



Have young workers more injuries than older ones? An international literature review

Simo Salminen*

Finnish Institute of Occupational Health, Department of Occupational Safety, Topeliuksenkatu 41b, FI-00250 Helsinki, Finland

Received 30 May 2003; received in revised form 9 June 2004; accepted 11 August 2004

Abstract

Problem: Two questions were posed in this global literature review: Do young workers have a higher occupational injury rate? Are the injuries of young workers more often fatal than those of older workers? **Method:** The studies of nonfatal and fatal injuries were collected based on the following criteria: (a) published in peer-reviewed journals; (b) the young workers were under 25 years of age; (c) the injury rate or fatality rate of young workers and the overall rate was published; and (d) description of the population and the number of injuries was presented. **Results:** The majority of 63 nonfatal studies reported showed that young workers had a higher injury rate than older workers. Twenty-nine out of 45 studies on fatal occupational injuries indicated that young workers had a lower fatality rate than older workers. These results are clearer for men than for women. **Impact on industry:** The results showed that young men were a risk group for occupational injuries. However, the injuries of young workers were reported as less often fatal than those of older workers.
© 2004 National Safety Council and Elsevier Ltd. All rights reserved.

Keywords: Occupational injuries; Fatalities; Age; Gender; Voting method

1. Introduction

The aim of this review is to find the answers to two questions: Do young workers have a higher risk of occupational injuries? Are the injuries of young workers more often fatal than those of older workers?

Previous reviews (Rhodes, 1983; Laflamme & Menckel, 1995; Salminen, 1996) have shown that injury rates tend to decrease as age increases. The reviews have also shown that the injuries of young workers are less serious than those of older workers, because the fatality rate of young workers was lower than that of older workers. Compared to these earlier reviews, the strengths of this review are the larger number of studies and that the studies are from many different countries and industries.

2. Methods

For this literature review, the studies were collected based on the following criteria:

- (1) The studies were published, most of them in peer-reviewed journals.
- (2) Workers under 25 years of age were classified as young workers.
- (3) There was information about the injury rate or fatality rate of young workers and older workers, or the overall injury rate regardless of age.
- (4) There was enough information on the population and the number of injuries on which the calculations of injury rate were based.

The studies reviewed were published in English, as well as in Finnish, Swedish, German, and Dutch. This broadens the variety of the studies and also the universality of the results.

* Tel.: +358 30 474 2731; fax: +358 30 474 2020.

E-mail address: simo.salminen@ttl.fi.

Table 1
A review of studies on occupational accidents of young workers

Source	Data	Result
Kossoris (1940)	26,058 workers at four companies, Wisconsin, 1937	Young men had a higher accident frequency than all age groups
King (1955)	1991 agricultural injuries in Great Britain, 1948	The proportion of young workers in injuries lower than in population
Griew (1958)	268 injuries in a British engineering factory, 1953–1956	The injury rate of young workers was higher than the overall rate
Fredin, Gerdman, and Thorson (1974)	303 construction injuries in Sweden, 1967	The proportion of injuries among young workers was lower than that in the population
Oi (1974)	BLS data in California, 1960 and 1968	The injury rate of young men was not different from the overall rate, but that of young women was lower
Wigglesworth (1976)	85,100 occupational injuries in Australia, 1969–70	The proportion of injuries among young men and women was lower than that in the population
Root & Hoefler (1979)	68,877 injuries in North Carolina and Iowa, 1977	The injury rate of young workers was higher than the overall rate
Dillingham (1981)	Workmen's Compensation in New York State, 1970	The injury rate of young men was higher than the overall rate, but that of young women was lower
Root (1981)	Bureau of Labor Statistics, USA, 1977	The injury rate of young workers was higher than that of older workers
Siskind (1982)	705,440 injuries in USA, 1978	The injury rate of young men was lower than the overall rate, whereas that of young women was higher
Coleman and Sanderson (1983)	3,182,500 occupational injuries treated in U.S. hospitals, 1982	The injury rate of young men and women was higher than the overall rate
Broberg (1984)	113,922 injuries in Sweden, 1980	The injury rate of young women and men was higher than the overall rate
Pines, Rohrmoser, and Pollak (1985)	792 hospital injuries in Israel, 1978–1980	The injury rate of young workers was higher than that of older workers
Schelp and Svanström (1986)	717 injuries in Falköping, Sweden, 1978	The injury rate of young men and women was higher than the overall rate
Jansson (1987)	163 injured farmers in Skaraborg, Sweden, 1983	The accident frequency of young men and women was lower than the overall frequency
Smit (1987)	7234 injuries to Dutch metal workers, 1978–1981	The injury rate of young workers was higher than the overall rate
Wilkinson (1987)	1988 injuries to American health care workers, 1982–1983	The injury rate of young women and men was higher than the overall rate
Butani (1988)	12,455 injuries in US coal mines, 1986	The proportion of young workers in injuries was the same as in the workforce
Jacobsson and Schelp (1988)	285 injuries in Falköping, Sweden, 1981–1982	The injury rate of young women and men was higher than the overall rate
Jensen and Sinkule (1988)	628 press operator amputations, USA, 1979–1981	The injury rate of young women and men was higher than the overall rate
Larsson (1988)	687 injuries among Swedish woodworkers, 1983	The injury rate of young workers was lower than the overall rate
Reich and Frumkin (1988)	Occupational injuries in Japan, 1978 and 1982	The injury rate of young workers was not different from older workers
Oleske, Brewer, Doan, and Hahn (1989)	146 injuries in a factory in Chicago, 1985	The injury rate of young workers was higher than the overall rate
Tsai, Bernacki, and Dowd (1989)	20,705 workers at two Tenneco factories, 1986	The injury rate of young men was higher than the total injury rate, but the injury rate of young women was lower than the total injury rate
Firth and Herbison (1990)	655 injuries in Dunedin, New Zealand, 1989	The injury rate of young men was higher than the overall rate
Leigh, Mulder, Want, Farnsworth, and Morgan (1990)	16,700 injuries in New South Wales coal mines 1986–1988	The proportion of young workers, among injured workers was higher than that among the workforce
Norrish and Cryer (1990)	307 fishermen's injuries from New Zealand, 1988	The injury rate of young men was the same as the overall rate
Brison and Pickett (1991)	113 dairy and beef farms in Eastern Ontario, 1989–1990	Young workers had a higher injury rate than the total rate
Heiskanen (1991)	A representative sample of Finns ($n=13,762$), 1988	Young workers were more often involved in accidents than older ones
Brison and Pickett (1992)	44 agricultural injuries in Ontario, 1989–1990	The injury rate of young workers was lower than the overall rate
Pines, Lemesch, and Grafstein (1992)	150,700 injuries in Israel 1970 and 1980	The injury rate of young women and men was not different from that of older workers

