Risk factors for work-related cardiovascular and musculoskeletal diseases among prehospital urgent care workers: a systematic review

Fatores de risco para doenças cardiovasculares e osteomusculares relacionadas ao trabalho em profissionais do atendimento pré-hospitalar de urgência: uma revisão sistemática

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ABSTRACT | Background: Studies conducted with prehospital urgent care workers investigated work-related stress and its repercussions on the workers' mental and physical health. **Objective:** To identify risk factors for development of work-related cardiovascular (CVD) and musculoskeletal (MSD) diseases among prehospital emergency care workers. **Methods:** We conducted a systematic search on databases PubMed, EBSCO, EMBASE and Science Direct. The inclusion criteria were: risk factors for CVD and MSD among prehospital emergency care workers. **Results:** From 370 articles, 11 were included for review. The included studies identified risk factors for CVD, such as body mass index and sedentary lifestyle, however, with limited level of evidence. For MSD, age and working as first responder were shown to behave as risk factors, with high level of evidence. We were not able to determine the cardiovascular risk factors due to lack of studies that analyzed this aspect. **Conclusion:** The most evident musculoskeletal risk factors reported in the literature are age and working as first responder. Registration PROSPERO: CRD42016042390.
Keywords | cardiovascular diseases; musculoskeletal pain; risk factors; occupational health; emergency care providers.

RESUMO | Contexto: Pesquisas com o trabalhador do atendimento pré-hospitalar de urgências têm investigado o estresse relacionado ao trabalho e suas repercussões na saúde mental e física desses profissionais. **Objetivo:** Identificar os fatores de risco para doenças cardiovasculares (DCV) e doenças osteomusculares (DOM) nos trabalhadores do atendimento pré-hospitalar de urgências. **Métodos:** Realizou-se uma busca sistemática nas bases de dados PubMed, EBSCO, Embase e Science Direct, com os seguintes critérios de inclusão: abordar fatores de risco para as DCV e DOM e envolver trabalhadores pré-hospitalar de urgências. **Resultados:** Inicialmente, foram encontrados 370 artigos, dos quais 11 foram incluídos na presente revisão. Os estudos considerados identificam fatores de risco para as DCV, como índice de massa corporal e sedentarismo, porém com limitado nível de evidência, bem como para as DOM, entre eles idade e atividade profissional dos socorristas, com forte nível de evidência. Não é possível afirmar os fatores de risco cardiovasculares em virtude da carência de estudos que analisem esses aspectos. **Conclusão:** Os fatores de risco osteomusculares, mais claros na literatura, referem-se à idade e à atividade profissional dos socorristas. Registro PROSPERO: CRD42016042390.
Palavras-chave | doenças cardiovasculares; dor musculoesquelética; fatores de risco; saúde do trabalhador; auxiliares de emergência.

INTRODUCTION

The aim of the Mobile Urgent Care Service (Serviço de Atendimento Móvel de Urgência – SAMU) is to tend to people with urgent conditions at the place where events occurred to ensure early care delivery and access to the health system[1].

In addition to transporting patients to hospitals, prehospital urgent care workers perform low- to medium-complexity procedures, ranging from administration of medications and dressing wounds to cardiopulmonary resuscitation (CPR). The working routine of these workers includes: adult and pediatric trauma cases, insecurity at the site, contact with toxics, violence in poor areas with high social vulnerability, and fires, among others[2].

Such high stress situations might be considered as risk factors for cardiovascular (CVD) and musculoskeletal (MSD) diseases. The cardiovascular system must respond to stress, and such response includes: elevation of the heart rate and contractility, blood pressure (BP) and peripheral vascular resistance[3].

Stressful work might also cause persistent and significant BP elevation, which is more evident among workers who are required to perform considerable physical effort[4]. This is a part of the routine of prehospital urgent care providers at the time of moving patients, which includes lifting stretchers and other equipment, which is often performed incorrectly, resulting in muscle adjustments and changes in response to the demands imposed by the task. These characteristics are risk factors for MSD.

Studies targeting prehospital urgent care providers investigated work-related stress and its impact on their mental and physical health. Therefore, the literature needs to be reviewed to identify risk factors for CVD and MSD among this population.

