OCCUPATIONAL HEALTH AND SAFETY AT A MANUFACTURING COMPANY

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ABSTRACT

Introduction. Effective occupational health and safety education plays an important role in the prevention of workplace accidents and work-related illnesses. In 2017, there were 23,387 occupational accidents resulting in incapacity for more than 3 working days and 281 suspected occupational diseases in Hungary. A significant part of these occurred in the manufacturing industry. *Objective.* The aim of this study was to investigate the working conditions, work-related health loss and workplace prevention at a manufacturing company, with particular focus on the role of education in preventing harm to workers. *Methods*. A questionnaire survey was conducted among the employees of a medium-sized manufacturing company. Of the 83 employees, 72 participated in the study. Workers completed an anonymous questionnaire consisting of 24 questions that covered, in addition to demographic characteristics, occupational health and safety training, situation of health and safety at work, preventive measures, occupational accidents and work-related ill health. Data were processed in a descriptive manner and by inferential statistical analysis. *Results.* In the survey, the employees reported about having attended regular occupational health and safety trainings, understanding what they have been taught and being familiar with their health and safety tasks, although some shortages in the effectiveness of the education, especially the limited practice, have been identified. Most of the participants evaluated their workplace to be safe and not harmful to health, those who deemed it harmful referred to dust release from the processed materials. Four of the respondents had work accident at their current workplace, and three people experienced ill health that they related to work.

Comparative analysis found a significant relationship ($p < 0.05$) between the modernity of work equipment and the occurrence of occupational accidents. In addition, the use of dangerous equipment, the modernity of work equipment, and the attention of the employer to health and safety at work correlated significantly with the employees' perception how much they considered their workplace to be harmful to health. *Conclusions.* The occupational health and safety education conducted at the examined workplace complied with the regulations but further improvement, especially in practical training, as well as priority given to collective protection is advisable. Provision of modern work equipment can reduce the risk of accidents, and, together with ensuring less dangerous work tools any paying substantial attention to workplace health and safety, is able to increase the perceived level of occupational health and safety leading to physical, mental and social well-being at work.

Key Words: occupational health and safety, manufacturing, training, occupational accident, work-related ill health

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Abbreviations:

MNE – Ministry of National Economy
NIOSH – National Institute for Occupational Safety and Health
HLI – Hungarian Labour Inspectorate
PPE – personal protective equipment
SAP – superabsorbent polymer
ML – Ministry of Labour
HCSO – Hungarian Central Statistical Office

INTRODUCTION

The principal role of occupational health and safety is to prevent workers from occupational diseases and injuries. In 2017, there were 23,387 reported occupational accidents resulting in incapacity for more than three working days in Hungary, of which 186 were serious accidents and 89 were fatal. Most workplace accidents occurred at medium-sized enterprises (8,053 cases) and many of them at manufacturing companies (4,217 cases) (MNE, 2018). According to the report of the occupational health and safety authority, there were 281 suspected occupational diseases in Hungary in the same year. In addition, 97 cases of increased exposure were reported. Most of the cases (30.9%) were reported from the manufacturing industry (MNE, 2017).

In most instances the occupational health and safety authority had to take action due to the lack of occupational health and safety knowledge in 2017 (4,103 cases), which signifies the importance of proper education. Another main reason was the lack of maintenance of the work equipment and their poor state (2,647 cases) (MNE, 2017).

The National Institute for Occupational Safety and Health of the USA (NIOSH) has prepared a systematic review on whether occupational health and safety education has a positive impact on the prevention of occupational ill health and attempted to explore those educational factors that may contribute to better prevention. The study concluded that effective occupational health and safety education provides information for recognising occupational hazards and raises awareness of occupational health and safety tasks and of the use of personal protective equipment. The results of the review revealed that occupational health and safety training has an impact on the employees' knowledge of workplace health and safety tasks, but there is not enough evidence to confirm that occupational health and safety education alone would be effective to prevent occupational diseases and injuries (NIOSH, 2010). A systematic review of pre-post randomized trial studies also found strong evidence that adequate training has an effect on workers’ occupational health and safety behaviour but evidence was insufficient for the effect of training on health outcomes (Robson, 2012).

The aim of this study was to assess the occupational health and safety situation of a medium-sized manufacturing company, and to examine the role of occupational health

and safety training, as well as other workplace factors in the development of occupational accidents and work-related ill health.

