

Workplace Accidents in Materials Transfer in Finland

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The aim of this study was to show the proportion of workplace accidents related to materials transfer and to decide whether they were more serious than other kinds of workplace accidents. The research material for this study were statistics and data, available in Finland, regarding workplace accidents and fatal accidents. Twenty-five percent of studied fatal accidents were related to materials transfer; 26.9–27.7% of all workplace accidents in Finland in 2003–2007 were workplace accidents related to materials transfer. Over half (54.7%) of workplace accidents related to materials transfer caused disabilities lasting over 3 days. Most accidents related to materials transfer occurred to men aged 20–49 years. The most common types of injuries were dislocations, sprains and strains.

severity fatal accident gender injury type

1. INTRODUCTION

Materials are transferred in almost every workplace and in every kind of trade, either manually or mechanically. Materials transfer is part of everyday occupational duties, e.g., transferring a waste container, bringing equipment from storage. Because materials transfer is performed almost everywhere every day, occupational safety is an important issue. The accidents in materials transfer operations occur mostly in transportation or storage work, but this paper addresses other aspects, too.

According to an American study, most truck drivers' accidents occurred to young men [1]. In U.S. trucking industry, the most frequently reported injuries were slips and falls, overexertion and injuries resulting from being struck by objects. Although the number of motor vehicles accidents was low, their severity was high [2]. Because truck drivers' work includes handling goods, they are exposed to overexertion [3, 4]. Injuries among

transport and retail workers are considered to be more serious than other kinds of accidents [5].

A Canadian study in a warehouse showed that switching from a mechanical to a manual handling system reduced the number of workplace accidents [6]. However, replacing manual transfers with mechanical could increase the risk of serious accidents [7]. Risk factors in manual materials handling include working with loads, where both hands are above shoulder height and may cause loss of balance [8]. Transportation workers in U.S. industries have the highest incidence rate in slips and falls on the same level [9].

The aim of this study was to show the percentage of workplace accidents related to materials transfer compared to all workplace accidents and to decide whether accidents related to materials transfer were more serious than other kinds of workplace accidents. Compared were also accidents related to materials transfer and other kinds of workplace accidents to see whether there were differences in gender and age of injured worker, branch of business and type of injury.

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2. MATERIALS AND METHODS

The research was conducted with the statistics and data, available in Finland, on workplace and fatal accidents. The data came from the database of the Federation of Accident Insurance Institutions (FAII). The data were chosen from two databases: (a) reports on fatal accidents (1994–2009) and (b) official statistics on workplace accidents in Finland (2003–2007).

The FAII functions as the co-ordinating organ of all organizations engaged in statutory accident insurance. Every insurance company handling statutory accident insurance in Finland has to be a member of the FAII. According to the Employment Accidents Insurance Act [10], the member institutions are obliged to provide the FAII with the information necessary for compiling and maintaining statistics.

2.1. Fatal Workplace Accidents

The database of fatal workplace accidents contains ~50% of fatal workplace accidents in Finland in 1987–2009. An external investigator examined the fatal workplace accidents in the database. The complete accident report was written on the basis of the investigation. The report included information on accidents and factors influencing them. Traffic and commuting accidents, fits and accidents where violence or intoxicants are involved are not included in the database of fatal workplace accidents.

The database consisted of 807 fatal accidents, which occurred in Finland in 1994–2009. Researchers read each description of fatal accident and chose accidents involving materials transfer for further analysis.

The occurrence of fatal accidents in materials transfer was analysed. The reliability of classification was independently estimated by the consensus of two researchers (Pia Perttula and Simo Salminen). Their consensus was 86.7%, which is over the acceptable level of 70% [11].

2.2. Nonfatal Accidents Statistics

The official statistics of workplace accidents include all compensable workplace accidents in

Finland. The compiled statistics provided information on workplace accidents, occupational diseases, injuries and illnesses they caused, types and amounts of compensation paid, factors influencing the amount of compensation and information on the policyholders, branch of business, payroll and insurance premiums.

Compared were accidents, which occurred in materials transfer and accidents not connected with materials transfer. Statistics on accident were examined in a 5-year period (2003–2007). The number of reported workplace accidents varied between 96221 and 119007 in that period.

Accidents which occurred in materials transfer were chosen from the statistics with certain European statistics on accidents at work (ESAW) variables [12] (Table 1). The number of accidents related to materials transfer was deducted from all workplace accidents and compared with the total number of accidents.

