

## URBAN STRESSORS: EFFECTS ON HEALTH

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Abstract: Air pollution is defined as any change of air due to the introduction of one or more substances in quantities and with features that affect or threaten human health or environmental quality. In industrialized countries, the main sources of urban pollutants are the anthropic ones: vehicular or air traffic, domestic heating, factories, etc. Our team realized several research programs about the effects of urban stressors on the health of occupationally exposed workers, both males and females. The researches aimed at evaluating several neuro-immune-endocrine, cardiovascular, respiratory, hepatic and stress parameters, in workers occupationally exposed to urban pollution. The workers who performed their duties in streets belonged to the exposed group; the workers who performed indoor-activities belonged to the control group. Starting from a wide casuistry, the two groups were made comparable by gender, age, working life, cigarette smoking history (number of smoked cigarettes, years of smoking), habitual consumption of alcohol, and other confounding factors that, each time, were required. Our results showed that urban pollution can cause effects on cardiovascular and respiratory systems, on liver, on neuro-immune-endocrine system and on several psychological functions evaluated by an ad-hoc questionnaire. The parameters that we evaluated could be used as early markers of effect.

## 1 INTRODUCTION

Air pollution is defined as any change of air due to the introduction of one or more substances in quantities and with features that affect or threaten human health or environmental quality (D. Lgs 152/2006).

The sources of urban pollution can be divided into: natural, caused by smoke, dust, gases of different origin (natural fumes decomposition electric discharges volcanic ash etc.); anthropic resulting from human activities. The main anthropic sources of urban pollutants in industrialized countries are vehicular or air traffic, domestic heating, factories, incineration and combustion of municipal solid waste, coal-burning power plants.

In the city where we performed our research work, the main source of urban pollution is vehicular traffic, resulting from exhausts of internal-combustion engines, from evaporation of fuel, from wear of road pavements and tires. There are about 698 motor vehicles per 1000 citizens in this town, and a density of 1471 vehicles per km<sup>2</sup> (ISPRA, 2007).

Urban stressors that act on exposed workers are chemical (benzene, benzo(a)pyrene, toluene, carbone monoxide, nickel, etc), physical (noise) and psychosocial (organization of work, shifts, etc.).

Our team realized several investigations about the effects of such urban stressors on the health of occupationally exposed workers, both males and females. Our work aimed at evaluating several neuro-immune-endocrine, cardiovascular, respiratory, hepatic and stress parameters, in workers occupationally exposed to urban pollution.

## 2 MATERIALS AND METHODS

In our researches, we analyzed the employees of the Municipal Police of a big Italian city, both men and women. Urban environment corresponds to working environment for traffic policemen, so they are an appropriate model for studying the effects of urban pollution on various markers of health-state.

The workers have been divided into two groups, depending on the degree of exposition to pollutants: exposed, who performed ordinary shift, working on parking control, control of access opening to limited traffic areas, control of crossroads or roads with heavy traffic, and performing other duties in streets; controls, who performed indoor-activities, such as administrative and bureaucratic duties. For inclusion into the study, a questionnaire with physiological anamnesis, remote and near pathological anamnesis, previous and current working history was collected for all workers.

Starting from a wide casuistry, the two groups were made comparable (by calculating the means, standard deviation and distribution into classes) by age, working life, cigarette smoking history (number of smoked cigarettes, years of smoking), habitual consumption of alcohol, habitual consumption of Italian coffee (number of cups per day), consumption of soy in the diet, and other confounding factors that, each time, were required.

Several neuro-immune-endocrine, cardiovascular, respiratory, hepatic and stress parameters were evaluated, in order to search for any difference between the two groups. For evaluation of work-related stress, the questionnaire "Rapid Stress-Assessment Scale" (RSA) was administered to workers: this questionnaire explores individual responses to stressful situations and divides them into five stress-quantifying dimensions (clusters), i.e. depression, anxiety, somatization, aggressiveness and lack of social support.

## 3 RESULTS AND DISCUSSION

As regard to the effects of urban stressors on neuro-endocrine system, our results show an increase in blood levels of the following hormones in exposed men and women with respect to the control groups: adrenocorticotrophic hormone (ACTH) (Tomei F et al, 2003a), cortisol (Tomei F et al, 2003b), luteinizing hormone (LH) (Tomao et al, 2009; Monti et al, 2006), 17-alpha-OH-progesterone (Ciarrocca et al, 2006a; Tomei G et al, 2007a), prolactin (Tomei F et al, 2006a), follicle stimulating hormone (FSH) (Tomei G et al, 2007b; Tomei G et al, 2009a), dopamine (Tomei G et al, 2007c). Blood levels of androstenedione (Tomei G et al, 2009b) and testosterone (Tomei G et al, 2008) were significantly higher in exposed women than in control group.