METHODS

The present review complied with the recommendations formulated in Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[5] and was registered at International Prospective Register of Systematic Reviews (PROSPERO) registration number CRD42016042390.

SOURCES OF INFORMATION AND SEARCH STRATEGY

We conducted a systematic search of scientific articles in databases PubMed (Table 1), EBSCO (Medline), Embase and Science Direct on July 2016 with no time limit.

ELIGIBILITY CRITERIA

The located articles ought to meet the following inclusion criteria: address risk factors for CVD and MSD and consider prehospital urgent care providers. Studies that assessed treatments for the target population, considered single events — as e.g., disasters, or were not written in English, Spanish or Portuguese were excluded.

STUDY SELECTION

Articles were independently selected by two reviewers based on titles and abstracts. The articles that met the eligibility criteria were subjected to full-text analysis. Cases of disagreement were initially solved by consensus; when doubts remained, a third reviewer was called to settle the matter.

Table 1. Search strategy used in database PubMed.

Research	Search terms
#1	"Emergency Medical Technicians"[Mesh] OR ""Emergency Medical Technicians" [Title/Abstract] OR "Technician, Emergency Medical"[Title/Abstract] OR "Medical Technician, Emergency"[Title/Abstract] OR "Paramedics, Emergency"[Title/Abstract] OR "Emergency Paramedic"[Title/Abstract] OR "Emergency Paramedics"[Title/Abstract] OR "Paramedic, Emergency"[Title/Abstract] OR "Emergency Medicine Technicians"[Title/Abstract] OR "Emergency Medicine Technician"[Title/Abstract] OR "Technician, Emergency Medicine"[Title/Abstract] OR "Technicians, Emergency Medicine"[Title/Abstract] OR "Emergency Medical Technician"[Title/Abstract] OR "Medical Technicians, Emergency"[Title/Abstract] OR "Technicians, Emergency Medical"[Title/Abstract]
#2	"Occupational Disease"[Title/Abstract] OR "Risk Factors"[Title/Abstract] OR "Risk Factors"[Title/Abstract] OR "Cardiovascular Diseases"[Title/Abstract] OR "Musculoskeletal Diseases"[Title/Abstract]
#3	#1 AND #2

DATA EXTRACTION

Data extraction was independently performed by two reviewers, for which purpose they used a standard form to collect the following information: country where study was conducted, population, sample, assessment instruments, aims and risk factors. Instances of disagreement were solved by consensus or a third reviewer.

ASSESSMENT OF THE QUALITY OF THE INCLUDED STUDIES

The quality of the articles was assessed by means of the Critical Appraisal of Studies scale[6], which considers 8 items: study design, sampling frame, sample size, outcome measurement, response rate, interpretation of results and applicability of results.

DATA ANALYSIS

First we clustered the collected data per similarity, thus discriminating between cardiovascular and musculoskeletal risk factors. Next we performed a narrative synthesis of the results of the included studies to describe the ratio associated with the identified risk factors. We could not perform a meta-analysis, as a function of the considerable amount of identified risk factors and divergence in the presentation of the results of the analyzed studies, which did not allow for a second statistical analysis. Thus we choose to analyze the strength of the scientific evidence by means of best evidence synthesis (BES) as previously done by the Cochrane Collaboration[7]. BES is an alternative to meta-analysis that consists in qualitative assessment of studies in which the strength of evidence is established based on the number and quality of studies and the coherence of their results[7].

Evidence was thus classified as follows: strong — derived from several high-quality studies; moderate — obtained from one high-quality study and one or more low-quality studies; limited — resulting from one high-quality or several low-quality studies; and none — based on one low-quality study or presence of contradiction among results[8].

RESULTS

We located 370 articles, as shown in Figure 1. After the various steps of article selection, 11 were included for systematic review.

The methodological quality of most studies was considered high; 7 out of the 11 analyzed studies exhibited 5 "yes" answers to the items in Critical Appraisal of Studies, and 4 had 4 "yes" answers (Table 2).

Table 3 describes the characteristics of the studies included for systematic review, to wit, country where study was conducted, population, sample and assessment instruments. Table 4 shows the main results of the articles included for systematic review.

