Work-related stress and cardiovascular effects

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Abstract

Introduction: the work-related stress is one of the emerging topic in Occupational Medicine; it is linked to a series of physical and mental disorders. The studies conducted between work-related stress and cardiovascular diseases give complex results, and often in contrast with each other.

Materials and Methods: to clarify the relationship between occupational stress and cardiovascular diseases we selected 35 studies from all the studies present in literature.

Results: the findings have shown that work-related stress can induce alterations in the cardiovascular system, both acute (high blood pressure, acute coronary syndromes), and chronic (hypertension, altered coronary circulation).

Discussion: according to the studies analyzed we can assume that the cardiovascular alterations induced by work-related stress seem to be triggered by neuroendocrine mechanisms (increase in cortisol and catecholamines), hemodynamic (abnormal coronary circulation) and aptitudinal (wrong lifestyles). However the precise mechanisms that regulate this interaction, are far from being clear.

KEY WORDS: cardiomyopathies, cardiovascular effects, hypertension, myocardial infarction, work-related stress, workers.

Introduction

The term “stress” indicates a physiological and/or psychological response to stimuli requiring changes in behavior. A recent study reported that 49% of subjects older than 12 years suffered from stress in daily life. The study examined 28 items, among which job, family, relationships with the neighborhood, financial, social and sanitary condition. Work-related problems were the most frequent as stressful factors, followed by the health and financial ones (1).

“Psychosomatic syndrome” is any physical condition with organic or functional damage, whose onset and/or development is influenced by psychosocial factors. This definition is in the most recent Diagnostic and Statistical Manual of Mental Disorders (IV edition, review of the text: DSM-IV-TR), published by the American Psychiatric Association (2).

Work-related stress indicates the dangerous, physical and emotional reactions that occur when the features of a job don’t meet the ability, resources and needs of a worker (3).

Work-related stress is linked to various physical and psychological alterations, such as cardiovascular diseases (4, 5), depression syndrome and anxiety. Stressful working conditions may affect the wellness of workers, by inducing behaviors harmful to health or, indirectly, by limiting the ability of a person to change bad habits, such as smoking habit or sedentary lifestyle (6, 7).

Work-related stress can cause short-term effects (for example, high blood pressure, depressive episodes, alcohol abuse) or long-term effects with subsequent onset of diseases (such as hypertension, depression syndrome, alcoholism) (8). Literary study are numerous but contradictory. Aim of the study is to carry out a systematic review of the literary study, in order to understand and to underline the work-related stress-induced cardiovascular effects. Our study tries to analyze the cardiovascular injuries induced by work-related stress and to explain the possible pathogenetic mechanisms.
Materials and methods

Observational studies on the relationship between work-related stress and cardiovascular effects were considered. Inclusion criteria were:
1) the sample was composed of both male and female workers;
2) work-related stress was evaluated by standard and/or repeatable criteria;
3) psychosomatic diseases were diagnosed by standard and international methods and all of them affected the cardiovascular system;
4) study design included prospective, cohort, case-control and cross-sectional studies; even systematic reviews and meta-analysis were considered;
5) the study was written in English and published by a peer-review journal.

The time period was from October 1991 to October 2014. Four online databases were used (PubMed, Scopus, PsychInfo e Web of Science). National and international meetings on work-related stress and psychosomatic syndromes were considered, too.

At first, 194 studies were selected; we eliminated n. 117 studies because the work-related stress was not evaluated by standard and repeatable criteria, n. 35 studies because cardiovascular diseases were not diagnosed by international and standard methods and n. 3 studies which were not published in English and on peer-review journal.

The final sample was composed of 39 research studies.

Results

Numerous international studies reported psychosocial stress as one of the ten main modifiable risk factors for stroke (9). During working life, psychosocial risk factors due to workplace are highly harmful to the cardiovascular system (10). Risk factors due to workplaces include items of the planning and management of the work which may cause psychological and physical damages in workers (11).

Work-related stress seems to be correlated to acute (stroke, myocardial infarction) (12, 13) and chronic cardiovascular accidents (hypertension, coronary artery diseases) (14).

It seems that work-related stress enhances the risk to develop cardiovascular diseases (CVD). Above all, the relationship between work-related stress and coronary heart disease (CHD) is strong and coherent. Moreover, actions of reducing work-related stress seem to reduce cardiovascular accidents (15).

The possible mechanisms may act both directly by the activation of neuroendocrine responses and indirectly via bad behaviors such smoking habit, sedentary lifestyle or bad eating habits. Recent studies reported a coherent and strong correlation between work-related stress and CVD on working populations (16).

Meta-analysis based on observational data reported an increased risk for coronary heart disease in female workers under work-related stress (17).

Jakobsson (2014) reported valid evidences demonstrating that work and work-related stress were risk factors for coronary heart diseases. However, the epidemiological evidence was scarce for stroke and the information on exposure were very poor (15).

A study (2014) reported that work-related stress was strongly associated to a reduced HR (heart rate variability) in workers. The workers with high levels of stress have levels of blood pressure higher than workers with lower levels of stress (18).