Table 1 (continued)

Source	Data	Result
Pratt et al. (1992)	600 farm workers in Otsego County, New York, 1986	The injury rate of young workers was the same as the overall rate
Webb, Redman, and Sanson-Fisher (1992)	1740 injuries at a metal plant, Australia, 1985–1986	The injury rate of young workers was not different from that of older workers
Wilkinson et al. (1992)	1513 injuries to American health care workers, 1983–1985	The injury rate of young workers was higher than the overall rate
Lee, Anderson, and Kraus (1993)	3442 injuries in US coal mines, 1986	The injury rate of young workers was higher than the overall rate
Sorock, Smith, and Hall (1993)	1250 finger amputations in New Jersey, 1985–1986	The injury rate of young men was higher than the overall rate, but that of young women was lower
Hammer (1994)	24,084 injuries around Hannover, Germany, 1979–1985	Young men had a higher injury rate than older men, but there was no age difference among women
Kisner and Fosbroke (1994)	702,867 U.S. construction workers, 1981–1986	The injury rate of young workers was not different from that of older workers
Rossignol (1994)	30,581 injuries in Quebec, 1986–1988	The injury rate of young workers was the same as the overall rate
Skov (1994)	1022 hand injuries in Odense, Denmark, 1991	The injury rate of young men was higher than the overall rate, whereas that of young women was not higher
Cellier, Eyrolle, and Bertrand (1995)	877 injuries to agro-food workers in France	The injury rate of young workers was higher than that of older workers
Pickett, Brison, Niezgodna, and Chipman (1995)	236 agricultural injuries in Ontario, 1991	The injury rate of young women and men was the same as the overall rate
Jensen (1996)	128 injured fishermen from Denmark, 1993	The injury rate of young men was higher than the overall rate
Kelsh and Sahl (1996)	31,438 electric utility injuries in California, 1980–1992	The injury rate of young women and men was higher than the overall rate
Laflamme (1996a)	942 injuries to Swedish female assemblers, 1980–1991	The injury rate of young women was higher than the overall rate
Laflamme (1996b)	5782 injuries to Swedish male assemblers, 1980–1991	The injury rate of young men was higher than the overall rate
Laflamme and Menckel (1996)	919 injuries to Swedish ore miners, 1980–1991	The injury rate of young workers was not different from that of older workers
Laflamme, Menckel, and Lundholm (1996)	1035 injuries of Swedish iron-ore miners, 1980–1991	The injury rate of young workers was not different from that of older workers
Lipscomb, Kalat, and Dement (1996)	7135 injuries of carpenters Washington State, 1989–1992	The injury rate of young workers was higher than the overall rate
Rabi, Al-Homran, AbuDhaise, and Alwash (1996)	898 permanent disabilities in Jordan, 1992	The injury rate of young workers was higher than the overall rate
Salminen (1996)	99 serious injuries in Southern Finland, 1988–1989	The injury rate of young workers was higher than the overall rate
Cloutier, David, and Duguay (1998)	6316 injuries to female Quebec nurses and food service workers, 1987–1991	The injury of young women was higher than the overall rate
Lowery et al. (1998)	4458 injuries at an airport construction site, 1990–1994	The injury rate of young workers was lower than that of older workers
McCaig, Burt, and Stussman (1998)	4,350,000 injuries in the United States, 1995–1996	The injury rate of young men was higher than the overall rate, whereas that of young women was the same
Bull, Riise, and Moen (1999)	7459 injuries in Norway, 1991–1996	The injury rate of young women and men was lower than the overall rate
Schoemaker, Barreto, Swerdlow, Higgins, and Carpenter (2000)	14,972 injuries in a steel plant in Brazil, 1977–1990	The injury rate of young workers was higher than that of older workers
Cloutier and Champoux (2000)	1041 accidents to Quebec firefighters, 1992	The injury rate of young workers was lower than the overall rate
Xiang et al. (2000)	1358 Chinese farmers in Hubei province, 1997	Young farmers were less often injured than middle-aged farmers
Bull, Riise, and Moen (2001)	446 fishing injuries Norway, 1995–1996	The injury rate of young workers in was higher than the overall rate
Chi, Chen, and Lin (2001)	5710 injuries in Taiwan, 1999	The injury rate of young workers was lower than the overall rate
Jackson (2001)	3.6 million occupational injuries treated in U.S. hospitals, 1982–1998	The injury rate of young men was higher than the overall rate, but that of young women was not higher
Findley and Bennett (2002)	214 injuries in a large plant in Tennessee, 1999–2000	The injury rate of young workers was higher than the overall rate
Hansen, Nielsen, and Frydenberg (2002)	1279 injuries to Danish seafarers, 1993–1997	The injury rate of young workers was same as that of older workers