DISCUSSION

In the present study we found that 5 articles mentioned risk factors for CVD, which included: body mass index (BMI) corresponding to overweight or obesity[9], sedentary
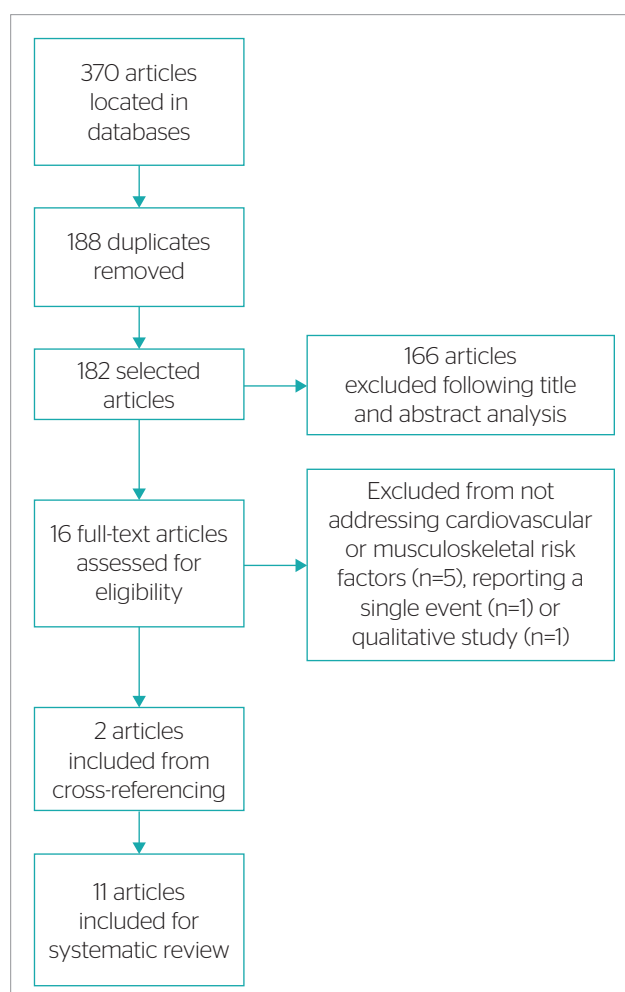

Figure 1. Flowchart representing the process of article selection.

lifestyle[9], systemic arterial hypertension (SAH)[11,12], smoking[12], hyperlipidemia[12], and work environment[13]. Analysis of the corresponding strength of evidence showed it was "limited" for BMI and sedentary lifestyle and "none" for all others,

Table 2. Results of the assessment of the methodological quality of studies by means of the Critical Appraisal of Studies scale.

First author (year)	Critical Appraisal of Studies criteria checklist								Total (number of V)
	1	2	3	4	5	6	7	8	
Cardiovascular risk factors									
Studnek et al. (2010)[9]	V	V	V	V	V	X	V	V	7
Barrett et al. (2000)[10]	V	V	V	V	V	V	X	V	7
Weiss et al. (1996)[11]	V	X	X	V	?	V	V	V	5
Boreham et al. (1994)[12]	X	V	X	V	?	X	V	V	4
Jamner et al. (1991)[13]	X	X	X	V	V	X	V	V	4
Musculoskeletal risk factors									
Roberts et al. (2015)[14]	V	V	V	?	-	-	V	V	5
Weaver et al. (2015)[15]	V	V	V	?	-	-	V	X	4
Kim et al. (2012)[16]	V	V	V	?	-	-	V	V	5
Studnek et al. (2010)[17]	V	V	V	V	V	X	V	X	6
Studnek & Crawford (2007)[18]	V	V	V	V	V	X	V	V	7
Lavender et al. (2000)[19]	X	X	X	V	?	V	V	V	4

V: yes; X: no; ?: indeterminable; -: not applicable.
1: Are the study design and sampling method appropriate for the research question?; 2: Is the sampling frame appropriate?; 3: Is the sample size adequate?; 4: Are objective, suitable and standard criteria used for measurement of the health outcome?; 5: Is the health outcome measured in an unbiased fashion?; 6: Is the response rate adequate? Are the refusers described?; 7: Are the estimates of prevalence or incidence given with confidence intervals and in detail by subgroup, if appropriate?; 8: Are the study subjects and setting described in detail and similar to those of interest to you?

the reason being lack of studies on the target population specifically analyzing theses aspects. Therefore, new studies investigating risk factors for CVD among emergency care providers are needed.