The masked hypertension (i.e., a seemingly normal blood pressure which is high during the daily activities) is associated to evening, night, or rotating shifts, suggesting a possible involvement of the hypothalamic-pituitary axis in the onset of this disorder. Moreover a more important correlation among work-related stress and effort-reward imbalance and masked hypertension was observed (19).

Toivanen (2012) reported an increased risk for stroke in women and men under high levels of work-related stress, high psychological demands and poor job control (11).

A research (2013) demonstrated that the police was at high risk to develop cardiovascular diseases linked to work-related stress (20).

A meta-analysis (2013) showed that work-related stress was correlated to bad lifestyles and diabetes. No correlation among work-related stress, blood pressure and blood lipids was observed (21).

Another prospective study demonstrated the correlation between strain job and infarction in Japanese workers: this research was carried out in Japan in order to evaluate the effect of the job strain (assessed in accordance with job demand-control model) on the risk of infarction in workers of both sexes and aged under 65 (12).

In addition to traditional cardiovascular risk factor (hypertension, dyslipidaemia, metabolic syndrome and diabetes), workplace was playing an increasingly important role in cardiovascular morbidity and mortality (22). This is due to various mechanisms: physical, chemical and psychosocial factors and shift work. The identification of these work-related psychosocial factors should be considered in order to improve preventive actions.

A correlation between work-related stress and high blood pressure, left ventricular hypertrophy, increased blood catecholamines, impaired immune and inflammatory response and early atherosclerosis was identified in older studies (23).

The whole circulatory system was involved even if research studies were carried out on the coronary system. Changes in other targets, such as carotid and cerebral arteries, were observed (24).

Two studies (2000) underlined the effects of work-related psychosocial factors, and in particular of stress, on the cardiovascular system (14, 25). Borkiewicz (2010) reported that stress was the most important occupational factor in causing myocardial infarction, together with noise and fine dust (13).

Another longitudinal study (1998) (26) monitored blood pressure in 195 workers for 3 years: it showed...
that the mean value of arterial blood pressure measured in two different times was higher in stressed workers than in not stressed workers.

The same study reported a reduction of about 3-5 mmHg of blood pressure in workers who worked under stressful conditions during the first period but not during the second phase of the study, 3 years later. Preventive efforts and/or the removal of work-related stressful sources may act positively on blood pressure.

Landsbergis et al. (27) showed that systolic blood pressure levels were higher of about 4.8 mmHg in workers under work-related stress and with over 25 years of service than not stressed workers, when measured in the workplace. This difference was up to 7.8 mmHg when systolic pressure was measured at home. Thus the effects of work-related stress on systolic pressure seem to be cumulative.

Other longitudinal studies, carried out on male and female workers, confirmed the correlation between blood pressure and work-related stress, strongly in men. Ohlin et al. (28) studied 448 male and female workers and reported a correlation between work-related stress and high blood pressure only in men (7.7 mmHg for systolic blood pressure and 5.6 mmHg for diastolic blood pressure).

Guimont et al. (29) monitored white collar workers for 7 years and showed a slight but significant increase in systolic blood pressure in work-related stressed men (+ 1.8 mmHg). This effect was lower in female workers (+ 0.5 mmHg).

Some longitudinal studies reported no correlation between ambulatory blood pressure and work-related stress. The Authors hypothesized that the lacking correlation was due to a short monitoring period without cumulative effect (30) or to having monitored younger subjects (31). In a research carried out on 527 subjects aged between 25 and 64 years, Cesana et al. (32) studied the correlation between blood pressure and work-related stress. In the group of 385 subjects with normal blood pressure, systolic blood pressure was measured at work and at rest and the measured levels were higher in subjects exposed to high levels of work-related stress (job strain: + 3.4 mmHg). The levels of blood pressure decreased in the passive group, in the active group and, lastly, in the group with low job strain.

In workers exposed to work-related stress, other studies reported high levels of blood pressure not only during work activities and at rest but also during sleeping hours.

In a Belgian study, Clays et al. (33) showed that the mean ambulatory (24-hour) blood pressure was higher in subjects exposed to work-related stress. The increased blood pressure continued outside the workplace and during sleep. Another study reported an increased diastolic blood pressure in exposed subjects during work activities (+ 7.4 mmHg), leisure time (+ 5.9 mmHg) and sleep (+ 7 mmHg) (34).

A French case-control study evidenced a strong correlation between work-related stress and increased blood pressure in women and men (35).

Siegrist (1996) demonstrated that the effort-reward imbalance was correlated to the onset of cardiovascular disease (36). A cohort study of the said research group underlined that hypertensive cardiopathy was related to a lack of career prospects (premiums) and to an overinvestment in work in a group of blue collar workers (37).

In a study conducted on 1970 workers by Steptoe et al., the overinvestment in work was a predictive factor for the increase in daily systolic blood pressure in male workers exposed to high psychological job demands (38).

High levels of work-related stress and an effort-reward imbalance seemed to be related to an increase in cardiovascular mortality (4), in coronary artery diseases (5) and in ischemic cardiopathies (10).