Table 2
A review of studies on fatal occupational accidents of young workers

Source	Data	Result
Dillingham (1981)	Workmen's Compensation in New York State, 1970	The fatality rate of young men was lower than the overall rate, whereas that of young women was higher
Root (1981)	Bureau of Labor Statistics USA, 1977	The fatality rate of young workers was lower than that of older workers
Baker, Samkoff, Fisher, and Van Buren (1982)	148 fatalities in Maryland, 1978	The proportion of young workers in fatalities was lower than among the workforce
Buskin and Paulozzi (1987)	208 fatalities in Washington State construction, 1973–1983	The fatality rate of young workers was lower than the overall rate
Cryer and Fleming (1987)	952 male fatalities in New Zealand, 1975–1984	The fatality rate of young workers was not different from the overall rate
Davis, Honchar, and Suarez (1987)	348 female fatalities in Texas, 1975–1984	The fatality rate of young women was lower than the overall rate
Goldberg, Bernstein, Garabrant, and Peters (1989)	2483 fatalities in California, 1972–1983	The fatality rate of young men was higher than the overall rate
Harrison, Frommer, Ruck, and Blyth (1989)	1738 fatalities in Australia, 1982–1984	The fatality rate of young workers was lower than the overall rate
Bell et al. (1990)	42,000 fatalities in USA, 1980–1985	The fatality rate of young workers was lower than that of older workers
Hasselback and Neutel (1990)	83 fatalities among Canadian fishermen, 1975–1983	The fatality rate of young men was higher than that of older men
Norrish and Cryer (1990)	79 fatalities among New Zealand fishermen, 1975–1984	The fatality rate of young men was higher than the overall rate
Stout, Frommer, and Harrison (1990)	19,367 fatalities in Australia and United States, 1982–1984	The fatality rate of young workers was not different from older workers
Mikkola (1992)	986 fatalities in Finland, 1980–1989	The fatality rate of young workers was lower than the overall rate
Rafnsson and Gunnarsdóttir (1992)	108 fatalities among seamen in Iceland, 1966–1986	The mortality rate of young men was not different from the overall rate
Erlich, Driscoll, Harrison, Frommer, and Leigh (1993)	233 agricultural fatalities in Australia, 1982–1984	The fatality rate of young workers was lower than the overall rate
Matthiasen et al. (1993)	3709 fatalities in the Nordic countries, 1980–1989	The fatality rate of young women and men was lower than the overall rate
Rossignol and Pineault (1993)	1180 male fatalities in Quebec, Canada, 1981–1988	The fatality rate of young men was lower than the overall rate
Shannon, Hope, Griffith, and Stieb (1993)	470 fatalities in Ontario, Canada, 1986–1989	The fatality rate of young workers was lower than the overall rate
Toscano and Windau (1993)	6083 fatalities in the United States, 1992	The fatality rate of young workers was lower than the overall rate
Jenkins (1994)	3821 female fatalities in USA, 1980–1989	The fatality rate of young women was about the same as the overall rate
Kisner and Fosbroke (1994)	11,417 fatalities at U.S. construction sites, 1980–1989	The fatality rate of young workers was the same as that of older workers
Rossignol (1994)	70 fatalities in Quebec, 1986–1988	The fatality rate of young workers was lower than the overall rate
Toscano and Windau (1994)	6271 fatalities in the United States, 1993	The fatality rate of young workers was lower than the overall rate
Myers and Hard (1995)	6727 agricultural fatalities in the United States, 1980–1989	The fatality rate of young men was lower than the overall rate, whereas that of young women was the same
Barreto, Swerdlow, Smith et al. (1996)	146 fatalities in a Brazilian steel plant, 1977–1992	The fatality rate of young workers was not different from the overall rate
Ore and Stout (1996)	264 deaths in Australian and 4158 in U.S. construction industries, 1988–1991	The fatality rate of young workers was lower than the overall rate in both countries
Pratt, Kisner, and Helmkamp (1996)	8502 machinery fatalities in United States, 1980–1989	The fatality rate of young workers was lower than the overall rate
Stout, Jenkins, and Pizatella (1996)	5700 fatalities in the United States, 1989	The fatality rate of young workers was lower than the overall rate
Castillo and Malit (1997)	15,571 fatalities in the United States, 1990–1992	The fatality rate of young workers was lower than that of older workers
Chi and Wu (1997)	1230 fatalities in Taiwan, 1989–1992	The fatality rate of young workers was lower than the overall rate
Loomis, Richardson, Wolf, Runyan, and Butts (1997)	2098 fatalities in North Carolina, 1977–1991	The fatality rate of young workers was lower than the overall rate

