidaemia compared with NRGs; police officers (HR: 1.19, 95% CI 1.18 to 1.20) and firefighters (HR: 1.13, 95% CI 1.11 to 1.15) had a greater risk of peptic ulcer compared with NRGs, while PEOs (HR: 0.97, 95% CI 0.96 to 0.98) had a lower risk. Compared with NRGs, police officers and firefighters had a greater risk of angina pectoris and acute myocardial infarction (police officer HR: 1.52, 95% CI 1.49 to 1.54; HR: 1.84, 95% CI 1.77 to 1.92 and firefighter HR: 1.06, 95% CI 1.02 to 1.10; HR: 1.21, 95% CI 1.10 to 1.32). For cerebrovascular diseases, police officers had a higher HR compared with NRGs, while firefighters and PEOs had lower HRs relative to NRGs. Both firefighters and police officers had a greater risk of admission due to injury, lower back pain, lumbar disc herniation and soft disease in the shoulder region relative to NRGs, with firefighters having the highest HRs for all these conditions. Finally, both firefighters and police officers had a higher risk of mental illnesses, mood disorders and sleep disorders compared with NRGs, while PEOs had a lower risk of incidence.

DISCUSSION

This is the first Korean population-based analysis of disease incidence among public officers using nationwide data and is based on one of the largest cohorts used for this type of study to date. Overall, we found that police officers and firefighters had higher incidences of a range of diseases compared with NRGs. Police officers also had higher HRs for all measured diseases, except for traumatic stress disorders, when compared with NRGs. Similarly, when compared with NRGs, firefighters had also higher HRs for peptic ulcer, angina pectoris, acute myocardial infarction, admissions due to injury, lower back pain, lumbar disc herniation, soft tissue diseases involving the shoulder region, mental illness, mood disorders, sleep disorders and traumatic stress disorders. Finally, the PEOs had a higher HR for traumatic stress disorders when compared with NRGs.

The most prominent HRs in this study were observed among police officers with regard to angina pectoris, acute myocardial infarction and cerebrovascular diseases. Among men, police officers had the highest incidences of all the three diseases. While women police officers had the highest incidences of angina pectoris and cerebrovascular disease, they had the second highest incidence of acute myocardial infarction. Even after adjusting for age and sex, police officers continued to have higher incidences of cerebrocardiovascular ailments with significantly high HRs for all conditions compared with NRGs.

A number of Western studies have found that police officers had several risk factors for CVD, including personal factors such as smoking, alcohol consumption, hypertension, obesity, DM or dyslipidaemia, and work-related factors such as night duties, high job stress, workplace violence and long work shifts.[12–15] Our research shows that the higher HRs among police officers compared with

NRGs for other diseases such as alcoholic liver disease, DM and dyslipidaemia were also associated with these risk factors suggesting that these are serious risk factors. We did not collect socioeconomic or demographic variables, except for age and sex, and therefore, were unable to ascertain the presence or absence of these risk factors among Korean public officers.

In view of the high incidence of cerebrocardiovascular diseases among police officers, it is important to establish preventative measures to reduce their risk for these diseases. We assumed that the distribution of socioeconomic variables such as education level, income or regional characteristics would also be comparable among public officers due to regulations on the working conditions and employment packages for these public officers. Therefore, the higher HR for CVD among police officers may be associated with working conditions, such as long working hours, night work and poor sleep or job-related stress. Several studies have suggested a correlation between shift work and cardiovascular disease or other negative health outcomes.[16 17] A meta-analysis found that longer working hours were associated with cerebrocardiovascular diseases.[18] A study involving police officers in Buffalo, New York, found that 28% of police officers worked afternoon shifts and 22% worked night shifts. The study also found that 54% of all police officers suffered from poor sleep quality: 44% for day shifts, 60% for afternoon shifts and 69% for night shifts.[19] Furthermore, police officers deal with a variety of civil complaints, increasing their exposure to violent situations which increase the job-related stress. Shift work, night shifts and higher workloads are more prevalent among both police officers and firefighters than among NRGs and education officers. This is consistent with our findings of higher CVD HRs in police officers and firefighters.

This study also found higher HRs for lower back pain, lumbar disc herniation and soft tissue diseases in the shoulder region among the firefighters compared with NRGs. These findings coincide with previous research which found that lower back pain was the most common work-related musculoskeletal disorder among firefighters in Korea.[20] Additionally, one study suggested that a primary contributing risk factor for lower back pain in firefighters was stress.[21] A common hypothesis regarding the association between stress and injury is that the severity of muscle strain, and therefore, the likelihood of injury, increases with stress which in turn can further heighten the awareness of the musculoskeletal symptoms or hamper their management.[22 23] Firefighters are required to move heavy equipment and engage in demanding physical activity as part of their work. This, combined with higher levels of stress, may explain the high levels of back pain among firefighters. Additionally, firefighters are often not fit enough to deal with the physical demands of emergency situations. Some studies have suggested that physical check-up programmes similar to those used for athletes may be necessary to achieve a higher VO_2 max and to improve the overall health.[24–27]

