

Avoiding chemical stress from organic solvents

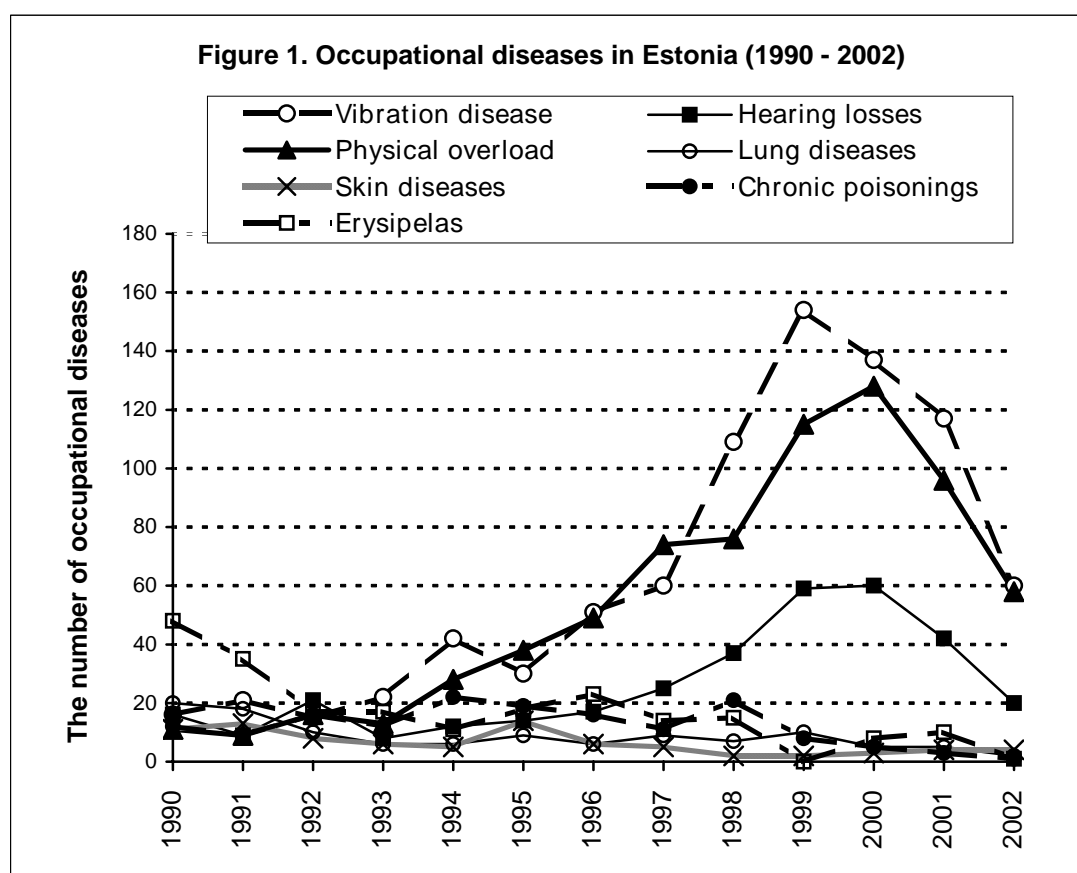
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Introduction

The number of occupational diseases is the specific indicator of influencing of existing hazards and risk factors in the work environment. Occupational diseases are registered usually in the late stage in Estonia when the patient is already disabled. The late registration is a reason why the number of diseases is very low compared with the Nordic countries.



The number of occupational diseases (Figure 1) rose during the years 1992-1999 and their structure changed completely to the year 1997 compared with 1990, when the number of erysipelas from the food industry was the greatest and constituted 30% of

all the cases. In 1997 the first place was taken by physical overload disease and from 1998 by vibration disease. The number of occupational diseases has been newly decreased during 2000-2002.

To diminish the mutagenic, carcinogenic and teratogenic and other harmful effects of chemicals, the health damages have to be diagnosed in the early stage of the illness.

Determination of risk level

The existing risk assessment models (on the basis of BS 8800) /2/ contain the need to determine the probability of the occurrence and the severity of consequences of the influence of hazardous factors on worker. The determination of the probabilities is complicated. It is more used in the case of major accidents. The need for setting the correlations between the exposure and the stages of occupational diseases considering both the exposure time and exposure limits, is very obvious. A scheme for risk level determination (based on BS 8800) has been worked out for the hazards originating from chemicals (considering exposure limits) by the Finnish researchers /3/.

The results are presented in Table 1.

Table 1 contains two factors: probability (likelihood) of the occurrence and consequences if the harm from a particular hazard is realized. The percentage of exposure limit (<10%, 10-50%, 50-100%) is taken as the probability in Table 1. Exposure limits are usually expressed as time-weighted, whole-shift concentrations and where necessary, short-term peak concentrations. But in many cases (for example exposure to neurotoxic hazards) also the exposure time to the chemical has to be considered at low concentrations, not exceeding the limits. The neurotoxic substances can react on the nervous system during long-term exposure to chemicals at low concentrations.

Limits are based on the assumption that exposure is limited to one substance only. However, in many workplaces there will be a variety of chemicals, forming a “cocktail” which can represent a greater danger. Other factors, such as high temperature and humidity, long hours of work and ultra-violet radiation may increase the toxic response to a substance /4/.

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temperature and humidity, long hours of work and ultra-violet radiation may increase the toxic response to a substance /4/.