Table 2 (continued)

Source	Data	Result
Bailer, Stayner, Stout, Reed, and Gilbert (1998)	51,964 fatalities in the United States, 1983–1992	The fatality rate of young workers was lower than that of older workers
Chen and Fosbrooke (1998)	4659 construction fatalities in the United States, 1990–1994	The fatality rate of young workers was lower than the overall rate
Ore (1998)	139 female construction fatalities in the USA, 1980–1992	The fatality rate of young women was not different from that of older women
Rabi, Jamous, AbuDhaise, and Alwash (1998)	705 fatalities in Jordan, 1980–1993	The fatality rate of young workers was higher than the overall rate
Ruser (1998)	12,548 fatalities in the USA, 1992–1993	The fatality rate of young workers was lower than that of older workers
Castillo, Adekoya, and Myers (1999)	3531 agricultural fatalities in the United States, 1992–1996	The fatality rate of young workers was lower than the overall rate
Collins et al. (1999)	1021 forklift fatalities in the United States, 1980–1994	The fatality rate of young men was higher than that of older men
Day (1999)	98 farm fatalities in Victoria, Australia, 1985–1996	The proportion of young farmers was lower than in the population
Peek-Asa, Erickson, and Kraus (1999)	3692 fatalities in the retail industry, USA, 1992–1996	The fatality rate of young workers was lower than the overall rate
Schieche, Schmeling, Strauch, and Geserick (2000)	141 fatalities in Berlin, 1990–1995	The fatality rate of young workers was not different from that of older workers
Driscoll et al. (2001)	2413 fatalities in Australia, 1989–1992	The fatality rate of young workers was lower than the overall rate
Feyer et al. (2001)	709 work-related fatalities in New Zealand, 1985–1994	The fatality rate of young workers was lower than the overall rate
Jackson and Loomis (2002)	525 construction fatalities in North Carolina, 1978–1994	The fatality rate of young workers was higher than the overall rate
Thelin (2002)	150 farming and forestry fatalities in Sweden, 1988–1997	The proportion of young workers in fatalities was higher than in the workforce

The results of the review are presented separately for fatalities versus less serious injuries. This is done because the previous review (Salminen, 1996) has shown that the effect of age is different for fatality rate and for injury rate. Usually, the injury or fatality rate of young workers was compared to the overall rate of injuries or fatalities, although this rate included also the rate for young workers. It was not possible to find the single rate for older workers in most of the studies.

The analysis of the results is based on the voting method in which every study is given one vote. Some articles presented results on both nonfatal and fatal injuries and they were calculated on both votes.

3. Results

With the abovementioned criteria, 63 studies on nonfatal injuries were found (see Table 1). The oldest one was Kossiris's study published in 1940 and the most recent one was from 2002. For 45 studies on fatalities, the time period was 21 years (1981 to 2002).

The studies on nonfatal injuries were from 18 countries (see Table 2). The three most often mentioned countries were the United States (22 studies), Sweden (9), and Canada (5). The studies on fatal injuries were from 13 countries. Most of the studies were from the United States (25 studies), Australia (5), and Sweden (3).

Table 3
Results of the review

Type of injury	Result			N
	Young had a higher rate (%)	No difference (%)	Young had a lower rate (%)	
Nonfatal	56	27	17	63
Fatalities	16	20	64	45
Nonfatal				
Men	70	15	15	26
Women	44	26	30	23
Fatalities				
Men	44	12	44	9
Women	17	50	33	6

The majority (56%) of nonfatal studies showed that young workers had a higher injury rate than older workers (Table 3). Only 17% of the studies showed an opposite result. The remaining 27% of these studies showed no difference between young and older workers.

There were 45 studies on fatal occupational injuries (see Table 3). The majority of them (64%) showed that young workers had a lower fatality rate than older workers. On the other hand, young workers had a higher fatality rate than older workers in 16% of these studies. One out of five studies found no difference in the fatality rate between young and older workers.

There may be gender differences in the injury rate, however. For nonfatal injuries, two out of three studies (70%) showed that young men had a higher injury rate than older men, whereas four studies found a negative result or no difference. Forty-four percent of the studies showed that young women had a higher injury rate than older women, whereas 30% of the studies indicated that young women had a lower injury rate.