According to some studies, 48% of paramedics exhibited high or very high risk of CVD[10]; 49% of workers under 40 years old and 83% of the ones over 40 exhibited two or more risk factors for CVD, which denote significantly higher odds of CVD in this population[12].

According to Studnek et al.[9], obese individuals are more prone to report a history of disease. Prevalence of over 50% of obesity/overweight was described for emergency medical service (EMS) workers[10,12]. Also individuals with sedentary lifestyle are more prone to report a history of disease, while the prevalence of sedentary lifestyle was high among the target population (30%)[12].

We should observe that a large part of the studies included in the present systematic review were performed in the United Stable; perhaps the aspects related to obesity and sedentary lifestyle do not apply to other countries.

None of the other analyzed risk factors exhibited any strength of evidence. Thus being, new studies are needed to conclude on this subject. For now, in regard to SAH Boreham et al.[12] found that EMS workers exhibited significantly higher BP compared to the overall male population. The prevalence of HAS was also high among the target population, 11%[10], while the systolic (SAP) and diastolic (DAP) arterial pressure was respectively 30% and 41% above the recommended levels[12].

Hyperlipidemia, i.e., a well-known risk factor for CVD, was described as the most prevalent condition among the reported diseases[9], its prevalence varying from 11.5% to 71%[9,10,12]. Among the relevant findings of the present study, we might mention the significant reduction of the average high-density lipoprotein (HDL) levels by comparison to the overall population[12]. The incidence of smoking was higher among EMS workers compared to the overall population[12], with prevalence of 19% among paramedics[10].

A much discussed risk factor is the professional activity of emergency care providers and their work environment. In their study, Jamner et al.[13] found higher SAP, DAP and heart rate (HR) when professionals were "at the scene" (i.e., in action) compared to the time of waiting at the station. However, Weiss et al.[11] reported opposite results, i.e., the mean arterial pressure (MAP) did not exhibit post-shift

Table 3. Characteristics of studies included for systematic review.

1st author (year)	Country	Population	Sample (n)	Assessment instruments
Cardiovascular risk factors				
Studnek et al. (2010)[9]	United States	EMS professionals[1]	19,960	Questionnaire on disease history, general state of health, physical activity, smoking and instruments Behavioral Risk Factor Surveillance System (BRFSS) and Longitudinal EMT Attributes and Demographics Study (LEADS)
Barrett et al. (2000)[10]	United States	Paramedics	85	Health Education Risk Reduction Training (HEAR2T)
Weiss et al. (1996)[11]	Not reported	Paramedics	40	Questionnaires for demographic data; logbooks to record caffeine intake, number of cigarettes, type of shift (day or night) and runs; BP and HR were measured with electronic wrist monitor before and after shifts
Boreham et al. (1994)[12]	Northern Ireland	EMS professionals	93	Questionnaire for demographic data and level of physical activity, complete medical assessment (resting ECG, BP, anthropometric data, maximal oxygen consumption on cycle ergometer)
Jamner et al. (1991)[13]	Not reported	Paramedics	33	Questionnaires for medical history and health-related habits, reports of ambulance occurrences, continuous measurement of systolic and diastolic arterial pressure and heart rate
Musculoskeletal risk factors				
Roberts et al. (2015)[14]	Australia	Ambulance officers and paramedics	2,632	Data collected from databases (injury reports)
Weaver et al. (2015)[15]	United States	EMS professionals	4,382	Records of shifts and work accidents
Kim et al. (2012)[16]	United States	EMS professionals	24,824	Description of injuries, demographic and occupational characteristics
Studnek et al. (2010)[17]	United States	Paramedics	930	Questions from instruments Efforts, Behavioral Risk Factor Surveillance System (BRFSS) and Aberdeen Back Pain Scale (ABPS)
Studnek & Crawford (2007)[18]	United States	Paramedics and emergency medical technicians	104 with back complaints and 475 controls	Questionnaire on participation in patient transport, job satisfaction and sociodemographic variables
Lavender et al. (2000)[19]	Not reported	Paramedics	20	Posture was assessed with 4 video cameras; trunk position and movement were measured with lumbar motion monitor. Relative risk of low back injury was measured with 3D trunk model

EMS: emergency medical services; BP: blood pressure; HR: heart rate; ECG: electrocardiogram.

