# Firefighters' Blood Pressure and Employment Status on Hazardous Materials Teams in Massachusetts: A Prospective Study

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*We evaluated the association between hypertension and changes in employment status in 334 hazardous materials firefighters. Firefighters were categorized by blood pressure (BP) at baseline (1996 or 1997) and subsequent follow-up examinations (1997, 1998, and 1999). They were followed up for a maximum of 4 years for possible adverse outcomes (death, placement on "injured-on-duty" status, termination of duty, resignation, retirement, or incident cardiovascular disease). In several analytic models, we found that firefighters with stage II hypertension (BP ≥ 160/100 mm Hg) were consistently 2 to 3 times more likely to experience an adverse outcome compared with those with normal BP. Cox proportional-hazards regression was used to adjust for age, body mass index, smoking, cholesterol, and antihypertensive medication. In these models, the hazard ratio for stage II hypertension was 3.2 (95% confidence interval [CI], 1.50 to 7.04, P = 0.003) and for untreated stage II hypertension, it was 4.6 (95% CI, 2.08 to 10.11, P = 0.0002). Firefighters with a BP ≥ 160/100 mm Hg should receive further evaluation and demonstrate improved BP control before being determined fit for duty.* (J Occup Environ Med. *2002;44:669–676*)

Untreated high blood pressure is a recognized risk factor for cardiovascular disease and mortality,[1–4] with higher risks associated with increasing blood pressure.[5] Because uncontrolled hypertension poses health risks and may jeopardize public safety through sudden incapacitation, blood pressure control is a major criterion in medically determining fitness for duty in firefighters, commercial drivers, pilots, and other professions.[6–11] Although research has characterized the risk of developing hypertension and cardiovascular disease in occupational settings,[12–18] little is known about the relation between high blood pressure, occupational safety, and employment status.[19]

The National Fire Protection Association (NFPA), the US Department of Transportation (DOT), and the Commonwealth of Massachusetts Human Resources Division have established blood pressure guidelines for firefighters, commercial drivers, and policemen and firefighters, respectively. Lacking evidence from occupational cohorts, their cutoff criteria for acceptable blood pressure are based on generalizations from nonoccupational settings. Each expert panel, however, reached different conclusions. The NFPA specifies acceptable blood pressure as a systolic blood pressure (SBP) <180, a diastolic blood pressure (DBP) <100 mm Hg, and no target-organ damage.[20] The DOT stipulates that commercial drivers are medically qualified if their SBP

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is ≤160 mm Hg and their DBP is ≤90 mm Hg. Drivers may be provisionally qualified when 161 ≤ SBP ≤180 mm Hg and/or 91 ≤ DBP ≤ 104 mm Hg. Drivers must be disqualified when their SBP exceeds 180 mm Hg or when their DBP exceeds 104 mm Hg.[21] Meanwhile, Massachusetts' Human Resources Division defines an SBP < 160 mm Hg and a DBP < 100 mm Hg as acceptable for the initial hire of firefighters and police officers.[22]

While objective, numerical criteria may simplify the medical examiner's task by sparing subjective human judgement,[23] the impact of current blood pressure guidelines on employment status and health is unknown. In addition, the lack of evidence on occupational outcomes may reinforce examiners' reluctance to follow guidelines and exclude workers from jobs based on a single examination finding.[10,23] Finally, we do not know which guidelines, even if consistently enforced, are the most appropriate. We undertook this study to examine blood pressure and changes in employment status among firefighters and the utility of resting blood pressure as a fitness-for-duty criterion.

## Methods

### Subjects

The study base consisted of 340 firefighters from six regional, hazardous materials teams in Massachusetts who underwent a baseline examination in 1996 or 1997, when a statewide medical-surveillance program was initiated. The firefighters joined the hazardous materials teams on a contractual basis in addition to their primary occupational duties as municipal firefighters in local fire departments. We excluded two persons who were examined but never joined a hazardous materials team; three firefighters with inadequate follow-up information; and one firefighter already on "injured-on-duty" status at his baseline examination. The Institutional Review Boards of the Harvard School of Public Health and the Cambridge Hospital approved review of the firefighters' medical records for research purposes.