In the case of fatalities, the results are more contradictory. Four studies showed that young men had a higher fatality rate than older men, and four other studies showed that young men had a lower rate. For women, half of the studies found no difference in fatality rate between young and older women. Two studies showed that young women had a lower fatality rate, and one showed a higher rate than older women.

4. Discussion

Before we discuss the results of this review, we must present some caveats. In most studies, the injury rate or fatality rate is based on the number of workers assuming full-time working. However, at least in Finland, many young people worked in part-time jobs. Secondly, young workers are less experienced in work than older workers, so that increases their injury risk (Root & Hoefler, 1979; Siskind, 1982). Thirdly, young workers should work on more dangerous jobs, although, for example, in Finland, the law of young workers prohibited dangerous jobs for young workers.

The first research question was: Do young workers have a higher risk of occupational injuries? The answer from this review is yes. The majority of studies on nonfatal injuries showed that young workers had a higher injury rate than the overall rate. This result is in line with previous reviews (Rhodes, 1983; Laflamme & Menckel, 1995; Salminen, 1996).

The second question was: Are the injuries of young workers more often fatal than those of older workers? The answer is no. The majority of studies on fatal occupational injuries showed that young workers had a lower fatality rate than older workers. This result is in line with previous reviews (Rhodes, 1983; Laflamme & Menckel, 1995;

Salminen, 1996). One explanation for this result is that young workers have a better impact resistance than older workers (Brorsson, 1989), so that the same impact that could kill an old worker would only injure a young worker. Young workers also recover from trauma better than older workers.

For industries, the highest number of studies (15) was done in agriculture. Mostly, they showed that young farmers had fewer accidents than older farmers. The second most popular industry was construction, with 10 studies. The results were divided more evenly, because two studies showed that young construction workers had a lower fatality rate than older ones, whereas two others showed contradictory results and yet two others found no difference between age groups.

The results of this review (see Table 3) showed consistently that young men had a higher injury rate than older men, as compared to young women versus older women. This result is in line with the earlier reviews showing that men had a three times higher injury rate than women (Salminen, Saari, Saarela, and Räsänen, 1992; Messing, Courville, Boucher, Dumais, and Seifert, 1994). This review thus confirmed that young men are a risk group for occupational safety.

The strength of this review is that it is based on a larger number of studies than previous reviews (Rhodes, 1983; Laflamme & Menckel, 1995; Salminen, 1996). Thus, the results of this review can be considered to be rather universal: it covers a time period of 62 years, 18 countries, and 5 languages. Most of the studies in this review were also peer-reviewed and published in well-respected journals.

The major problem of this review is related to the voting method. As every study has only one vote, the number of subjects and injuries in the study is ignored. This is unfair especially for the largest data set of this study (Jackson, 2001). In addition, the factor describing how much higher the injury rate of young workers was compared to that of older workers was not included in the measurement.

An interesting contradiction was found between general data set (Bull et al., 1999) and fisheries (Bull et al., 2001). The general data set showed that the injury rate of young men and women was lower than that of older workers, whereas in the fishing industry, the injury rate of young workers was higher than the overall rate. However, the data set from the fishing industry was subdata of the general data set. The small number of fishing injuries compared to the number of all injuries explained this contradictory, because the opposite results of the fishing industry disappeared into the general results.

For the industry, this review showed that young workers and especially young men were a higher risk group for occupational injuries. On the other hand, the injuries of young workers were less often fatal than those of older workers, because young workers resisted impacts better than older workers.