METHODS

In this cross-sectional study, the employees of a medium-sized manufacturing company processing superabsorbent polymer were involved in a paper-based anonymous questionnaire survey. In addition to demographic data, information was collected on health and safety status of the workplace, occupational health and safety education, applied preventive measures, and on occupational accidents and work-related ill health. The construction of the questionnaire was partly based on the methodology of a 2009 study of the Hungarian Labour Inspectorate (HLI), which was carried out with the aim to assess the health and safety situation of micro-, small- and medium-sized enterprises (HLI, 2010). Questions on the theoretical and practical occupational health and safety training, knowledge of health and safety tasks at work, workplace safety, dangerousness and modernity of work equipment and on the employer's attention to health and safety at work were adopted from this source.

All employees of the company were invited to participate in the survey. Respondents had given their consent to participate in the study upon prior notification, by signing a declaration of informed consent. Data collection was in accordance with the ethical standards of the Ethical Committee of the University of Debrecen, the Ethical Committee of the Hungarian Scientific Council on Health and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. In addition to the survey, the occupational health and safety documentation of the company was also reviewed.

Data processing and descriptive analysis was performed using Microsoft Excel 2010, in which the answers to the questionnaire were coded into numeric values. The relationship between independent and dependent variables was investigated by univariate and multivariate analysis using STATA 13. In univariate analysis, Fisher-exact test was performed due to the small number of cases of occupational accidents and work-related ill health (dependent variables). Due to the same reason, multivariate analysis with logistic regression was attempted but could not give meaningful results.

RESULTS

The company employed 83 workers at the time of the investigation, of which 72 participated in the study, 23 (32%) men and 49 (68%) women. Most of them were in the 50-60 years age group and had altered workability.

The spectrum of their jobs covered trained manual worker, administrator, accountant, other office worker, cleaner, maintenance worker, social worker, salesperson, shop assistant, commercial agent and manager, truck driver, commercial forklift driver and material registrar. Most of them were employed as a trained worker at the company, which is not tied to prior education. As a consequence, the level of education at the company was relatively low, only 24% had a college or university degree.

Occupational health and safety education

Everyone participated in occupational health and safety training at the company. The answers to the question about the frequency of training varied although the training was provided annually at the workplace *(Figure 1).* Most (67%) but not all the participants knew the right answer for this control question.

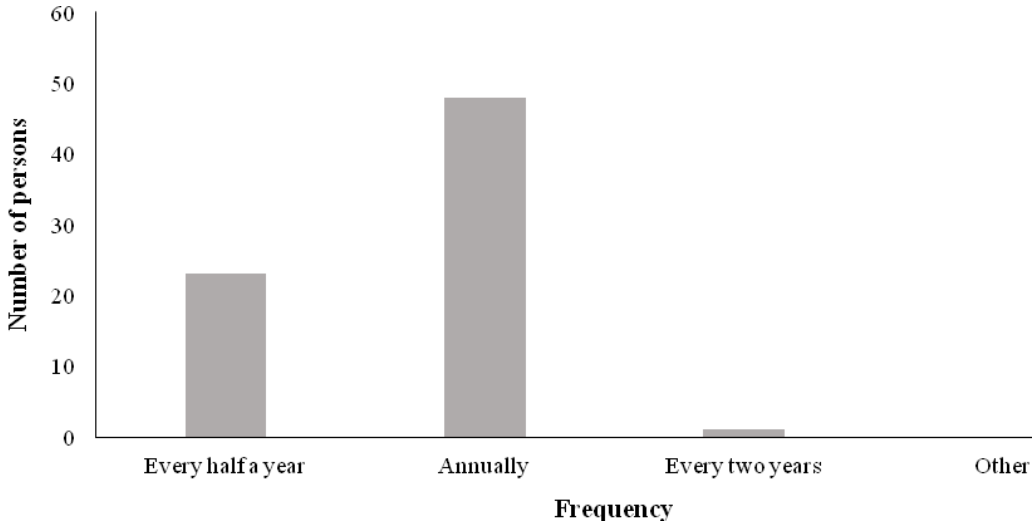

Figure 1. Frequency of occupational health and safety training

The health and safety education was deemed to be fully informative by most of the responders (68%) on a 5-item Likert scale *(Figure 2*).