### Baseline and Follow-Up Medical Examinations

Medical-surveillance examinations were performed, on a confidential basis, at one of three contracted Massachusetts hospitals. Eighty-two percent of the baseline examinations took place in 1996, and most of the firefighters ($n$ = 214) had the first follow-up examination during 1997. The subsequent periodic examinations for all teams took place during the fall of 1998, 1999, and 2000. All examinations were performed for the dual purposes of medical surveillance and determination of fitness-for-duty status for the hazardous materials teams and were conducted in a similar fashion based on a written protocol. The physicians performing or supervising the medical examinations were board-certified or board-eligible in occupational medicine. Initially, all fitness decisions were left to the clinical discretion of the examining physicians at each hospital. Since 1998, threshold guidelines for resting blood pressure (SBP < 180 mm Hg, DBP < 100 mm Hg) and visual and acoustic acuity criteria were recommended, but the ultimate fitness-for-duty decisions remained with the attending physicians and were not subject to secondary review or audit. Examining physicians were blinded to the hypothesis of this investigation and were not informed that we were evaluating blood pressure ≧160/100 mm Hg as a threshold for increased risk. Summary results for each firefighter's examination, including the physicians' determination of fitness for duty, were transferred to a computerized medical record repository.

### Blood Pressure Readings

Resting blood pressure readings were recorded routinely, in mm Hg, as part of the vital-signs evaluation and documented at every examination. For this study, the blood pressure for each examination was the single reading that was documented on each firefighter's summary sheet and sent to the central repository. Before entry into the computerized repository, blood pressure readings were rounded up to the nearest even digit. The Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-VI)[5] was used to classify firefighters into three blood pressure categories based on the 1996 to 1999 examinations. The first category was normal blood pressure (SBP < 140 and DBP < 90 mm Hg), the second category was stage I hypertension (140 ≤SBP < 160 mm Hg and/or 90 ≤DBP < 100 mm Hg), and the third category was stage II hypertension or higher (SBP ≥ 160 mm Hg and/or DBP ≥ 100 mm Hg).

### Additional Risk Factors

Prospective information on other factors was routinely collected at every examination, including the following: measured height and weight, age, gender, job type, allergies, medications, smoking history, and physical examination findings. Laboratory tests were also administered at each annual examination, including electrocardiogram (baseline only), spirometry, complete blood count, blood glucose, total cholesterol, serum triglycerides, liver enzymes, serum creatinine, and urinalysis. Since the 1996 or 1997 medical examinations, most data that were initially missing in the central data repository had been recovered from the original medical records of the examining hospital and entered into the repository.

### Change in Employment Status

Changes in employment status (death, placement on injured-on-duty status, termination of duty, resignation, or retirement) were reported by the state Office of Hazardous Materials Response. Information on inci-

**TABLE 1**
Characteristics of the Hazardous Materials Firefighters by Blood Pressure Category ($N = 334$)

| | | Blood Pressure Categories (mm Hg) | | | |
|---|---|---|---|---|---|
| | *n* | Normotensive at All Exams (SBP < 140 and DBP < 90) (*n* = 215) | Any Stage I Hypertensive Reading (140 ≤ SBP < 160 and/or 90 ≤ DBP < 100) (*n* = 93) | Any Stage II Hypertensive Reading (SBP ≥ 160 and/or DBP ≥ 100) (*n* = 26) | *P* Value |
| Age (mean ± SD) | 334 | 38.0 ± 6.6 | 41.2 ± 7.0 | 43.0 ± 7.1 | <0.001 |
| SBP (mean ± SD) | 334 | 118 ± 10 | 129 ± 12 | 142 ± 16 | <0.001 |
| DBP (mean ± SD) | 334 | 76 ± 8 | 82 ± 9 | 91 ± 10 | <0.001 |
| BMI, (kg/m$^2$) [*n* (%)] | 327 | | | | 0.004 |
| <25 Normal | | [36 (17%)] | [6 (7%)] | [0] | |
| 25–29 Overweight | | [115 (55%)] | [46 (50%)] | [12 (48%)] | |
| ≥30 Obese | | [60 (28%)] | [39 (43%)] | [13 (52%)] | |
| Cholesterol [*n* (%)] | 296 | | | | 0.481 |
| <200 mg/dL | | [60 (31%)] | [21 (27%)] | [6 (24%)] | |
| 200–239 mg/dL | | [74 (38%)] | [27 (35%)] | [7 (28%)] | |
| ≥240 mg/dL | | [60 (31%)] | [29 (38%)] | [12 (48%)] | |
| Creatinine (mg/dL), (mean ± SD) | 333 | 1.1 ± 0.2 | 1.1 ± 0.2 | 1.1 ± 0.1 | 0.928 |
| Smoking [*n* (%)] | 333 | | | | 0.896 |
| Nonsmoker | | [193 (90%)] | [83 (89%)] | [24 (92%)] | |
| Current smoker | | [21 (10%)] | [10 (11%)] | [2 (8%)] | |

