

# RISK FACTORS AND HEALTH STATUS OF A GROUP OF WORKERS EXPOSED AT WASTE WATER IN TIMISOARA CITY

Laura JEBEREANU<sup>1,2</sup>, Sorin Adrian JEBEREANU<sup>3</sup>, Brigitha VLAICU<sup>1</sup>, Elena-Ana PĂUNCU<sup>1</sup>

<sup>1</sup>"Victor Babeș" University of Medicine and Pharmacy Timișoara

<sup>2</sup>Lupeni Municipal Hospital

<sup>3</sup>Timisoara Clinic Emergency Municipal Hospital

**ABSTRACT.** Occupational exposure at waste water poses specific problems of pathology of treating plant and canal workers. Climate and professional effort, job demands, chemical, physical and biological risks form a sum of factors that conduct at work related and occupational diseases. Our paper is a part of a larger study, dedicated to evidence the link between work conditions and the health status of waste water workers. Special attention was given at emerging risks in the professional environment, like biological risks associated with irritating substances and other chemicals. There were studied two similar male groups, waste water plant workers and canal workers. No significant differences were found in their pathology, concerning chronic and infectious diseases, dermal or musculoskeletal disorders. Infectious illnesses were rare, in despite of workplace conditions, result that conduct at new fields to be explored.

**Keywords:** waste water, worker, occupational health

## INTRODUCTION

The professional activity of the workers from the canal department of the water-canal operator from Timisoara takes place outdoors in special conditions, leads to specific damage of their health. Our paper presents the first results of a larger study performed in a waste water plant and at canal workers of a Timisoara water-canal operator.

## MATERIALS AND METHODS

We performed the observation of the technological process and analysis of noxious' measurement bulletins.

Workers health was evaluated using medical records analyse and medical examination. Total number of studied population was 179 male workers exposed at waste water. 109 persons work in the canal system maintenance, "C" group, and 70 persons work in the waste water plant "W" group. All selected persons participated voluntary at the study.

There were performed: clinical examination with attentive anamnesis, pulmonary function tests (spirometry), audiometric tests, vision tests, ECG, laboratory (blood glucose, coproparasitologic examinations, throat swab).

Data statistical analyse was performed in EPI Info program.

## RESULTS AND DISCUSSIONS

Majority of work is performed outdoors, entire shift, for both groups, all the year.

Group "C" have 8 hours daily shifts, and group "W" works 12/24 hours, including night hours. Activity is developed in two manners: planned, maintenance works and emergency interventions (preventive and corrective maintenance).

Professional effort is high, including some physical activities that imply handling heavy materials. Awkward posture is usual adopted by both group workers, especially when they are obliged to enter into the canal. The new technology implemented since 2009 reduced the time spent in canal, by "C" group workers.

Accident risk is high; especially to fall into tanks and canals, in confined space where workers enter for maintenance operations. Acute poisoning can occur in these workplaces, where VOCs, methane, chlorine, sodium and calcium hypochlorite, hydrogen sulphide, and ammonia can be inhaled (Pauncu, 2008, Wastewater and Ambient Water Quality, Environmental, Health, And Safety (EHS) Guidelines, 2007).

Exposure to chemical, biological and physical noxious was evaluated in winter time. The obtained values for chemical noxious (Table 1) at the "surface external workplaces" show low values for ammonia, hydrogen sulphide, carbon oxide.

Wastewater workers may be exposed by inhalation of aerosols and gasses, by dermal contact, and by ingestion. The microbial agents include Gram negative bacilli such as *Klebsiella spp* and *Escherichia coli*, *Clostridium perfringens*, fecal streptococci, *Leptospira spp*, hepatitis virus, enterovirus, and *Aspergillus spp*. (Fakhrul-Razi et al., 2002, Malmros et al., 1988) In addition, the workers may be exposed to such agents that may be produced by or from these organisms, including exotoxins, endotoxins, butyl acetate, and hydrogen sulphide (Malmros et al., 1988).