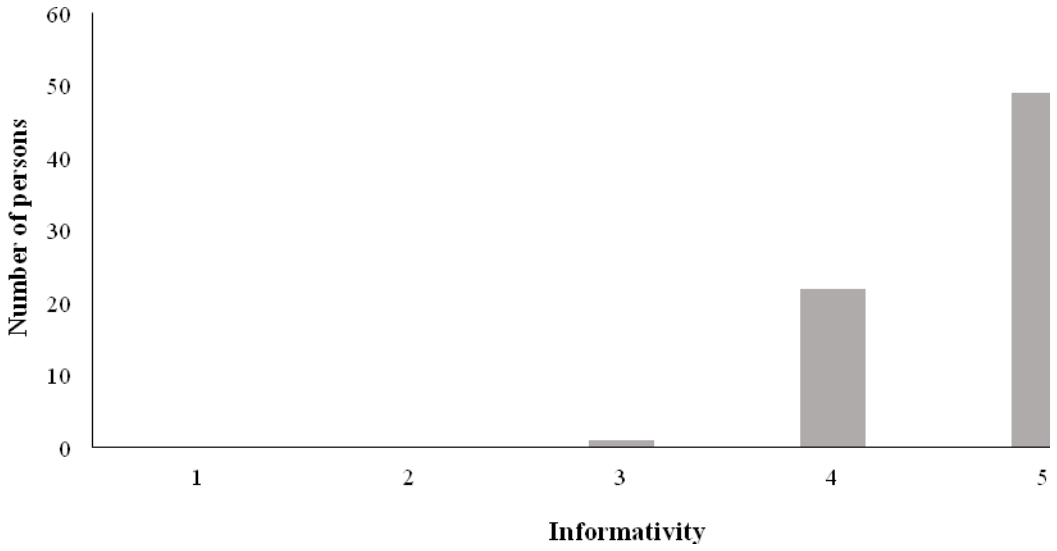

Figure 2. Informativity of occupational health and safety education

58% of the workers confirmed that they received practical training during the education and this significantly correlated with their job status ($p = 0.001$). The majority of the employees (76%) indicated that they were fully familiar with their health and safety duties *(Figure 3).*

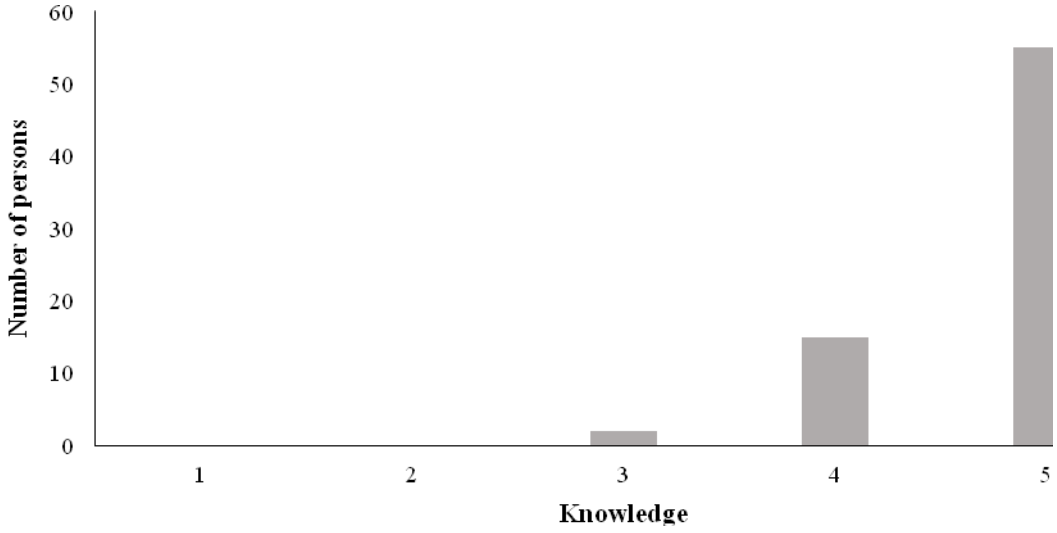

Figure 3. Knowledge of occupational health and safety tasks

Occupational health and safety situation

Most of the respondents (62.5%) indicated that they did not work with dangerous equipment at all, and the rest of the answers varied between working with moderately to highly dangerous tools *(Figure 4).* Mainly cutting tools were considered dangerous, such as wire cutter, scissors and angle grinder.