Furthermore, our research found that compared with NRGs, police officers had also higher HRs for lower back pain, lumbar disc herniation and soft tissue diseases of the shoulder. Police officers and firefighters were both found to have significantly high HRs for hospital admissions due to injury, with firefighters having the highest HRs compared with NRGs. This coincides with the findings of a study of American emergency responders which found high rates of injury in both firefighters (7.4 cases per 100 full-time equivalent firefighters) and police officers (8.5 cases per 100 full-time equivalent police officers).[28] As previously observed, police officers and firefighters are exposed to a variety of environmental, physical and chemical hazards leading to relatively higher rates of injury.[4–6] Particularly for firefighters, chemicals hazards including the inhalation of fire smoke, asbestos, diesel exhaust and other chemicals are of concern.[8]

Police work and firefighting are generally regarded as high-risk and high-stress occupations. Firefighters and police officers spend significant time working outside their workplaces and managing unpredictable and urgent situations. These factors contribute to the high-stress work environment reported by a number of studies.[29] It is generally accepted that high levels of stress affect all areas of health and that stress can exacerbate pre-existing ailments. An American study found that stress was a potential factor for negative health outcomes among police officers.[9] Additionally, several studies have noted that factors, such as a lack of sleep, job insecurity, workplace conflicts, physical environment, levels of alcohol consumption and organisation systems, contributed to the stress of firefighters.[30 31] Other studies have suggested that the inherent risk associated with the job, high workloads, shift work and the police administrative system contributes to the stress experienced by police officers. This is consistent with our finding of high HRs for a considerable number of diseases among police officers and firefighters.[9 32]

Both police officers and firefighters were found to have similar high HRs for cerebrocardiovascular and musculoskeletal diseases, as well as for mental, mood and sleep disorders. However, police officers, unlike firefighters, did not have a significantly higher HR for traumatic stress disorders compared with NRGs. This could be due to the organisational culture of police work in Korea, and more research is required in this area. In Korea, candidates for jobs as police officers need to pass a very competitive official examination and mental health check-up, including a clinical psychology test. Once selected, the police officers may feel pressured to maintain their psychological health to maintain their careers and for promotions within the workplace, which can lead to under-reporting of psychological diseases, such as traumatic stress disorders. An anonymous study found that the prevalence of stress-related psychological symptoms, particularly post-traumatic stress disorder (PTSD), remains high among police

officers in Korea. According to this study, 41.1% of a study population of 3000 South Korean police officers were at high risk for developing PTSD.[7]

Finally, another interesting finding of our study was the higher HR for traumatic stress disorders among the PEOs compared with NRGs. For all other diseases measured in our study, the HRs in PEOs were lower than the reference or were not significant. PEOs usually are required to care for students and their parents, and the education culture in Korea is competitive, with suicide among adolescents representing a significant social problem. Therefore, the emotional demands could be severe or distressing for the PEOs, and could potentially produce traumatic effects.

There were a number of limitations in our study. First, because our study used only ICD-10 codes and procedure codes to identify each disease, incidences could be overestimated. However, incidences of some diseases such as mental disorders could also be underestimated due to under-reporting in response to workplace culture. For example, some police officers may feel reluctant to receive treatments for a variety of reasons, including fear of losing eligibility for promotions or fear of losing their jobs. Another limitation was that the public officers were divided into four categories and compared. It is likely that there are additional subgroups within each category which may show different rates of incidence. For example, while we compared firefighters and NRGs, we did not compare different types of firefighting work with each other. Likewise, the category 'police officer' includes very different subfields of police work each with different sets of risk factors. For instance, the most common health risk for the majority of police officers is low physical activity due to the sedentary nature of their work, yet this is not true for the special forces.[33 34] Additionally, this study did not account for the regional differences, which may also influence the risk of death or injury.[35–37] Lastly, a final limitation of our study could be its inability to account for a 'healthy worker effect'. Compared with other public officers, firefighters and police officers have to meet more stringent health-related selection criteria due to the physical demands of their job. Therefore, police officers and firefighters may, depending on their subfield of work, be in better general health than the average population, including other public officers. Similarly, comparing firefighters and police officers with other public officers may lead to an underappreciation of the severity of risk factors that they encounter. We recommend more research on the specific characteristics, risk factors and incidences of diseases for specific subgroups within each field.

Contributors IK and SH planned the study. MH and SP analysed the data. JHP abstracted the variables and established the data set. MH drafted the article. All authors interpreted the results, critically revised the article and approved the final version.

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Competing interests None declared.

Patient consent Not required.

Ethics approval Ethics approval for this study was obtained from Institutional Review Board (IRB) of Hanyang University (IRB no: HYI-15-213-4).

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