Microbiological analysis in the waste water treatment plant shows the presence of a total number of germs (TNG) that vary between 315-787/m<sup>3</sup> and 1575 – 11,023/m<sup>3</sup> at various stages of waste water treatment. There were evidenced in airmicroflora: *Staphylococcus aureus*, *White Staphylococcus ne-haemolytic*, *Citrine*

*Staphylococcus*, *Streptococcus viridans*, *Bacillus cereus*, molds, *Bacillus Proteus*, *Escherichia coli*, saprophytic bacteria. Haemolytic flora was present both in laboratories and in different parts of the treatment plant, the maximum being found at vents. The canal section microbiological analysis in the air highlights the presence of a 27,560/m<sup>3</sup> total number of

germs of in a channel, during the activity. There were found *Staphylococcus aureus*, White ne-haemolytic *Staphylococcus*, citrine *Staphylococcus*, *Streptococcus viridans*, *Bacillus cereus*, molds, *Bacillus Proteus*, *Escherichia coli*, saprophytic bacteria. Haemolytic Flora was present values of 15.748 NTG/m<sup>3</sup>.

**Table 1.** Chemical noxious measurements in waste water plant air

Workplace	Noxious	Found values (mm/m <sup>3</sup> )	Medium Limit Values		Maximum Limit Values	
			8 hours	15 min	8 hours	15 min
Chemical Lab	Sulphuric acid	0.50	-	0.50	0.50	1
	Chloroform	1.85	1,85	-	10	-
De-sanding	Ammonia	0.69	-	0.69	14	36
	Hydrogen sulphide	absent	-	absent	10	15
Pump zone	Ammonia	absent	-	absent	14	36
	Hydrogen sulphide	1.38	-	1.38	10	15
Gratings (rare and dense)	Ammonia	0.69	-	0.69	14	36
	Hydrogen sulphide	absent	-	absent	10	15
Weir	Ammonia	1.38	-	0.92	14	36
	Hydrogen sulphide	absent	-	absent	10	15
Power station	Carbon oxide	absent	-	absent	20	30

Germ such as: *Staphylococcus aureus*, ne-haemolytic white *Staphylococcus*, citrine *Staphylococcus*, *Streptococcus viridans*, *Bacillus cereus*, molds, *Escherichia coli*, haemolytic saprophytic bacteria and flora has been found in various areas on the surfaces in significant numbers.

Air microflora and surfaces' microbiological repeated analyse put in evidence the presence of coagulase-negative *Staphylococci*, *Streptococcus viridians*, *Bacillus proteus*, *Escherichia coli*, molds, *Bacillus sp.*, *Bacillus cereus*, *Pseudomonas fluorescens / putida*, *Raoultella terrigena*, hemolytic flora.

The total number of germ was high in some points, especially in the canal system.

The presence in the waste water plant workers hands lavage of a variable number of bacteria and flora, including some haemolytic germs, pathogens or conditioned pathogens, found in aeromicroflora too, like *E. coli*, *Staphylococcus aureus* shows an increased infectious risk. TNG on hand ranged from freshly washed hands 160-300/cm<sup>2</sup> increases at 6,000-14,000/cm<sup>2</sup> during the activity. Similar situation for the hands lavage was revealed for canal workers. Total number of haemolytic germs was between 60-860/cm<sup>2</sup> and 660-2,500/cm<sup>2</sup> during the activity.

Contact with wastewater in the treatment plant and in the canal system, possibly contaminated with

pathogens and / or potential pathogens (specific wastewater, faecal waste: *E. coli*, *Klebsiella*, etc.) can cause: hepatitis A, acute diarrheal disease (bacillary dysentery, cholera, typhoid, diarrhoea syndrome), tetanus, leptospirosis, brucellosis, diverse dermal sufferings, frequent skin infections, etc (Al-Batanony et al., 2011, Divizia et al., 2008, Jebereanu, 2011).