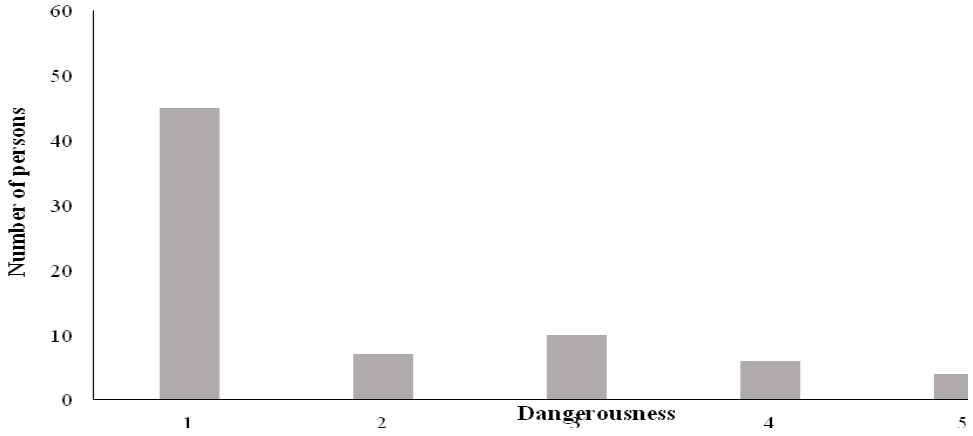

Figure 4. Dangerousness of work equipment

Most of the employees (97%) were fully or moderately satisfied with the modernity of their work equipment, only one worker expressed absolute dissatisfaction *(Figure 5).* The material handling hand pallet truck and the force cutter were mentioned as equipment being out of date.

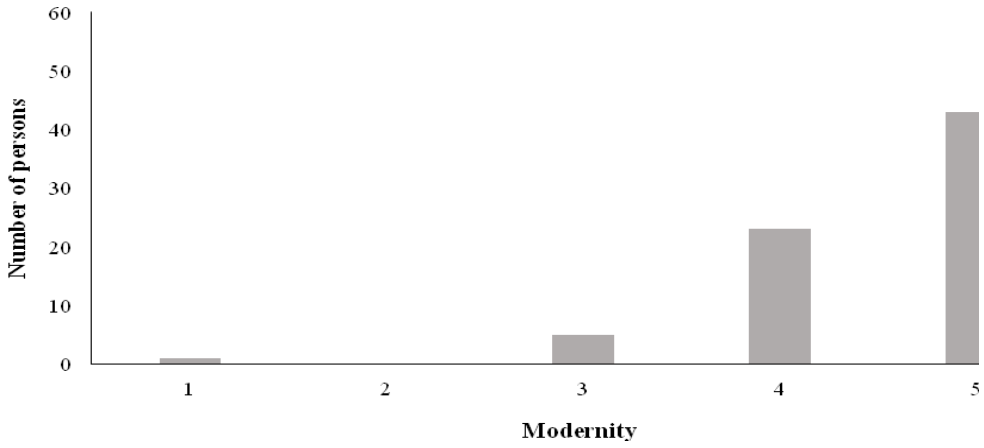

Figure 5. Satisfaction with the modernity of work equipment

The majority of the workers (72%) thought that their employer was fully attentive to health and safety at work *(Figure 6).*