The variables used to compare workplace accidents and workplace accidents related to materials transfer were length of disability, gender, age, branch of business and type of injury. The comparison was made with the χ^2 statistical test.

3. RESULTS

3.1. Fatal Accidents

Reports of 807 fatal accidents, 202 (25%) of which were related to materials transfer, were analysed, e.g.,

- a construction worker fell from the 6th floor through an opening in a guard rail while carrying waste to a bin;
- a worker was crushed with a conveyer while removing a disruption from it;
- a worker was run over by a forklift transferring materials at the workplace.

3.2. Nonfatal Workplace Accidents

The number of all reported workplace accidents in Finland in 2003–2007 was 538159. The number of accidents related to materials transfer in the same period was 145816. Thus, the number of workplace accidents related to materials trans-

TABLE 1. European Statistics on Accidents at Work (ESAW) Variables Used to Determine Workplace Accidents Related to Materials Transfer

ESAW Variable	ESAW Code	
The material agent of the contact— mode of injury	1100 ground level buildings/structures/surfaces	
	1201 fixed parts of building, above ground	
	1210 fixed ladders	
	1211 columns/pylons/gangways/mezzanines/masts	
	1219 other fixed structures above ground	
	1221 mobile ladders/stepladders	
	1222 improvised supports	
	1223 mobile scaffolding	
	1229 other mobile structures above ground	
	1320 underground areas/tunnels	
	1330 underwater environments	
	1399 other buildings/structures below ground	
	2100 supply systems for materials/pipe networks	
	2200 motors/energy transmissions and storage	
	2300 hand tools, not powered	
	2400 mechanical hand-held/hand-guided tools	
	2500 hand tools (power source not known)	
	2601 portable/mobile machines, ground work	
	2602 portable/mobile machines, farm work	
	2603 portable/mobile machines, construction	
	2604 mobile floor cleaning machines	
	2699 other portable/mobile machines	
	2718 other farming machines	
	2801 fixed conveyors/handling equipment	
	2802 elevators/lifts/hoists/jacks, etc.	
	2803 cranes/hoisting devices with suspended loads	
	2811 non-lifting load transport devices	
	2812 wheelbarrows	
	2813 hand trucks	
	2814 tilting conveyors/trolleys/carts	
	2815 pallet trucks	
	2816 forklift trucks	
	2819 other mobile handling devices	
	2820 lifting/securing/misc. handling devices	
	2840 mobile storage equipment/containers	
	2850 storage pallets/pallet tracks/shelving, etc.	
	2860 misc. mobile packaging, small/medium	
	2899 transport/storage systems not listed	
	3100 land vehicles	
	3200 other transport vehicles	
	4100 materials/products/components/debris/dust	
	Deviation	30 break, fall of material agent
		40 loss of control of machines, etc.
		50 slipping, stumbling, falling
		60 body movement without any physical stress
		70 body movement under or with physical stress

TABLE 1. (continued)

ESAW Variable	ESAW Code
Specific physical activity	30 driving/being on board
	40 handling of objects
	50 carrying by hand
Contact—mode of injury	10 contact with electrical voltage, temperature, hazardous substances
	12 direct contact with electricity
	20 drowned, buried, enveloped
	30 horizontal or vertical impact with or against a stationary object
	40 struck by object in motion, collision with
	50 contact with sharp, pointed, rough, coarse material agent
	60 trapped, crushed, etc.
70 physical or mental stress	
Year	2003
	2004
	2005
	2006
	2007

Notes. misc. = miscellaneous.

fer was 26.9–27.7% of all workplace accidents in Finland in 2003–2007.

The length of disability varied depending on whether accidents were related to materials transfer. Workplace accidents related to materials transfer represented a greater proportion of workplace accidents causing disabilities of 4–30 days (Table 2). The difference is statistically significant ($p < .001$).

TABLE 2. Differences in Length of Disability Caused by Workplace Accidents

Disability (Days)	Materials Transfer	No Materials Transfer
	Frequency (%)	Frequency (%)
>30	10875 (7.5)	33508 (8.5)
15–30	13156 (9.0)	33002 (8.4)
7–14	30035 (20.6)	67830 (17.3)
4–6	25659 (17.6)	53793 (13.7)
0–3	66091 (45.3)	204210 (52.0)

Notes. $\chi^2 = 2881.9$, $df = 4$, $p < .001$.