Occupational risk factors may cause staff illness and accidents: unfavourable microclimate (temperature, relative humidity, air flow rate, radiant heat), summer / winter activity outdoors, exercise (lift - carrying weights, different movements: bending, twisting, stretching, etc.), work at height (according to Romanian law, > 2 meters), alternating shift work, including night, 7 days / week, chemical pollutants: H<sub>2</sub>S, NH<sub>3</sub>, CO<sub>2</sub>, CH<sub>4</sub>, chemical reagents used in the laboratory, acids and alkalis, noise, vibration, infrared radiation, ultraviolet light (sunlight), risk of injury from slipping, falling, electrocution, indiscipline.

Studied groups general characteristics can be found in table 2 and 3.

The two groups are similar like age, education, life style, professional qualification and seniority at work, including the length in service at the actual workplace. The workplace is stable and salaries are satisfying.

**Table 2.** Age and length in service

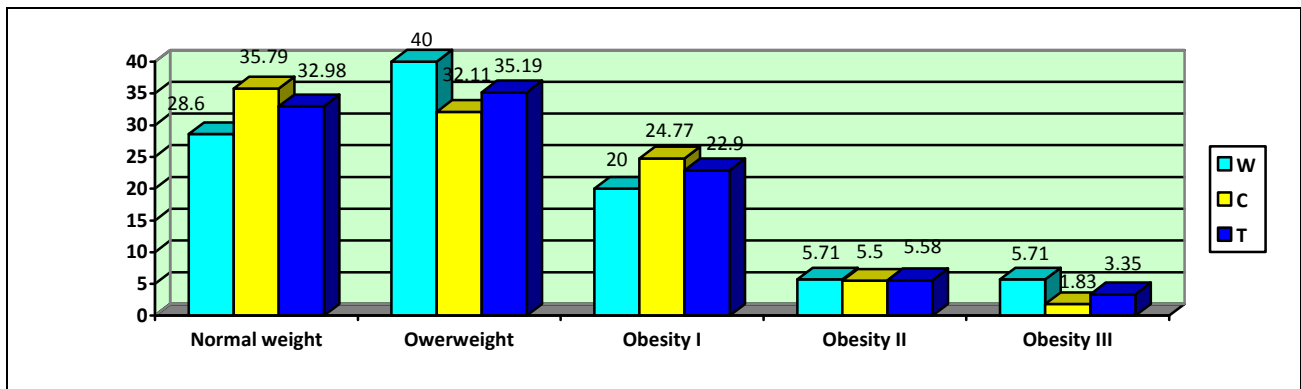
Parameter	W = 70	C = 109	T = 179
Age (M. ± S.D.) Limits (minimum – maximum)	47.22 ± 8.85 23 – 61	44.25 ± 8.51 22 – 62	45.41 ± 8.74 22 – 62
Seniority at work (M. ± S.D.) Limits (minimum – maximum)	24.18 ± 8.65 1 - 39	23.27 ± 10.93 1 – 41	23.97 ± 9.42 1 – 41
Length in service, actual workplace Limits (minimum – maximum)	14.58 ± 9.37 1 - 29	11.71 ± 12.32 1 – 28	12.81 ± 8.65 1 – 29

All the workers have similar nutritional habits: salt in excess, meet and fats, unbalanced diet, low amount of fruit and vegetables, concentrated sugar.

Parameter	W = 70	C = 109	T = 179
BMI (M. ± S.D.)	28.27 ± 5.67	27.25 ± 5.08	27.61 ± 5.33
BMI, limit values	18.10 – 45.67	18.28 – 43.35	18.10 – 45.67
Systolic Blood Pressure, mmHg (M. ± S.D.)	133.48 ± 21.95	129.6 ± 22.5	131.12 ± 22.3
Limits, Systolic Blood Pressure, mmHg	80 - 200	95 - 210	80 - 210
Diastolic Blood Pressure, mmHg (M. ± S.D.)	79.71 ± 12.65	80.13 ± 11.97	79.96 ± 12.56
Limits, Diastolic Blood Pressure, mmHg	50 - 120	55 - 110	50 - 120

Nutritional status can be observed in Figure 1, just 33% of total group is normal weight. Overweight are another 35% of workers. Obesity represents more than 30% in both groups, in non-significant report. Obesity

grade I is the most common, more than 20% of workers are affected. Life style, nutrition, bad habits and sedentary tendencies are responsible for this problem.