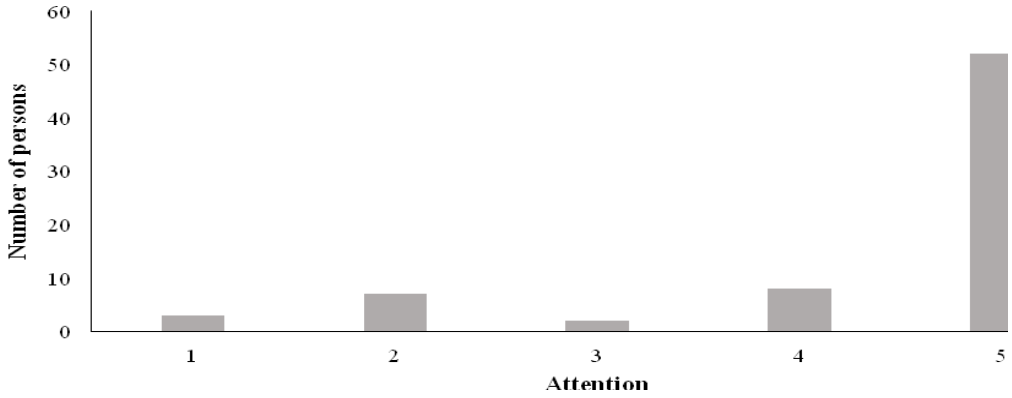

Figure 6. Employer's attention to occupational health and safety

Most of the respondents (78%) thought that their workplace was absolutely safe (*Figure 7).* Perception of workplace safety level depended on the modernity of work equipment ($p < 0.0001$), the dangerousness of work equipment ($p = 0.002$), the attention paid by the employer to occupational health and safety ($p = 0.001$), the job of the worker ($p = 0.005$) and the time spent at the company ($p = 0.003$).

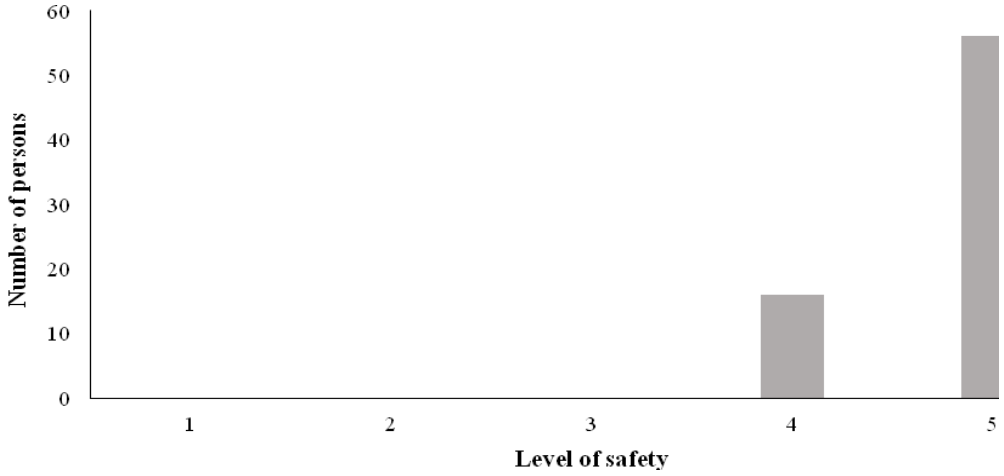

Figure 7. Perception of workplace safety level

Workers mostly (69%) considered the workplace not harmful to their health at all; nevertheless, 7% of them thought they worked in a completely health-damaging environment *(Figure 8).* Most of the negative responses claimed that the dusty material they have to work with was hazardous to health. In addition, insufficient natural illumination and not enough fresh air were mentioned as occupational risk factors in the workplace. There could be a significant relationship observed between the harmfulness of the workplace and the modernity of work equipment ($p < 0.0001$), the dangerousness of work equipment ($p < 0.0001$) and the attention paid by the employer to occupational health and safety ($p < 0.0001$).