References

- Bailer, A. J., Stayner, L. T., Stout, N. A., Reed, L. D., & Gilbert, S. J. (1998). Trends in rates of occupational fatal injuries in the United States (1983–92). *Occupational and Environmental Medicine*, 55, 485–489.
- Baker, S. P., Samkoff, J. S., Fisher, R. S., & Van Buren, C. B. (1982). Fatal occupational injuries. *Journal of the American Medical Association*, 248(6), 692–697.
- Barreto, S. M., Swerdlow, A. J., Smith, P. G., Higgins, C. D., & Andrade, A. (1996). Mortality from injuries and other causes in a cohort of 21 800 Brazilian steel workers. *Occupational and Environmental Medicine*, 53, 343–350.
- Bell, C. A., Stout, N. A., Bender, T. R., Conroy, C. S., Crouse, W. E., & Myers, J. R. (1990). Fatal occupational injuries in the United States, 1980 through 1985. *Journal of American Medical Association*, 263(22), 3047–3050.
- Brisson, R. J., & Pickett, C. W. L. (1991). Nonfatal farm injuries in Eastern Ontario: A retrospective survey. *Accident Analysis and Prevention*, 23(6), 585–594.
- Brisson, R. J., & Pickett, C. W. L. (1992). Non-fatal farm injuries on 117 Eastern Ontario beef and dairy farms: A one-year study. *American Journal of Industrial Medicine*, 21, 623–636.
- Broberg, E. (1984). Use of census data combined with occupational accident data. *Journal of Occupational Accidents*, 6, 147–153.
- Brorsson, B. (1989). Age and injury severity. *Scandinavian Journal of Social Medicine*, 17, 287–290.
- Bull, N., Riise, T., & Moen, B. E. (1999). Occupational injuries reported to insurance companies in Norway from 1991 to 1996. *Journal of Occupational and Environmental Medicine*, 41(9), 788–793.
- Bull, N., Riise, T., & Moen, B. E. (2001). Occupational injuries to fisheries workers in Norway reported to insurance companies from 1991 to 1996. *Occupational Medicine*, 51(5), 299–304.
- Buskin, S. E., & Paulozzi, L. J. (1987). Fatal injuries in the construction industry in Washington state. *American Journal of Industrial Medicine*, 11, 453–460.
- Butani, S. J. (1988). Relative risk analysis of injuries in coal mining by age and experience at present company. *Journal of Occupational Accidents*, 10, 209–216.
- Castillo, D. N., Adekoya, N., & Myers, J. R. (1999). Fatal work-related injuries in the agricultural production and services sectors among youth in the United States, 1992–96. *Journal of Agromedicine*, 6(3), 27–41.
- Castillo, D. N., & Malit, B. D. (1997). Occupational injury deaths of 16 and 17 year olds in the US: Trends and comparisons with older workers. *Injury Prevention*, 3, 277–281.
- Cellier, J. -M., Eyrolle, H., & Bertrand, A. (1995). Effects of age and level of work experience on occurrence of accidents. *Perceptual and Motor Skills*, 80, 931–940.
- Chen, G. -X., & Fosbroke, D. E. (1998). Work-related fatal-injury risk of construction workers by occupation and cause of death. *Human and Ecological Risk Assessment*, 4(6), 1371–1390.
- Chi, C. -F., Chen, C. -L., & Lin, T. -Y. (2001). Risk for occupational injury of handicapped workers in Taiwan. *Perceptual and Motor Skills*, 93, 89–94.
- Chi, C. -F., & Wu, M. -L. (1997). Fatal occupational injuries in Taiwan—relationship between fatality rate and age. *Safety Science*, 27(1), 1–17.
- Cloutier, E., & Champoux, D. (2000). Injury risk profile and aging among Québec firefighters. *International Journal of Industrial Ergonomics*, 25, 513–523.
- Cloutier, E., David, H., & Duguay, P. (1998). Accident indicators and profiles as a function of the age of female nurses and food services workers in the Québec health and social services sector. *Safety Science*, 28(2), 111–125.
- Coleman, P. J., & Sanderson, L. M. (1983). Surveillance of occupational injuries treated in hospital emergency rooms—United States, 1982. *Morbidity and Mortality Weekly Report*, 32(2), 31–37.