SBP, systolic blood pressure, and DBP, diastolic blood pressure, are in mm Hg. Ages are in years.

dent cardiovascular disease events (coronary heart disease or significant arrhythmia potentially interfering with duty) was collected by systematically reviewing the medical examination summaries. The following possible changes in employment status were included as a summary outcome measure: death, placement on injured-on-duty status, termination of duty, resignation, retirement, and incident cardiovascular disease events.

## Statistical Analyses

Statistical analyses were performed using SAS software (version 6.12)[24] and SPSS version 9.0.[25] *T* test and chi-square tests were used to compare the differences in risk factors between the blood pressure categories. Person-years of follow-up were calculated from the baseline examination (1996) until the end of the study's follow-up period, which ended with the annual fall examination of 2000. Individual person-years subsequent to each examination were excluded if a firefighter had been found medically unfit for duty, was otherwise occupationally inactive, or on injured-on-duty status at the time of the index examination. Cox proportional-hazards regression models (adjusted for age, smoking, body mass index [BMI], total cholesterol, and blood pressure medication use) were used to evaluate the association between blood pressure and the risk of adverse employment status change.

We generated several separate models using either dichotomous measures for blood pressure (≧140/90 mm Hg or ≧160/100 mm Hg) or a three-category blood pressure variable. Effect modification was also evaluated using age, BMI, and antihypertensive medication as possible modifiers. Stratified analyses were performed for two different BMI categories and among those who were taking versus those who were not taking antihypertensive medications.

## Results

The 334 firefighters included in our study were followed up for an average of 3.8 years (range, 1 to 4 years) and generated 1,262 person-years of follow-up. Their initial mean age was 39 ± 7 years (range, 20 to 58 years), and the vast majority were men ($n = 331$). At baseline, 66% had optimal or normal blood pressure (SBP < 130 mm Hg and DBP < 85 mm Hg), 17% had high-normal readings (130 ≤SBP < 140 mm Hg and/or 85 ≤DBP < 90 mm Hg), and 15% had stage I hypertension according to the JNC-VI guidelines. Only nine firefighters (2.7%) at baseline were found to have stage II hypertension (SBP ≥ 160 mm Hg and/or DBP ≥ 100 mm Hg). The highest SBP observed at any examination was 180 mm Hg, and the highest DBP was 114 mm Hg. Among the 26 firefighters with any stage II readings (1996–1999), 23% had both systolic and diastolic stage II readings, 23% had stage II systolic readings alone, and 54% had stage II diastolic readings alone.

Table 1 describes the baseline characteristics of the study population by summary blood pressure categories for all examinations from 1996 to 1999. Firefighters with higher blood pressure were significantly older ($P < 0.001$) and more obese ($P = 0.004$) compared with

**TABLE 2**
Employment Status Changes Between 1996 and 2000 Based on Blood Pressure Categories at 1996–1999 Examinations ($N = 334$)

| | | Blood Pressure Categories (mm Hg) | | | |
|---|---|---|---|---|---|
| | *n* | Normotensive at All Time Points (*n* = 215) | Some Stage I Hypertensive Readings (*n* = 93) | Any Stage II Hypertensive Readings (*n* = 26) | *P* Value |
| Total years of follow-up, 1996–2000, or prior to a change in work status | 334 | | | | |
| 1 | | 2 (1%) | 2 (2%) | 2 (8%) | 0.022 |
| 2 | | 11 (5%) | 2 (2%) | 1 (4%) | |
| 3 | | 16 (7%) | 9 (10%) | 6 (23%) | |
| 4 | | 186 (87%) | 80 (86%) | 17 (65%) | |
| Adverse events | 334 | | | | |
| No event | | 180 (84%) | 84 (90%) | 18 (69%) | 0.029 |
| Event | | 35 (16%) | 9 (10%) | 8 (31%) | |
| Adverse events (those on BP medication excluded)* | 314 | | | | |
| No event | | 178 (85%) | 75 (90%) | 13 (62%) | 0.005 |
| Event | | 32 (15%) | 8 (10%) | 8 (38%) | |
| Adverse events (excludes BMI < 30)† | 112 | | | | |
| No event | | 46 (77%) | 34 (87%) | 7 (54%) | |
| Event | | 14 (23%) | 5 (13%) | 6 (46%) | 0.013 |
| Adverse events (excludes BMI < 30 and BP medication use) | 102 | | | | |
| No event | | 46 (78%) | 28 (85%) | 4 (40%) | |
| Event | | 13 (22%) | 5 (15%) | 6 (60%) | 0.042 |