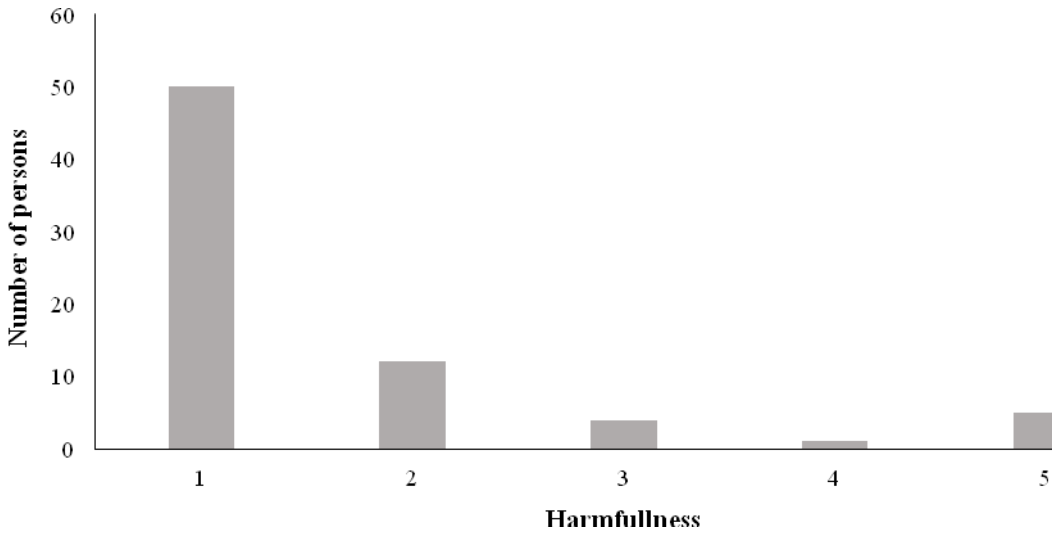

Figure 8. Perception of harmfulness of the workplace

Preventive measures

85% of the employees could not mention any collective preventive measures used in the workplace. Those who could indicate any collective measure named finger protection mounted on sewing machines, ventilation window, ventilation and air conditioning system, and water-based fire extinguishing system.

Regarding provision of personal protective equipment (PPE), 76% of the workers indicated that they did not receive PPE. According to the responses of those who used PPE, they received them monthly (3%), semi-annually (1%), annually (4%) or when the equipment lost its protective ability.

Occupational injury and work-related ill-health

93% of the employees have not had any occupational accident since they have been working at this company. Four people suffered accident related to work. Half of them indicated that inadequacy of the health and safety training somewhat influenced the occurrence of the accident and one person admitted inattentiveness as a contributing factor. None of them regarded lack of PPE a determining factor of the accident. As a reaction from the employer, after an accident an out of turn safety training was arranged in order to avoid similar events in the future. There was a significant correlation between the occurrence of occupational accidents and the modernity of work equipment ($p = 0.003$).

94% of respondents have not experienced any work-related health problem since they have been working at this workplace. Three people indicated to have developed ill health that could be related to work. Asthma, low back pain and numbness of hands were mentioned as conditions which could have been induced or aggravated by work.

DISCUSSION

The study conducted at a medium-sized manufacturing company revealed that organisation of occupational health and safety trainings was in accordance with legislation and all related documentation complied with legal requirements. Workers considered the occupational health and safety education informative. The majority of them were well aware of their health and safety tasks according to their own judgement. On the other hand, it was indicative for some shortage in training effectiveness that one-third of the participants could not specify the correct, yearly frequency of the training and half of the accidents were related to inadequacy of the health and safety education by the victims. Just over half of the workers reported that they received practical training during the health and safety education. The reason for the relatively low proportion could be that practical training was organised only during the pre-employment education for the workers.

The way how occupational health and safety education is organised essentially determines its effectiveness. According to the results of a systematic review and meta-analysis on the factors of effectiveness of worker safety and health training, more engaging educational techniques that require the trainees' active participation, such as

behavioural modelling, hands-on training, dialogue and feedback interventions, can result in better knowledge acquisition and consequently in decreased work-related injuries and illnesses (Bruke et al., 2006). In addition, it is important to specifically tailor the education to the company's training needs, ideally through occupational health and safety appraisal processes (Clark and Flitcroft, 2013).

The principal material that is processed in the factory is a superabsorbent polymer (SAP) based on sodium polyacrylate or sodium polycarbonate. Superabsorbent polymers are capable of absorbing and retaining large amounts of fluid (200-300 times their own size). SAP substances are white, odourless, crystalline or powder-like, which, when in contact with water, become gelatinous. Exposure to SAP chemicals may cause irritation to the eyes or the skin, but they are not considered to be hazardous substances (Farkas, 2006). Sodium polyacrylate can induce inflammation in the lungs but does not cause cancer (Sodium polyacrylate Safety Data Sheet, 2010). 0.05 mg/m^3 of respirable superabsorbent polymer dust (<10 mm) in the workplace air is a recognised threshold, but occupational exposure limit for superabsorbent polymer is not established in Hungary. The raw materials arrive to the factory in bales. The wire cutters, scissors, and the whole wire cutting activity used to open up bundles are perceived by workers as dangerous, although these work tools are not classified as dangerous work equipment by law, unlike the forklift in operation at this workplace (Decree No 5/1993 (ML) on the implementation of certain provisions of Act No XCII of 1993 on Occupational Safety and Health). During material handling, heavy manual work with lifting heavy loads needs to be carried out.