Table 4. Description of aims and results of articles included for systematic review.

1st author (year)	Aim	Risk factors
Cardiovascular risk factors		
Studnek et al. (2010)[9]	To quantify state of health and describe its main indicators	Obese individuals were more prone to report history of disease (OR 3.2); the participants with adequate physical fitness were less prone to report history of disease (OR 0.7).
Barrett et al. (2000)[10]	To investigate the prevalence of cardiac risk factors	48% of paramedics exhibited very high risk for cardiovascular disease (CVD); 11% had systemic arterial hypertension (SAH); 79% had body mass index (BMI) 30±5; 30% had sedentary lifestyle; 19% were smokers; 31% reported hyperlipidemia; 34% had family history of CVD
Weiss et al. (1996)[11]	To investigate the interaction of caffeine intake, smoking and stress with mean arterial pressure (MAP) and heart rate (HR)	MAP did not exhibit significant changes after shifts in any analysis. HR exhibited significant reduction after shits among individuals under 32, paramedics working the night shift and single workers
Boreham et al. (1994)[12]	To investigate state of health and cardiac risk factors	Blood pressure (BP) was significantly higher than the one described for the male population of Northern Ireland. The mean high-density lipoprotein (HDL) concentration was significant lower compared to the local population. The incidence of smoking was higher compared to the overall population. 49% of the individuals under 40 exhibited 2 or more risk factors, which suggests higher risk of coronary artery disease
Jamner et al. (1991)[13]	To investigate the effects of occupational stress episodes on cardiovascular reactivity and self-reported stress	Analysis of variance evidenced elevation (p<0.001) of systolic (SAP) and diastolic (DAP) arterial pressure and HR at work. SAP, DAP and HR were measured while paramedics where "at the scene" compared to waiting at station
Musculoskeletal risk factors		
Roberts et al. (2015)[14]	To investigate risk of low back and upper limb injury with comparison to nurses, caregivers and social workers	Relative risk of reports increased with age, but was not influenced by sex. Ambulance officers and paramedics exhibited 3.5 to 13 times higher risk of low back injury compared to nursing staff
Weaver et al. (2015)[15]	To assess the impact of shift length on work accidents and occupational disease	Shift length was associated with injury or disease reports; night shift, consecutive shifts and recovery period had no association. 8-hour shift reduced the risk of occupational injury or disease by 30%. 12-hour shift increased the risk of injury or disease by 49%. The risk of injury or disease increased 4% per additional working hour
Kim et al. (2012)[16]	To investigate the effect of patient handling on musculoskeletal injuries	56.6% of musculoskeletal injuries occurred when lifting patients and 87.5% when handling patients. Night shift workers exhibited 40% higher odds of injury
Studnek et al. (2010)[17]	To describe work-life and demographic characteristics associated with reporting backache and to estimate back pain severity	Poor health was significantly associated with low back pain. Individuals with higher educational level were less prone to report low back pain

Table 4. Continuation.

1st author (year)	Aim	Risk factors
Studnek & Crawford (2007)[18]	To investigate variables possibly associated with back complaints	Paramedics and workers involved in patient transport were more prone to report back complaints. Workers satisfied with the job and with better physical fitness were significantly less prone to report back complaints. Higher odds of back complaints were associated with increasing age
Lavender et al. (2000)[19]	Assess biomechanical stresses during paramedics' tasks to quantify musculoskeletal load and low back injury risk	The most hazardous tasks were transferring a patient from bed to stretcher, early descent of stairs with a stretcher and lifting victim from the floor. Lifting and pushing stretchers result in average L4-L5 compression of 5,476N (above the recommended level). Regression showed that bed-to-stretcher transfer was associated with high risk of low back injury. Mean probability varied from 89% to 96%, the main responsible factor was the resulting momentum of extreme reach and anterior flexion. When lifting victim from the floor, professionals placed at the patient's head exhibited higher L4-L5 compression compared to the ones placed at the feet (p<0.01). Regression showed higher odds of low back injury for professionals who lift victims from the head, the main responsible factor being the resulting momentum on the spine (69Nm on the head area and 41 Nm on the feet area)

OR: *Odds ratio.*

changes, and in some individuals HR decreased after the shift. These authors observe that their results do not support the hypothesis that intervention is needed for management of cardiovascular risk factors among paramedics. Given that the results are thus contradictory, new studies investigating the influence of professional activity and work environment of emergency care providers on BP and HR are needed to establish whether this population is exposed to higher risk of CVD.