On the contrary, blood levels of growth hormone (GH) (Tomei F et al, 2003c), vasopressin (Tomei F et al, 2004a) and 17- $\beta$ -estradiol (Tomei F et al, 2006b; Tomei G et al, 2007d) were significantly lower in exposed workers of both sexes with respect to the control groups; blood levels of androstenedione (Tomei G et al, 2006a) and testosterone (current research) were significantly decreased in exposed men.

As regard to urinary parameters, in exposed workers of both sexes it was found a significant increase in homovanillic acid (HVA) levels (Tomei F, 2003d) and a significant decrease in 5-hydroxy-3-indolacetic acid (5-HIAA) levels (Tomei F, 2004b); furthermore, a current research of our group shows significantly higher levels of urinary metanephrines in male exposed workers than in control group.

These results show that urban stressors can affect neuro-endocrine system, interfering with the synthesis and release of hormones and mediators of nerve impulse, altering receptors and competing with natural substances on receptors.

As regard to the effects of urban stressors on immune system, our studies show: a significant increase in blood levels of natural killer cells (NK), interleukine-2 (IL-2) and C3 in exposed women (Ciarrocca et al, 2006b); a significant increase in blood levels of natural killer cells (NK) and interleukine-2 (IL-2) in exposed men (Tomei G et al, 2006b); a significant increase of plasma insulin-like growth factor 1 (IGF-1) in exposed men and women (Tomei F, 2004c).

These results show that urban stressors can affect the immune response, acting on immune effectors.

As regard to the effects of urban stressors on hepatic function, our group found a significant increase in blood levels of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) in exposed workers with respect to control groups (Tomao et al, 2002); a current research of our group shows a significant increase also in blood levels of gamma glutaryltransferase ( $\gamma$ -GT) in exposed workers.

As regard to the effects on respiratory and cardiovascular systems, a study of our group shows that workers exposed to urban pollution under physical effort (cycle-ergometer test) may be subject to a reduction of resistance to physical effort and to an increased risk of cardiovascular and respiratory diseases (Volpino et al, 2004). Another research of our group found significantly higher levels of systolic blood pressure (SBP) during 24 hours (evaluated by ambulatory blood pressure monitoring) and significantly higher levels of diastolic blood pressure (DBP) between 6 AM and 11 AM and between 10 PM and 6 AM in exposed workers with respect to control groups (Tomei F et al, 2004d). A study about the effects of urban noise on cardiovascular system shows a significant increase in hearth rate and blood pressure in exposed workers, depending on intensity, duration and exposure to the stimulus (Tomei F et al, 2005); this result suggests that chronic occupational exposure to noise may be a risk factor for hypertension.

Another forthcoming research of our group shows that a synergy between cigarette smoking and chronic exposition to urban pollution may lead to an increased risk of developing suspicious lung nodules (evaluated by low-dose computed tomography ld-ct), suggesting that ld-ct could be a useful diagnostic tool for screening of lung nodules in groups of workers occupationally exposed to urban pollution (Sancini et al, *in print*).

The evaluation of work-related stress by RSA shows a greater psychological distress in exposed workers (who are assigned to traffic regulation and who could fight against crime) than in control group, especially for women and depending on the shift (Pancheri et al, 2002; Tomei G et al, 2006c).

In another current research, we are assessing work-related stress by an 8 items questionnaire, prepared by our group, in order to search possible concomitants between stress levels and biological parameters; 60.7% of workers exposed to urban pollutants show

moderate or severe stress conditions, with a statistically significant prevalence in women than in men.

#### 4 CONCLUSIONS

Several studies from our group highlight that various biological parameters could be used as early biological markers, to be employed in occupational sets, valuable for the group, even before the onset of the related disorders.

The development of preventive interventions aimed at containing and reducing pollutant emissions appears to be very important.

Technical measures could be: insulation of cabins and provision of air conditioning and filtration (using filters for particulate matter and gases, if possible); provision of air conditioning and filtration in cars (using filters for particulate matter and gases, if possible); proper maintenance of service vehicles and structures; possible use of adequate protective equipment for proper time.

Organizational measures could be: work organization aimed at a staff turnover in outdoor and indoor activities (if possible); specific information and training of workers.

Obviously, it would be of fundamental importance a reorganization of urban transport policies and a promotion of sustainable urban mobility by: reduction of private vehicular traffic, enhancement of public transport, facilitation of rail systems, reduction - until elimination - of very polluting vehicles.

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