**Fig. 1** Nutrition status and obesity

Smoking habit (Fig. 2) is most common in the group C (more than 57%), compared with group W (37%) The significant difference ( $p < 0.0003$ ) can be explained by working time and specific schedule in the waste water plant. Canal workers assure the maintenance of the canal system in whole the city, they change permanently the workplace; they are in movement, and activity is organized in general in day

eight hours shifts. They find easier time and motivation to smoke.

Alcohol consumers are more than 65% in both groups, but 6 persons can be included in the alcoholic category. No violence or other manifestations at the workplace, they consume alcoholic beverages after work.

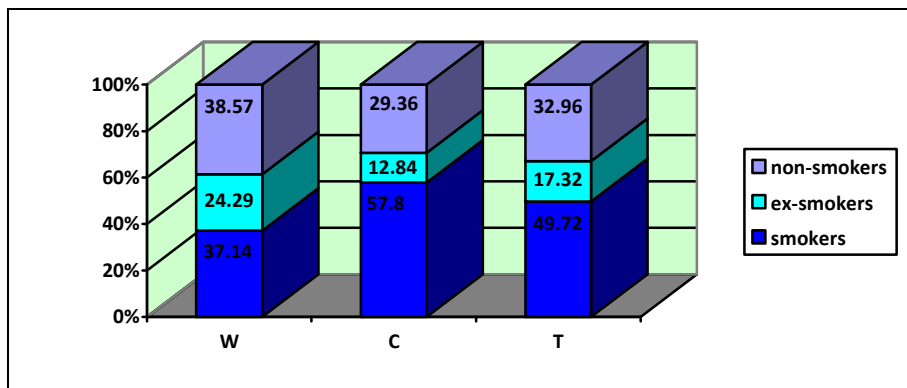


Fig. 2 Smoking habits

High blood pressure is the most frequent chronic health problem (Fig.3). It can be correlated with sex, age, genetic factors, lifestyle and professional

demands, especially night shift ( $p < 0.005$ ). In group C 26% of workers have hypertension and in group W 41% are affected.

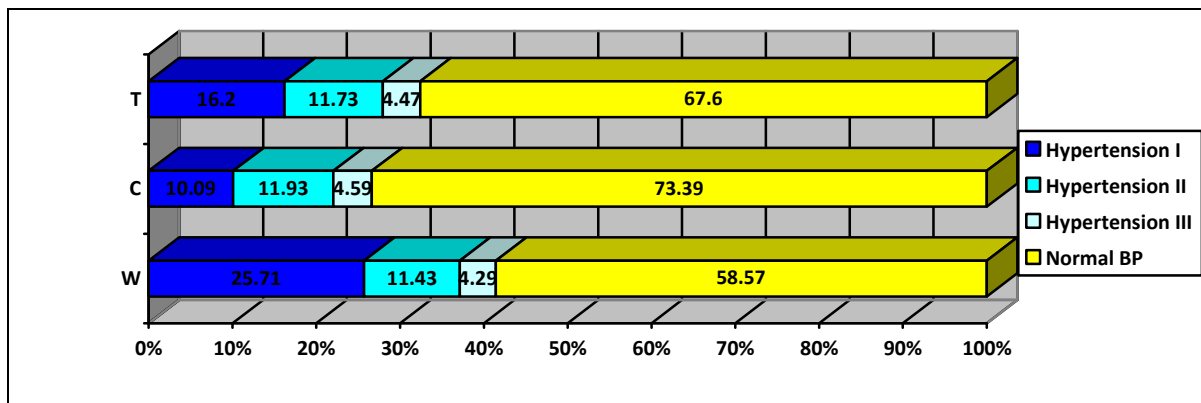


Fig.3 Hypertension situation

Possible work related diseases are presented in Fig. 4.