Six studies mentioned risk factors for MSD, including: age[14,18], sex[14], educational level[17], physical fitness[18], professional activity[14,18,19], night shift[15,16], working hours, consecutive shifts and recovery period[15], self-reported general health[17] and job satisfaction[18].

Analysis of the strength of evidence showed it was "strong" for age and professional activity, "limited" for educational level, physical fitness, general health and job satisfaction, and "none" for the remainder of the risk factors.

Relative to the factors for which strong evidence I currently available, increasing age was associated with higher relative risk of reporting musculoskeletal injuries[14] and also higher odds of back complaints[18].

The studies that analyzed the influence of emergency care providers' professional activities found this population

exhibits higher odds of low back injury compared to others[14,18]. For most emergency care providers, musculoskeletal injuries are associated with handling of patients, and most of them involve the upper limbs and back[15,16]. A probable reason for such higher risk is patient transport, which tasks poses heavy physical demands. For instance, bed—to-stretcher transfer was described as posing high risk for low back injury, especially as a function of extreme reach and degree of anterior flexion, being even more serious for professionals who lift patients from the head, which demands lifting a heavier weight, and the resulting moment on the spine[19].

In addition to the physical effort demanded by patient handling, emergency care providers are subjected to other adverse conditions, such as emotional stress and work in ergonomically inappropriate locations. Examples are the scene of accidents, which was mentioned as the most common site where injuries and MSD occur (51.7%) or the ambulance during patient transportation, which accounted for 29.2% of injuries[15].

All the other aforementioned risk factors with limited strength of evidence were analyzed by one single study, which does not allow for a more thorough discussion of aspects such as job satisfaction, physical fitness, educational

level and general health. Shortly, according to the currently available data, dissatisfied workers[18], the ones with poor physical fitness[18] and those who reported poor general health[17] were significantly more prone to reporting back complaints. In turn, workers with higher educational level were less prone to reporting backache[17].

The strength of evidence for the remainder of the analyzed risk factors was categorized as "none". As a rule, these factors were related to work. One example is shift length, which was associated with reporting occupational injury or disease. Shifts of 8 hours or shorter reduced the risk of injury or disease by 30%, shifts of 12 hours or longer increased such risk by 49%, and risk of injury or disease increased 4% per each additional hour. Yet, working consecutive shifts and recovery period were not associated with reporting injury or disease[15]. Relative to the night shift, the studies described divergent results[15,16], and thus we cannot draw any conclusion at this moment.

To summarize, the studies included in the present systematic review did not adequately elucidate the risk factors for CVD and MSD. In addition, the vast majority of the studies were conducted in the United States, and the results perhaps might not be extrapolated to other countries. Therefore, we suggest that future studies should investigate these risk factors in other countries, including the Latin American ones. Such studies are relevant, because accurate knowledge about the risk factors for CVD and MSD among prehospital urgent care providers is necessary to implement actions and strategies aiming at promotion and maintenance of the workers' health, reaffirming to managers the relevance of health care and of the right to health.

CONCLUSION

The risk factors for CVD found in the present review were high BMI and sedentary lifestyle, but both had only limited strength of evidence. The strength of evidence for the remainder of the analyzed risk factors for CVD was categorized as "none", and thus no conclusion may be drawn on this subject. As a function of the lack of studies analyzing this aspect, we are not able to state which the cardiovascular risk factors are.

In regard to the musculoskeletal risk factors, the evidence for age and professional activity exhibited was strong. In turn, job satisfaction, physical fitness, educational level and general health had limited strength of evidence. Therefore, although several studies addressed risk factors for disease among emergency care providers, the literature is still poor in analyses of risk factors for CVD and MSD in this population. As a result, the currently available evidence on the effective risk factors for CVD and MSD is inconclusive.