* Excludes firefighters who were receiving an antihypertensive medication in 1996.
† Excludes all firefighters with a body mass index (BMI) < 30.

those with normal blood pressure. The prevalence of elevated total cholesterol was not significantly different among the blood pressure categories; however, we observed a dose–response trend ($P = 0.093$) of increasing cholesterol by increasing blood pressure.

During 4 years of follow-up, 52 firefighters experienced adverse changes in their employment status. Twenty-five firefighters resigned at some point during the study period; 19 firefighters were placed on injured-on-duty status; three were terminated from their duties; two were removed from the hazardous materials teams; one died on duty; and two experienced cardiovascular disease events.

Table 2 summarizes years of follow-up and adverse events for the entire study period based on blood pressure categories as described in Table 1 from the 1996 to the 1999 examinations. Adverse events for the entire study period were more frequent for those with any stage II hypertension readings (31%) compared with the other two groups (10% to 16%) ($P = 0.029$). Considering only obese firefighters or those not taking antihypertensive medications further increased the risks of adverse events. When both nonobese firefighters and those taking antihypertensive medications were excluded, the rate of adverse events was 60% for obese persons with any stage II hypertension readings compared with 15% to 22% among obese subjects in stage I hypertension and normotensive groups ($P = 0.013$).

Table 3 examines the risk of an adverse event before the next follow-up examination, based on the single blood pressure recorded at the preceding examination. For firefighters with a stage II hypertension reading, the rate of events before the next examination was 10.8 per 100 person-years ($P < 0.05$) compared with those with normal and stage I hypertension readings pooled. Again, further increases in risk were observed for stage II readings among obese firefighters and those with untreated hypertension. When nonobese firefighters and persons taking antihypertensive medications were excluded, the rate of adverse events after a stage II reading was 21 events per 100 person-years. Again, this was significantly higher ($P < 0.05$) than the pooled rate for obese firefighters in the two groups with lower blood pressure.

Cox proportional-hazards regression models adjusting for age, BMI, smoking, cholesterol, and antihypertensive medication are presented in Table 4. Stage II hypertension was a significant predictor of adverse events in all models. We found that firefighters with stage II hypertension readings, at any examination, were 3.2 (95% confidence interval [CI], 1.50 to 7.04) times more likely

**TABLE 3**
Employment Status Changes Between 1996 and 2000 per Person-Years of Follow-Up in Different Blood Pressure Categories at Each Individual Examination 1996–1999

| Adverse Events | Person-Years | Blood Pressure Categories (mm Hg) | | | |
|---|---|---|---|---|---|
| | | Normotensive Readings | Stage I Hypertension Readings | Stage II or Higher Readings | (*P* Value*) |
| All firefighters | | | | | |
| Events/person-years | 1,262 | 40/1,049 | 8/176 | 4/37 | |
| Events/100 person-years | | 3.81 | 4.54 | 10.81 | (<0.05) |
| On BP med excluded† | 1,186 | | | | |
| Events/person-years | | 37/1,003 | 7/156 | 4/27 | |
| Events/100 person-years | | 3.68 | 4.48 | 14.81 | (<0.005) |
| Excludes BMI < 30‡ | 413 | | | | |
| Events/person-years | | 17/320 | 5/72 | 3/21 | |
| Events/100 person-years | | 5.3 | 6.9 | 14.3 | NS |
| BMI < 30‡ or on BP med excluded† | 376 | | | | |
| Events/person-years | | 16/300 | 5/62 | 3/14 | |
| Events/100 person-years | | 5.3 | 8.1 | 21.4 | (<0.05) |

* Fisher's exact tests comparing adverse events in stage II vs normal and stage I hypertension categories combined.
† Excluding firefighters who were receiving an antihypertensive medication in 1996.
‡ Excluding all firefighters with a body mass index (BMI) < 30.