Most workplace accidents related to materials transfer occurred to men (389392 from 538159 workplace accidents). Comparison of workplace accidents related to materials transfer and those

which were not related showed that more workplace accidents related to materials transfer occurred to men, and more workplace accidents not related occurred to women (Figure 1). The difference is statistically significant ($p < .001$).

Workplace accidents related to materials transfer occurred mostly to workers aged 20–49 (Figure 2). In contrast, workplace accidents not related to materials transfer occurred significantly more often to workers aged over 50 and under 20. The difference is statistically significant ($p < .001$).

The main branches of business in which most workplace accidents related to materials transfer occurred were manufacturing, construction, wholesale and retail trade, transport, storage, communication and the municipal sector (Table 3). The fewest workplace accidents, related to materials transfer and not, occurred in extraterritorial organizations, fishing, mining and quarrying, and private households. The difference is statistically significant ($p < .001$). There were significant differences between workplace accidents related to materials transfer and those not related in wholesale trade and transport, where the number of accidents related to materials transfer was higher.

The most common injuries in workplace accidents related to materials transfer were disloca-



Figure 1. Comparison of the occurrence of workplace accidents.

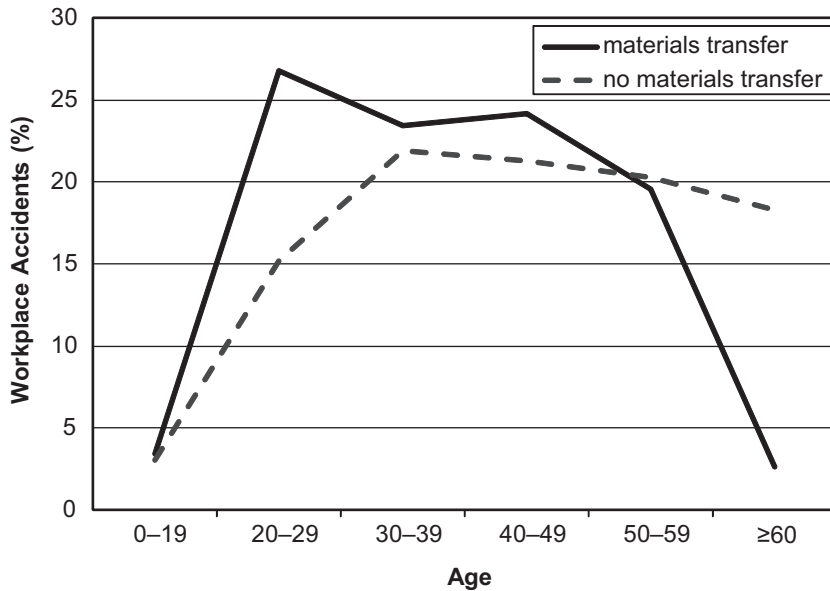


Figure 2. Age distribution of injured workers in workplace accidents.

tions, sprains and strains (Table 4). Wounds and superficial injuries occurred mostly in workplace accidents not related to materials transfer. The difference is statistically significant ($p < .001$).

4. DISCUSSION

Data from two different sources, fatal accident reports and official accident statistics, were compared to collect necessary information on workplace accidents related to materials transfer. The

TABLE 3. Frequency of Workplace Accidents in Main Branches of Business

Branch of Business	Materials Transfer	No Materials Transfer
	Frequency (%)	Frequency (%)
Agriculture, hunting and forestry	1 686 (1.2)	5 612 (1.4)
Fishing	46 (0.0)	141 (0.0)
Mining and quarrying	285 (0.2)	948 (0.2)
Manufacturing	40 358 (27.7)	105 145 (26.8)
Electricity, gas and water supply	729 (0.5)	2 183 (0.6)
Construction	23 008 (15.8)	61 378 (15.6)
Wholesale and retail trade	19 719 (13.5)	34 777 (8.9)
Hotel and restaurant	4 213 (2.9)	10 043 (2.6)
Transport, storage and communication	17 839 (12.2)	33 163 (8.5)
Financial intermediation	294 (0.2)	1 467 (0.4)
Real estate, renting and business	13 052 (9.0)	33 216 (8.5)
Public administration	2 333 (1.6)	9 887 (2.5)
Education	1 051 (0.7)	5 216 (1.3)
Health and social work	2 248 (1.5)	9 628 (2.5)
Other community service act	3 370 (2.3)	11 376 (2.9)
Private household with employed person	483 (0.3)	1 468 (0.4)
Extraterritorial organizations	3 (0.0)	9 (0.0)
Industry unknown	396 (0.3)	1 398 (0.4)
Municipal sector	14 703 (10.1)	65 288 (16.6)

Notes. $\chi^2 = 11300.9$, $df = 18$, $p < .001$.