Several recent studies reported a positive correlation between work-related psychosocial stress and acute coronary accident. Chandola et al. (39) conducted a longitudinal study on over 10,000 UK employees with low exposure to physical stressors, lasting for 12 years. This research revealed a dose-response relationship between work-related stress evaluated according to the Karasek model and the onset of coronary heart disease (myocardial infarction or angina under treatment with nitrates).

In a systematic review, Belkic et al. (40) evaluated the results of 17 longitudinal studies that investigated the relationship between work-related stress and cardiovascular mortality or coronary heart disease. Eight of these studies evidenced a positive correlation with RR (relative risk) values from 1.21 (1.08 - 1.35) to 4 (1.1 - 14.4); other three studies showed a positive but not significant correlation. With regard to the six studies that did not show any association, the Authors underlined the presence of methodological errors.

A meta-analysis conducted on studies published from 1979 to 2006 assessed the RR of coronary artery disease related to occupational stress indicators evaluated by Karasek and Siegrist models (41). This meta-analysis was based on 14 longitudinal studies conducted in Europe, the US and Japan. Studies based on Karasek model included 83.014 workers, while those based on Siegrist model included 11.528 workers. The RR of coronary heart disease or cardiovascular accidents matched by age and gender was 1.43 (1.15 - 1.84) for studies using the Karasek model. After adjusting for cardiovascular risk factors, the RR remained positive but not significant [1.16 (0.84 - 1.36)]. In the studies that used the Siegrist model, the adjusted RR matched by age and gender was 1.58 (0.84 - 2.97). After adjustment for confounders, the RR was 2.05 (0.97 - 4.32). Although some results were not significant, this meta-analysis showed an increased risk of cardiovascular diseases among workers exposed to psychosocial stress in the workplace.

Finally, other cross-sectional or case-control studies showed a correlation between coronary heart disease and psychosocial stress. In a review conducted by Belkic et al., four cross-sectional studies and six case-control studies reported a statistically significant relationship between psychosocial stress at work and car-
diovascular morbidity and mortality (40).
In a case-control study conducted in China, Xu et al.
showed that a high effort-reward imbalance together
with overcommitment was associated to risk of coro-
nary heart disease, with a dose-response effect. This
correlation was significant after considering traditional
risk factors (42).

Discussion

On the basis of the examined studies, it seems that
work-related stress may induce cardiovascular dam-
ages, both acute (coronary syndromes, stroke, and
sporadic high blood pressure), and chronic (hyperten-
sion, impaired coronary circulation).
This correlation appears to be higher in susceptible in-
dividuals (subjects with a history of hypertensive dis-
ease, family history positive for cardiovascular acci-
dents) (43) and it is closely related to improper
lifestyle (sedentary lifestyle, smoking habit, obesity,
drinking habits). Stress is indeed one of the factors
that can induce to develop and worsen improper
lifestyles.
The mechanisms by which the work-related stress af-
flicts the cardiovascular system is still unclear. Stress
causes an increase in plasma cortisol, which is able to
increase blood pressure by various mechanisms (for
example, fluid retention and vasoconstriction). Hyper-
cortisolemia has been associated to cardiac ischemia,
and acute coronary syndromes, by inducing coronary
vasospasm.
Stress may also act directly, by inducing a transient
acute myocardial ischemia, and in the long term a
chronic cardiac disease (44). On the other hand, the
 tako-tsubo syndrome is a stress-induced cardiomy-
opathy, with well-defined anatomical and pathological
alterations and characterized by a transient dysfunc-
tion of the left ventricle which can often turn into more
severe clinical patters and become chronic .
As already said, work-related stress may cause in-
creased blood catecholamines, alterations of the im-
une and inflammatory responses and early-onset
atherosclerosis. These factors, together with in-
creased blood cortisol, could therefore cause an in-
crease in systolic pressure and left ventricular hyper-
trophy, by triggering an adverse vicious circle.
The role of gender is much debated. In several stud-
ies, differences of pressure increases between males
and females were observed. However, as already
mentioned, these studies had purely statistical limits.
It would be interesting to investigate this topic, by
stratifying samples according to gender, age and oth-
er possible confounders.
We can therefore assess that the correlation between
work-related stress and high blood pressure is widely
supported by numerous studies, type of study or pop-
ulation. The importance of this correlation is, however,
debatable: some Authors believe that work-related
stress can raise blood pressure only at work, but it is
not a long-term predictive factor for hypertension (45).
Other Authors instead emphasize the cumulative ef-
fect of work-related stress, which leads to develop hy-
pertension: in fact, Sparrenberger et al. (2009) high-
lighted the predominant role of chronic stress on the
onset of hypertensive disease (46).
In conclusion, work-related stress seems to induce al-
terations in the cardiovascular system by triggering
neuroendocrine, haemodynamic and psycho-aptitudi-
 nal mechanisms. The precise mechanisms that regu-
late this interaction are still unclear.
However, it is crucial to monitor the psycho-physical
health of workers, particularly of those susceptible, in
order to prevent the develop of severe diseases.

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