**TABLE 4**
Multivariable-Adjusted Hazard Ratios and 95% CIs for the Association of Hypertension and Change in Employment Status in Hazardous Materials Firefighters ($N = 334$)*

| | Hazard Ratios (95% CI) | *P* Value |
|---|---|---|
| Hypertension (model 1)† | 1.4 (0.85–2.35) | 0.19 |
| Stage II Hypertension (model 2)‡ | 3.1 (1.47–6.60) | 0.003 |
| Firefighters with BMI ≥ 30 | 3.0 (1.12–8.07) | 0.03 |
| Firefighters with no medication use for BP | 4.2 (1.96–8.81) | 0.0002 |
| Hypertension (model 3)§ | | |
| Stage I hypertension | 0.9 (0.48–1.57) | 0.6 |
| Stage II or higher | 3.2 (1.50–7.04) | 0.003 |
| Firefighters with BMI > 30 | | |
| Stage I hypertension | 1.1 (0.52–2.30) | 0.8 |
| Stage II or higher | 2.9 (1.06–8.09) | 0.04 |
| Firefighters with no medication use for BP | | |
| Stage I hypertension | 0.8 (0.40–1.50) | 0.45 |
| Stage II or higher | 4.6 (2.08–10.11) | 0.0002 |

* Adjusted for age (continuous), smoking (yes/no), total cholesterol (continuous), body mass index (BMI, continuous), and blood pressure (BP) medication use (yes/no).
† Hypertension was defined as a dichotomous variable with BP < 140/90 mm Hg as the reference category.
‡ Hypertension was defined as a dichotomous variable with BP < 160/100 mm Hg as the reference category.
§ Hypertension was defined as a three-category variable. Normal BP (BP < 140/90 mm Hg) was used as the reference category. Stage I hypertension (140/90 ≤ BP < 160/100 mm Hg) and stage II hypertension or higher (BP ≥ 160/100 mm Hg) were compared with the reference category to explore possible dose–response relationships.

to experience an adverse employment status change compared with those with normotensive readings. The hazard ratio increased to 4.6 (95% CI, 2.08 to 10.11) among firefighters with stage II hypertension who were not taking antihypertensive medications. This dose–response model demonstrated that only stage II hypertension readings were significantly associated with higher risks of employment status changes. Neither age (hazard ratio, 1.0; 95% CI, 0.95 to 1.02) nor the interaction of age and hypertension (hazard ratio, 1.0; 95% CI, 0.99 to 1.02) were significant predictors of adverse events in multivariable-adjusted regression.

## Discussion

To our knowledge, this is the first study to prospectively examine blood pressure control and changes in employment status. Using various methods of analysis, we found that firefighters with stage II hypertension (BP ≥ 160/100 mm Hg) were consistently 2 to 3 times more likely to experience an adverse event than firefighters with normal blood pressure. This finding persisted after adjustment for a number of possible confounders. Therefore, our results provide evidence-based support for using <160/100 mm Hg as a cutoff criterion for occupationally acceptable resting blood pressure among firefighters. Only a single systolic reading exceeded the NFPA systolic

guideline (SBP < 180 mm Hg) during 1262 person-years. Therefore, this particular systolic criterion lacked sensitivity and utility in our study population.

A second important finding regards two other modifiable risk factors. Among firefighters with stage II hypertension readings, adverse events were even more frequent among those not receiving antihypertensive medications and those with obesity (BMI ≥ 30). Obese firefighters with untreated stage II hypertension experienced the highest rate of adverse events. Therefore, although all firefighters with hypertension should be referred for treatment, our data suggest that certain groups warrant further consideration before receiving clearance as fit for duty, as well as more aggressive risk factor detection and management.

The overall prevalence of hypertension (defined by blood pressure readings and/or antihypertensive medication use) among our study population was relatively high (20%); however, it was lower than the prevalence in the general population (23% to 40%),[26] perhaps because of the healthy worker effort.[27] In any case, if <160/100 is used as a strict fitness-for-duty cutoff, only a small proportion of firefighters (about 3% per year) will be temporarily disqualified on this basis until improved blood pressure control is achieved. Thus, in addition to support from our study, this proposed guideline is practical to implement and reasonable public health policy.