TABLE 4. Frequency of Injuries Caused by Workplace Accidents

Type of Injury	Materials Transfer	No Materials Transfer
	Frequency (%)	Frequency (%)
Wound and superficial injury	49 861 (34.2)	143 166 (36.5)
Fracture	9 549 (6.5)	24 532 (6.3)
Dislocation, sprain and strain	54 153 (37.1)	122 069 (31.1)
Concussion and internal injury	29 292 (20.1)	67 323 (17.2)
Other	2 961 (2.0)	35 253 (9.0)

Notes. $\chi^2 = 10081.0$, $df = 14$, $p < .001$.

results from the databases were very similar. At least 25% of workplace accidents occurred in materials transfer. In 2003–2007, 26.9–27.7% of reported workplace accidents in Finland were related to materials transfer. From 807 fatal accidents, 25% of accidents were related to materials transfer.

The number of workplace accidents in materials transfer (25%) is lower than in earlier studies (33%) [7]. The results in this study are not accu-

rate because data necessary for the research were not available. Thus, assumptions and estimations were made. The assumptions were made because certain variables (e.g., poisoning, infections and violence) in the statistic database were not related to materials transfer, and were removed from data. The researchers made the assumptions.

The basic question is whether accidents related to materials transfer are more serious (i.e., cause longer disabilities) than other types of accidents.

This study does not directly support this assumption. The study shows that workplace accidents related to materials transfer cause more disabilities lasting 4–30 days than workplace accidents not related to materials transfer. Accidents not related to materials transfer are minor or disabilities last over 30 days.

Over 52% of workplace accidents not related to materials transfer caused disabilities of under 3 days. However, about half (54.7%) of workplace accidents related to materials transfer caused disabilities of over 3 days. Disabilities of over 30 days occur more often in accidents not related to materials transfer. The length of disability depends on two factors. Most workplace accidents related to materials transfer occur to young people and the most common injuries are dislocations, sprains and strains. The risk of serious injuries increases with the age [13]. Young people need less time to recover physically from injuries and to return to work than older people [1, 14, 15].

Most workplace accidents related to materials transfer occur to men, because their work involves more materials transfer than the women's work. Men's workplace accidents were more often related to materials transfer than not related. For women, the opposite was true. This is partly because women are believed to be more risk averse than men. Men are more likely to have accidents at work than women [16].

The study shows that accidents related to materials transfer occur more often to workers aged 20–49, as they do more materials transfer than younger or older workers. This means that the workers who are at the beginning of their work life are at a higher risk of being involved in workplace accidents related to materials transfer. That is why orientation and organization, proper working methods and appropriate equipment for materials transfer need to be properly implemented from the very beginning. According to previous research, it is possible to reduce accidents through safety training [17, 18]. Davies, Kemp, Frostick, et al. recommended a few improvements in the working environment (e.g., suitable lighting, clear workspaces and routes) to avoid workplace accidents in materials transfer [19].

The fact that most accidents related to materials transfer occur in transport and storage might be the basic assumption. This study shows that accidents related to materials transfer are also common in other branches of business. The highest rate of workplace accidents in materials transfer was in manufacturing, construction, wholesale and retail trade, transport and storage, and real estate. The fewest workplace accidents, both related and not related to materials transfer, was in extraterritorial organizations, fishing, mining and quarrying, and private households.

The most common types of injuries in workplace accidents related to materials transfer, i.e., dislocations, sprains and strains, prove that more attention should be paid to proper working methods, appropriate equipment transfer and the working environment.

In conclusion, this study shows that materials transfer causes many workplace accidents. Materials are transferred in every workplace. Recognizing the risks of materials transfer could help to introduce actions preventing workplace accidents. Improved methods, better materials handling and personnel training can prevent accidents related to materials transfer.

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