REFERENCES

1. Ciconet RM, Marques GQ, Lima MADS. Educação em serviço para profissionais de saúde do Serviço de Atendimento Móvel de Urgência (SAMU): relato da experiência de Porto Alegre-RS. Interface (Botucatu). 2008;12(26):659-66.

2. Soerensen AA, Moriya TM, Soerensen R, Robazzi MLCC. Atendimento pré-hospitalar móvel: fatores de riscos ocupacionais. Rev Enferm UERJ. 2008;16(2):187-92.

3. Loures DL, Sant'Anna I, Baldotto CSR, Sousa EB, Nóbrega ACL. Estresse Mental e Sistema Cardiovascular. Arq Bras Cardiol. 2002;78(5):525-30.

4. Rocha R, Porto M, Morelli MYG, Maestá N, Waib PH, Burini RC. Efeito de estresse ambiental sobre a pressão arterial de trabalhadores. Rev Saúde Pública. 2002;36(5):568-75.

5. Moher D, Liberati A, Tetzlaff J, Altman DG, PRISMA Group. Reprint-preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Phys Ther. 2009;89(9):873-80.

6. Loney PL, Chambers LW, Bennett KJ, Roberts JG, Stratford PW. Critical appraisal of the health research literature: prevalence or incidence of a health problem. Chronic Dis Can. 1998;19(4):170-6.

7. Trinh K. Summaries and recommendations of the global impression method. J Acupunct Tuina Sci. 2009;7(5):296-302.

8. Van Tulder MW, Koes BW, Bouter LM. Conservative treatment of acute and chronic nonspecific low back pain: a systematic review of randomized controlled trials of the most common interventions. Spine. 1997;22(18):2128-56.

9. Studnek JR, Bentley M, Crawford JM, Fernandez AR. An assessment of key health indicators among emergency medical services professionals. Prehosp Emerg Care. 2010;14(1):14-20.

10. Barrett TW, Norton VC, Busam M, Boyd J, Maron DJ, Slovis CM. Self-reported cardiac risk factors in emergency department nurses and paramedics. Prehosp Disaster Med. 2000;15(2):14-7.

11. Weiss SJ, Silady MF, Roes B. Effect of individual and work characteristics of EMTs on vital sign changes during shiftwork. Am J Emerg Med. 1996;14(7):640-4.

12. Boreham CA, Gamble RP, Wallace WF, Cran GW, Stevens AB. The health status of an ambulance service. Occup Med (Lond). 1994;44(3):137-40.

13. Jamner LD, Shapiro D, Goldstein IB, Hug R. Ambulatory blood pressure and heart rate in paramedics: effects of cynical hostility and defensiveness. Psychosom Med. 1991;53(4):393-406.

14. Roberts MH, Sim MR, Black O, Smith P. Occupational injury risk among ambulance officers and paramedics compared with other healthcare workers in Victoria, Australia: analysis of workers' compensation claims from 2003 to 2012. Occup Environ Med. 2015;72(7):489-95.

15. Weaver MD, Patterson PD, Fabio A, Moore CG, Freiberg MS, Songer TJ. An observational study of shift length, crew familiarity, and occupational injury and illness in emergency medical services workers. Occup Environ Med. 2015;72(11):798-804.

16. Kim H, Dropkin J, Spaeth K, Smith F, Moline J. Patient handling and musculoskeletal disorders among hospital workers: analysis of 7 years of institutional workers' compensation claims data. Am J Ind Med. 2012;55(8):683-90.

17. Studnek JR, Crawford JM, Wilkins JR, Pennell ML. Back problems among emergency medical services professionals: the LEADS health and wellness follow-up study. Am J Ind Med. 2010;53(1):12-22.

18. Studnek JR, Crawford JM. Factors associated with back problems among emergency medical technicians. Am J Ind Med. 2007;50(6):464-9.

19. Lavender SA, Conrad KM, Reichelt PA, Johnson PW, Meyer FT. Biomechanical analyses of paramedics simulating frequently performed strenuous work tasks. Appl Ergon. 2000;31(2):167-77.

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