All diabetes mellitus (9) cases are type two, but four cases were found with high values of basic glycaemia, secondary at indiscipline in treatment and improper regime. Psoriasis cases cannot be linked at working conditions.

Chronic recurrent dermatitis with *Staphylococcus* is an infection due by possible hygiene deficiencies, which occur in waste water exposure. Vaccination and antibiotics can solve the acute problem, but individual predisposition and lack in basic hygiene are two possible explanations for new cases and recurrence.

Chronic hepatitis cases were with B and C virus, associated with alcohol excess and nutrition problems.

Giardiasis is the most common parasitosis in waste water workers, but in general population, too. We did

not find evidence based data on this topic, in our region, so we cannot appreciate correct the gravity of cases. Proper treatment was recommended, but the workers refuse it, or they do not the correct scheme of therapy.

Wastewater treatment workers reported a wide range of symptoms that may be work-related; microbial exposures seem to play a causal role (Milczarek et al, 2010, Smit et al, 2005, Korzeniewska, 2011)

Hydrostatic varicose is common problem linked at orthostatic position, effort, and genetic predisposition. Usual workers refuse correct prophylaxis, and treatment. Complications occur at young ages. In general this is the moment when workers start to be receptive and accept to follow the medical advice.

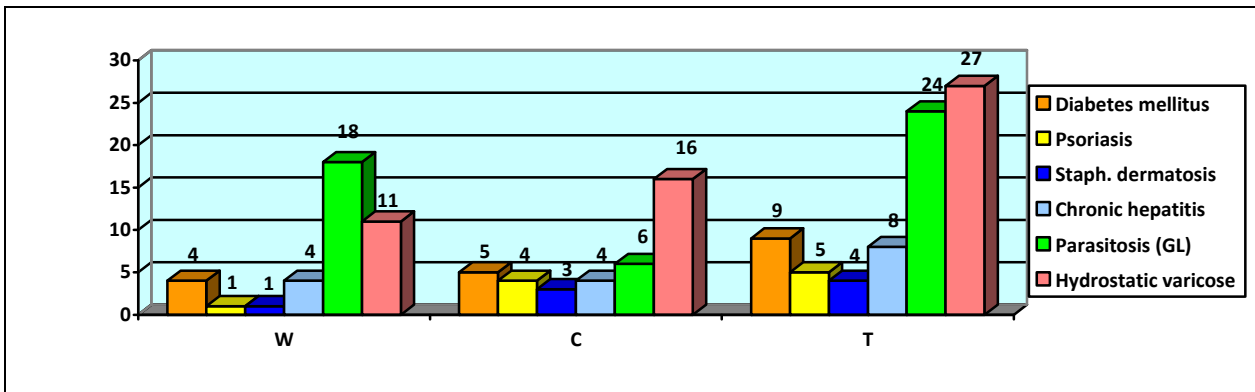


Fig. 4 Chronic illnesses and possible work related diseases (no.)

Presence of pathogen germs in work environment and in throat or nasal swab of a half of total investigated people of W group argues their professional origin. There was highlight: *Staphylococcus aureus* and white haemolytic *Staphylococcus*, *Escherichia coli* and *Klebsiella*. It was isolated beta haemolytic *Streptococcus* group B, too. In group C there were found: haemolytic *Staphylococcus aureus*, *Escherichia coli*, beta haemolytic *Streptococcus* group B.

Antibiogram was performed for pathogen germs found and the treatment was made.

In 2001 one worker from C group was diagnosed with leptospirosis. It was difficult to sustain the professional origin of the problem; he is fisherman too. After few months of treatment, he returned at work, but not exposed at biological risk.