Table 1. Determination of risk level in the case of hazardous chemicals in the air of work environment

Consequences → ↓ Probability	Slightly harmful uncomfortable, irritable feeling, overcoming illnesses R20, 21, 36, 37, 38	Harmful burning, skin diseases, long-lasting severe damages, stable slight disturbances R23, 24, 25, 33, 34, 40, 43, 48, 62, 63, 64	Extremely harmful poisonings, occupational cancer, asthma, stable severe damages, illnesses dangerous to health R26, 27, 35, 39, 41, 42, 45, 49, 60,61, 65
Highly unlikely severe damage from <10% of the limits (ELV ¹), other 10–50% of the limits	trivial risk no risk reduction measures needed	tolerable risk follow-up of risks	moderate risk risk reduction measures needed
Unlikely severe damage from 10–50% of the limits, other 50–100% of the limits	tolerable risk follow-up of risks	moderate risk risk reduction measures needed	substantial risk risk reduction measures inevitable
Likely severe damage from 50-100% of the limits, other over limits	moderate risk risk reduction measures needed	substantial risk risk reduction measures inevitable	intolerable risk risk reduction measures to be implemented at once

¹ELV – Exposure limit value

The chemical exposure limits in Estonia give two different numbers: 8 hours' mean concentration in the air of the work environment and 15 minute's momentary limit. The norms also identify three levels of hazardousness of the chemical: harmful, toxic, very toxic.

Correlations between risk levels and disease stages in the case of neurotoxic substances

One of the most important problems in diagnosing chronic neurological occupational diseases is their early detection and exact diagnoses in the early stage of functional disorders. Only then it is possible to rehabilitate the workers' health and work ability to a great extent.

The nervous system is one of the most sensible systems of the organism that dynamically reacts to various exogenous factors.

Also lead can cause neurotoxic effect /5/. In the investigation of work conditions of Tallinn bus drivers /6/ the functional state of workers was estimated by a neurologist. The neuropsychological investigation consisted of the determination of reaction time, measurement of dominating hand's tremor, calculation of memory index, measurement of attention, learning and seeing ability. In 76.8% of the investigated persons were diagnosed various diseases of nervous system. In 16% of drivers had heart disorders. Functional disorders of nervous system were found in 44% of the investigated persons. Various stress levels were diagnosed in 52% of the bus drivers on the basis of psychological investigations. 3.5% of respondents suffered from fatigue. The concentration of benzene and aliphatic hydrocarbons was measured. The mean concentration of benzene in the cabin of buses was above the limit concentration (0.25 mg/m^3 , limit – 0.2 mg/m^3). The concentration of benzene (carcinogenic substance) in the cabin changed from 0.27 mg/m^3 in summer to 0.01 mg/m^3 in winter.

The chemical hazards that affect industrial workers are considered to be stress factors for the central nervous system (CNS). To diagnose chemical poisoning it is important to clear the symptoms in the early stage of the illness. The early symptoms of poisoning are fatigue, sleeping disturbances, depression and headaches

The first step to set the correlations between the clinical, psychological and electrophysiological symptoms of workers' long-lasting exposure to chemical substances in Estonia was taken by V.Tuulik /7,8/. 42 workers of dry cleaning stations and 35 workers of the furniture industry exposed to organic solvents in every-day work were examined. Ordinary medical examinations and additional investigations to diagnose neurotoxic damages were carried out. The control group consisted of fishermen (145) and students (41 persons).

The changes in the functional state of the CNS at syndrome level were diagnosed.

The syndromes were characterized in three stages:

1. **Hypersthenic** syndrome (mild level of asthenia, irregular speed of mental activity, deficient ability to concentrate, increased number of errors in the psychological tests);
2. **Hyposthenic** syndrome (moderate asthenia, decreased speed of mental activity, decreased ability to concentrate, prolonged reaction time);

3. **Organic psychosyndrome** (expressed asthenia, memory disorders of organic type, lowered visual-constructive ability, clearly prolonged reaction time).

Toxic chemicals in the work environment affect the functional status of the nervous system. The functional disorders develop by stages. The chemical burden, resulting from the long-term exposure, displays at every stage both non-specific and relatively specific characteristics of the changes in the functional status of the CNS.

Using presented the results /7,8/ the correlation between risk levels and stages of occupational diseases has been worked out (Table 2).

Table 2. Determination of risk level in the case of neurotoxic substances in the air of work environment

Consequences → ↓ Probability	Slightly harmful	Harmful	Extremely harmful
	Hyperstenic syndrome (mild level of asthenia, irregular speed of mental activity, deficient ability to concentrate, increased number of errors in the psychological tests)	Hypostenic syndrome (moderate asthenia, decreased speed of mental activity, decreased ability to concentrate, prolonged reaction time)	Organic psychosyndrome (expressed asthenia, memory disorders of organic type, lowered visual-constructive ability, clearly prolonged reaction time)
Low duration of exposure <5 years	trivial risk no risk reduction measures needed	tolerable risk follow-up of risks	moderate risk risk reduction measures needed
Medium duration of exposure 5-10 years	tolerable risk follow-up of risks	moderate risk risk reduction measures needed	substantial risk risk reduction measures inevitable
High duration of exposure >10 years	moderate risk risk reduction measures needed	substantial risk risk reduction measures inevitable	intolerable risk risk reduction measures to be implemented at once

Improvement of the situation in Estonia is possible if the understandable risk assessment instructions are available for safety specialist, occupational health doctor and for every worker, and if the information about chemical safety is available. Also the mass communication means (booklets, advertisements) have to be used for drawing attention of people.

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