- Collins, J. W., Landen, D. D., Kisner, S. M., Johnston, J. J., Chin, S. F., & Kennedy, R. D. (1999). Fatal occupational injuries associated with forklifts, United States, 1980–1994. *American Journal of Industrial Medicine*, 36, 504–512.
- Cryer, P. C., & Fleming, C. (1987). A review of work-related fatal injuries in New Zealand 1975–84—Numbers, rates and trends. *New Zealand Medical Journal*, 100, 1–6.
- Davis, H., Honchar, P. A., & Suarez, L. (1987). Fatal occupational injuries of women, Texas 1975–84. *American Journal of Public Health*, 77(12), 1524–1527.
- Day, L. M. (1999). Farm work related fatalities among adults in Victoria, Australia. The human cost of agriculture. *Accident Analysis and Prevention*, 31, 153–159.
- Dillingham, A. E. (1981). Age and workplace injuries. *Aging and Work*, 4, 1–10.
- Driscoll, T., Mitchell, R., Mandryk, J., Healey, S., Hendrie, L., & Hull, B. (2001). Work-related fatalities in Australia, 1989 to 1992: An overview. *Journal of Occupational Health and Safety, Australia and New Zealand*, 17(1), 45–66.
- Erlich, S. M., Driscoll, T. R., Harrison, J. E., Frommer, M. S., & Leigh, J. (1993). Work-related agricultural fatalities in Australia, 1982–1984. *Scandinavian Journal of Work, Environment and Health*, 19(3), 162–167.
- Feyer, A. -M., Langley, J., Howard, M., Horsburgh, S., Wright, C., Alsop, J., & Cryer, C. (2001). The work-related fatal injury study: Numbers, rates and trends of work-related fatal injuries in New Zealand 1985–1994. *New Zealand Medical Journal*, 114, 6–10.
- Findley, M. E., & Bennett, J. O. (2002). Safety the silver collar worker. *Professional Safety*, 47(5), 34–38.
- Firth, H., & Herbison, G. P. (1990). Occupational injuries in Dunedin. *New Zealand Medical Journal*, 103, 265–266.
- Fredin, H., Gerdman, P., & Thorson, J. (1974). Industrial accidents in the construction industry. *Scandinavian Journal of Social Medicine*, 2, 67–77.
- Goldberg, R. L., Bernstein, L., Garabrant, D. H., & Peters, J. M. (1989). Fatal occupational injuries in California, 1972–1983. *American Journal of Industrial Medicine*, 15, 177–185.
- Griew, S. (1958). A study of accidents in relation to occupation and age. *Ergonomics*, 2(1), 17–23.
- Hammer, W. (1994). Unfallgefährdung und -verhütung beim Gehen, Laufen, Tragen, Schieben und Ziehen im landwirtschaftlichen Betrieb. *Safety Science*, 17(2), 117–143.
- Hansen, H. L., Nielsen, D., & Frydenberg, M. (2002). Occupational accidents aboard merchant ships. *Occupational and Environmental Medicine*, 59(2), 85–91.
- Harrison, J. E., Frommer, M. S., Ruck, E. A., & Blyth, F. M. (1989). Deaths as a result of work-related injury in Australia, 1982–1984. *Medical Journal of Australia*, 150, 118–125.
- Hasselback, P., & Neutel, C. I. (1990). Risk for commercial fishing deaths in Canadian Atlantic provinces. *British Journal of Industrial Medicine*, 47, 498–501.
- Heiskanen, M. (1991). Work-related accidents. In M. Heiskanen, K. Aromaa, H. Niemi, A. Ruusinen, & R. Sirén (Eds.), *Accidents and violence 1988* (pp. 55–65). Oikeuspoliittisen tutkimuslaitoksen julkaisu 108. Oikeus 1991:8. Helsinki.
- Jackson, L. L. (2001). Non-fatal occupational injuries and illnesses treated in hospital emergency departments in the United States. *Injury Prevention*, 7(Suppl. 1), i21–i26.
- Jackson, S. A., & Loomis, D. (2002). Fatal occupational injuries in the North Carolina construction industry, 1978–1994. *Applied Occupational and Environmental Hygiene*, 17(1), 27–33.
- Jacobsson, B., & Schelp, L. (1988). One-year incidence of occupational injuries among teenagers in a Swedish rural municipality. *Scandinavian Journal of Social Medicine*, 16, 21–25.
- Jansson, B. R. (1987). The yield of systems for continuous and periodic injury surveillance in emergency care with emphasis on farm-work-related accidents. *Scandinavian Journal of Social Medicine*, 15, 247–252.