Musculoskeletal disorders (Fig. 5) that can occur at waste water workers are interesting usual lumbar and cervical zones. Especially low back pain is registered as cause of absenteeism and work disability. Lumbar zone is affected in 25% of canal workers, and 18.5% of cases of the waste water plant accuse lumbar problems

( $p < 0.07$ ). Cervical zone is significant high affected at W group workers. Other zones can be affected, but not in significant way. Musculoskeletal disorders are caused and maintained by some working conditions: activity in the same position for a long period (standing, sitting, kneeling, leaning over), cold, high humidity, atmospheric water, continue work despite pain or injury, moving, lifting, manual transport of materials or heavy equipment.

The activity implies standing the majority of the time, lean position, some difficult and precision movements, handling/carrying 1 – 90 kg. A problem is that the workers do not respect ergonomic rules at the workplace. They carry heavy masses alone, and not using devices or in team, with the colleagues (Jebereanu, 2011).

Spirometric tests were normal in majority of cases. Just 17 persons had mild dysfunctions. 8 workers had restriction and 9, obstruction. Pulmonary function is rare affected and can have like cause professional exposure and antecedents. Obesity and smoking habit are major risk factors in these cases ( $p < 0.002$ ).

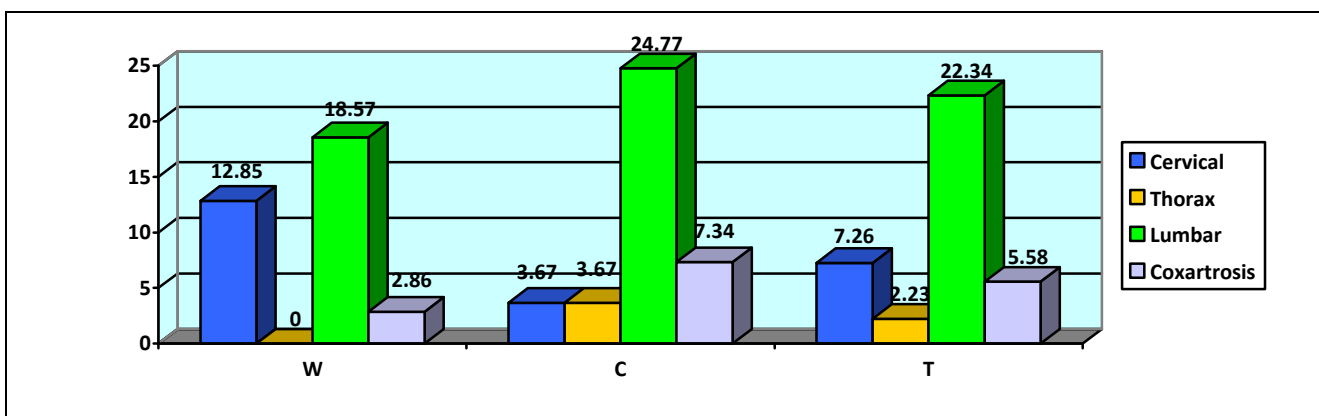


Fig. 5 Musculoskeletal disorders (%)

## CONCLUSIONS

Canal and waste-water plant workers are exposed to a sum of risk factors like unfavourable climate, solar radiation, medium to high physical effort, vicious, awkward positions, dust, chemicals, noise (compressors, pumps), microbiological agents.

Other important health determinants are: genetic factors, age, behaviours, education, and life style.

The specific pathology of the workers can be caused by the occupational exposure and professional requirements.

Microbiological analysis of samples from sewage workers showed a great deal of microbiological load. For this kind of workplaces there are not established limit values for biological risk.

Top health problems in C and W group are various degrees of hypertension, obesity, raised levels of blood glucose/diabetes mellitus, musculoskeletal disorders (low back pain), hydrostatic varicose, dermatitis, bowel giardiasis.

To maintain health and wellbeing of the workers are necessary correct prophylaxis (engineering control and medical surveillance) (Harwood, 2005), respect of hygiene and occupational safety norms with adequate protection, implementation of specific programs for workplace health promotion. Very important is the aspect of health education, awareness of the workers.

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