The study identified four occupational accidents and three cases of ill-health reported to be work-related by the 72 participants since they have been working at their current job (4.8 years per worker in average, 344.5 work-years in total). The comparison of the health and safety situation at the company to the national average has severe limitations due to the different methodology of collecting and processing data; nevertheless, providing a broad view can be attempted. The incidence rate of accidents was 11.6/1000 work-years at the company compared to the 5.3/1000 work-years national average and the 9.1/1000 work-years average in the manufacturing industry in 2017 (MNE, 2018; HCSO, 2019a; HCSO, 2019b). The accident rate at the company is well comparable to the average rate in the manufacturing industry.

The comparison of work-related ill health is even more problematic since any symptoms self-reported to be related to work were identified by the study, while only diagnosed diseases suspected by health care professionals to be occupational are included in the national statistics. The 8.7/1000 work-years incidence rate is considerably higher than the 0.06/1000 work-years national rate and 0.09/1000 work-years manufacturing industry rate of suspected occupational diseases reported to authorities in 2017 (MNE, 2017; HCSO, 2019a; HCSO, 2019b). The reasons for the two magnitude difference can be multiple ranging from real difference in the values of the essentially different measures to the problems with validity and certainty of the national as well as of the study data.

Statistics show that the number of occupational accidents and occupational diseases have an overall decreasing pattern in Hungary in the last two decades with some increase in recent years. However, these figures are probably strongly biased for many reasons. The employer is obliged to report occupational accidents, any physician suspected occupational diseases and increased exposure cases to the occupational health and safety authority, and the authority is required to investigate these cases. According to expert assumption, a considerable proportion of occupational injuries are not reported in Hungary (Ungváry, 2010). The main reasons for underreporting accidents are illegal and non-organized employment (e.g. self-employed individual entrepreneurs). The reporting of occupational diseases is even more problematic since, besides the above-mentioned issues, there is severe under-recognition and negligence for reporting by health care providers, as well as difficulties with identifying and confirming causal relationship of a disease with occupational factors. Due to these reasons, occupational diseases are substantially underreported in a systematically biased way in Hungary as it becomes visible in international comparison (Kudász et al., 2017). The essentially different magnitude of occupational diseases and work-related ill-health points out the need for valid data on work-related diseases provided by a so far lacking surveillance system in Hungary.

All employers are required to ensure work conditions that do not compromise the health and safety of employees. Among the workplace preventive measures, collective protection is favoured to individual protection (Act No XCII of 1993 on Occupational Safety and Health). Apart from a safety device mounted on sewing machines and gene-

ral ventilation, workers did not mention any other collective preventive measures in the factory and mainly referred to personal protective equipment. According to the company's PPE provision rules, mechanical protective gloves are used when breaking up the bales of raw material. Maintenance technicians get long welding gloves, safety welding boots, welding leggings, apron, goggles and shield. In addition, they are provided with reusable, washable earplugs and mechanical protective gloves. Cleaners get rubber gloves and safety shoes.

According to the findings of the study, the occurrence of occupational accidents is significantly determined by the modernity of work equipment. The perceived health and safety of the workplace is associated with the dangerousness of work equipment, the employer's attention to workplace health and safety, the job of the worker and the time spent at the company. Probably due to the low number of cases, relationship of work-related ill health with potential risk factors could not be detected. Nevertheless, considering the available information and the problems indicated by the workers, it is possible to recommend the installation of effective central and local ventilation system to improve the quality of workplace air.

The study had limitations that must be acknowledged. The study population was small that limits statistical power and consequently decreases the likelihood to find significant associations, especially with rare outcomes. The age distribution of the workers was towards higher ages (50-60 years), reflecting the aging working population of the country, and most of them had altered workability. In addition, the study was conducted in only one medium-sized manufacturing company; hence the generalizability of the results even to the manufacturing industry is limited.

Nevertheless, the findings of the study allow for drawing some general conclusions. The occupational health and safety training at the company complied with the regulations but further improvement, especially involving behavioural modelling and hands-on interactive training that can effectively develop practical skills, is advisable. The focus of prevention should move from individual to collective protection (e.g. installing local exhaust ventilation). These recommendations can be well applicable to several Hungarian workplaces. Using modern work equipment is likely to reduce the risk of accidents. Efforts by the employer to provide modern and less dangerous work tools as well as to pay substantial attention to workplace health and safety in general can increa-

se the level of occupational health and safety as perceived by the employees and can consequently contribute to physical, mental and social well-being at work.

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