Our investigation does have several limitations. The annual examinations and data collection processes were conducted in three different hospitals for six regional hazardous materials teams. Despite written protocols for medical surveillance, we know that not all physicians followed the same fitness determination practices.[10] Therefore, their clinical practices regarding uncontrolled hypertension may have differed also. When we adjusted for the examining hospital, however, the significantly increased risk for stage II hypertension persisted. It might also be postulated that from 1998 on, when a blood pressure guideline was recommended, some physicians might have been less likely to document a reading higher than 179 mm Hg, systolic or 99 mm Hg, diastolic to avoid disqualifying firefighters. This scenario would have misclassified some firefighters with high DBPs as <100 mm Hg. Another possible concern is differential methods of blood pressure assessment among examiners. Both misclassification scenarios, however, would be likely to drive the results toward the null hypothesis. Finally, the study subjects were classified primarily on the basis of single blood pressure readings. Single readings, however, have previously been shown to be significant predictors of cardiovascular disease outcomes.[28]

A different limitation, imposed by our relatively small sample size, was the inability to study specific outcomes (eg, on-duty incapacitation or injury). Therefore, we needed to use a broad outcome measure encompassing significant changes in employment status. Thus, the summary measure included retirement and resignation as well as health events. We believe our choice of outcomes was justified for several reasons. First, we did not consider fitness-for-duty decisions themselves because they can be directly linked to the exposure under study, uncontrolled hypertension. Second, we excluded from consideration resignations that resulted from promotions to higher rank and were unlikely to be health related. In other cases, however, there is good reason to believe that retirements and resignations in firefighters under the age of 60 may involve health issues. Likewise, termination of duty is likely to occur due to lack of compliance with the medical examination process, which again may relate to health problems. We do not have definitive evidence because the departing firefighters did not take advantage of an exit medical examination. Nonetheless, support for this ill-health hypothesis is the fact that in multivariable-adjusted models, stage II hypertension, obesity, and smoking were significant predictors of adverse events while age was not. Regarding injured-on-duty status, we lacked detailed information regarding the nature of the health problem in most reports. Injured-on-duty status usually relates to an injury occurring during the firefighter's municipal firefighting duties or a significant intervening medical illness. These injuries and illnesses resulted in sick leaves for several months to years from the hazardous materials teams and in several firefighters, to eventual retirement. In summary, the adverse employment outcomes included in the study were also likely to reflect changes in functional status that could interfere with some aspects of active duty.

It is not entirely clear why stage II blood pressure levels were associated with adverse employment status changes, since the majority of these events were not cardiovascular in nature. Stage II hypertension may be a marker of reduced fitness and other health problems, especially when untreated. In this sense, our results may be analogous to those of Cady et al,[29] who found that decreased measures of physical fitness in firefighters conveyed increased risks of injury. The majority of adverse events among hypertensive firefighters occurred in individuals who were not treated for hypertension rather than those who were prescribed medication but with inadequate blood pressure control. Therefore, their other health problems were also likely to be untreated.

Our baseline data demonstrated some cardiovascular risk factor clustering, such as increasing age, obesity, and elevated cholesterol among firefighters with hypertension. In a previous study,[30] we found that firefighters with various single and aggregate measures of possible decreased fitness tended to have worse examination results on other parameters as well. General population

studies have shown that cardiovascular risk factors may cluster together in certain groups, especially hypertensives.[31–34] On the other hand, although elevated blood pressure may be a marker of other health problems, firefighters with stage II hypertension had significantly increased risks for adverse events, after adjustment for possible confounders including age and BMI. Moreover, the results were not an artifact of medication side effects because untreated hypertension was associated with higher risks.

Although we could not directly measure the impact of hypertension on cardiovascular outcomes, persons with hypertension, especially stage II hypertension, are more prone to cardiovascular disease and should receive further evaluation.[35,36] Myocardial infarctions are the most common cause of on-duty fatalities among firefighters, accounting for 45% of deaths,[37] and risk factor identification and management could reduce mortality.[38] In addition, based on our findings of increased risks of adverse employment events, firefighters with blood pressure ≥160/100 mm Hg should demonstrate improved blood pressure control before receiving medical clearance as fit for duty.

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