- Jenkins, E. L. (1994). Occupational injury deaths among females: The US experience for the decade 1980 to 1989. *Annals of Epidemiology*, 4(2), 146–151.
- Jensen, O. C. (1996). Work related injuries in Danish fishermen. *Occupational Medicine*, 46(6), 414–420.
- Jensen, R., & Sinkule, E. (1988). Press operator amputations: Is risk associated with age and gender? *Journal of Safety Research*, 19(3), 125–133.
- Kelsh, M. A., & Sahl, J. D. (1996). Sex differences in work-related injury rates among electric utility workers. *American Journal of Epidemiology*, 143(10), 1050–1058.
- King, H. F. (1955). An age-analysis of some agricultural accidents. *Occupational Psychology*, 29, 245–253.
- Kisner, S. M., & Fosbrooke, D. E. (1994). Injury hazards in the construction industry. *Journal of Occupational Medicine*, 36(2), 137–143.
- Kossoris, M. D. (1940). Relation of age to industrial injuries. *Monthly Labor Review*, 789–804.
- Laflamme, L. (1996a). Age-related accident ratios in assembly work: A study of female assembly workers in the Swedish automobile industry. *Safety Science*, 23(1), 27–37.
- Laflamme, L. (1996b). Age-related accident risks among assembly workers: A longitudinal study of male workers employed in the Swedish automobile industry. *Journal of Safety Research*, 27(4), 259–268.
- Laflamme, L., & Menckel, E. (1995). Aging and occupational accidents: A review of the literature of the last three decades. *Safety Science*, 21(2), 145–161.
- Laflamme, L., & Menckel, E. (1996). Age and occupational accidents in the light of fluctuations on the labor market: The case of Swedish non-ferrous ore miners. *Work*, 6, 97–105.
- Laflamme, L., Menckel, E., & Lundholm, L. (1996). The age-related risk of occupational accidents: The case of Swedish iron-ore miners. *Accident Analysis and Prevention*, 28(3), 349–357.
- Larsson, T. (1988). Risk and the inexperienced worker: Attitudes of a social anthropologist. *Journal of Occupational Health and Safety, Australia and New Zealand*, 4, 35–40.
- Lee, T., Anderson, C., & Kraus, J. F. (1993). Acute traumatic injuries in underground bituminous coal miners. *American Journal of Industrial Medicine*, 23, 407–415.
- Leigh, J., Mulder, H. B., Want, G. V., Farnsworth, N. P., & Morgan, G. G. (1990). Personal and environmental factors in coal mining accidents. *Journal of Occupational Accidents*, 13, 233–250.
- Lipscomb, H. J., Kalat, J., & Dement, J. M. (1996). Workers' compensation claims of union carpenters 1989–1992: Washington State. *Applied Occupational and Environmental Hygiene*, 11(1), 56–63.
- Loomis, D. P., Richardson, D. B., Wolf, S. H., Runyan, C. W., & Butts, J. D. (1997). Fatal occupational injuries in a Southern state. *American Journal of Epidemiology*, 145(12), 1089–1099.
- Lowery, J. T., Borgerding, J. A., Zhen, B., Glazner, J. E., Bondy, J., & Kreiss, K. (1998). Risk factors for injury among construction workers at Denver International Airport. *American Journal of Industrial Medicine*, 34, 113–120.
- Matthiasen, L., Jørgensen, K., Mikkola, K., Warren, S., Hagevik, M., Broberg, E., & Malmros, E. (1993). *Fatal accidents at work. Fatal accidents in the Nordic countries over a ten-year period*. Copenhagen, Denmark: Arbejdstilsynet.
- McCaig, L. F., Burt, C. W., & Stussman, B. J. (1998). A comparison of work-related injury visits and other injury visits to emergency departments in the United States, 1995–1996. *Journal of Occupational and Environmental Medicine*, 40(10), 870–875.
- Messing, K., Courville, J., Boucher, M., Dumais, L., & Seifert, A. M. (1994). Can safety risks of blue-collar jobs be compared by gender? *Safety Science*, 18(2), 95–112.
- Mikkola, K. (1992). *Kuolemaan johtaneet työtapaturmat 1975–1989* (Occupational fatal accidents 1975–1989). SVT Työmarkkinat 1992:23. Tampere: Työsuojeluhallitus.
- Myers, J. R., & Hard, D. L. (1995). Work-related fatalities in the agricultural production and services sectors, 1980–1989. *American Journal of Industrial Medicine*, 27, 51–63.
- Norrish, A. E., & Cryer, P. C. (1990). Work related injury in New Zealand commercial fishermen. *British Journal of Industrial Medicine*, 47, 726–732.
- Oi, W. Y. (1974). On the economics of industrial safety. *Law and Contemporary Problems*, 38, 669–699.
- Oleske, D. M., Brewer, R. D., Doan, P., & Hahn, J. (1989). An epidemiologic evaluation of the injury experience of a cohort of automotive parts workers: A model for surveillance in small industries. *Journal of Occupational Accidents*, 10, 239–253.
- Ore, T. (1998). Women in the U.S. construction industry: An analysis of fatal occupational injury experience, 1980 to 1992. *American Journal of Industrial Medicine*, 33, 256–262.
- Ore, T., & Stout, N. A. (1996). Traumatic occupational fatalities in the U.S. and Australian construction industries. *American Journal of Industrial Medicine*, 30, 202–206.
- Peek-Asa, C., Erickson, R., & Kraus, J. F. (1999). Traumatic occupational fatalities in the retail industry, United States 1992–1996. *American Journal of Industrial Medicine*, 35, 186–191.
- Pickett, W., Brison, R. J., Niezgodna, H., & Chipman, M. L. (1995). Nonfatal farm injuries in Ontario: A population-based survey. *Accident Analysis and Prevention*, 27(4), 425–433.
- Pines, A., Cleghorn de Rohmose, D. C., & Pollak, E. (1985). Occupational accidents in a hospital setting: An epidemiological analysis. *Journal of Occupational Accidents*, 7, 195–215.
- Pines, A., Lemesch, C., & Grafstein, O. (1992). Regression analysis of time trends in occupational accidents (Israel, 1970–1980). *Safety Science*, 15(2), 77–95.
- Pratt, D. S., Marvel, L. H., Darrow, D., Stallones, L., May, J. J., & Jenkins, P. (1992). The dangers of dairy farming: The injury experience of 600 workers followed for two years. *American Journal of Industrial Medicine*, 21, 637–650.
- Pratt, S. G., Kisner, S. M., & Helmkamp, J. C. (1996). Machinery-related occupational fatalities in the United States, 1980 to 1989. *Journal of Occupational and Environmental Medicine*, 38(1), 70–76.
- Rabi, A. Z., Al-Homran, W. K., AbuDhaise, B. A., & Alwash, R. H. (1996). Occupational permanent disabilities reported to the social security corporation in Jordan. *Safety Science*, 24(2), 111–119.
- Rabi, A. Z., Jamous, L. W., AbuDhaise, B. A., & Alwash, R. H. (1998). Fatal occupational injuries in Jordan during the period 1980 through 1993. *Safety Science*, 28(3), 177–187.
- Rafnsson, V., & Gunnarsdóttir, H. (1992). Fatal accidents among Icelandic seamen: 1966–86. *British Journal of Industrial Medicine*, 49, 694–699.
- Reich, M. R., & Frumkin, H. (1988). An overview of Japanese occupational health. *American Journal of Public Health*, 78(7), 809–816.
- Rhodes, S. R. (1983). Age-related differences in work attitudes and behavior: A review and conceptual analysis. *Psychological Bulletin*, 93(2), 328–367.
- Root, N. (1981). Injuries at work are fewer among older employees. *Monthly Labor Review*, 104, 30–34.
- Root, N., & Hoefler, M. (1979). The first work-injury data available from new BLS study. *Monthly Labor Review*, 102(1), 76–80.
- Rossignol, M. (1994). The case-fatality rate of occupational injuries: The effect of aging. *American Journal of Public Health*, 84(10), 1696–1697.
- Rossignol, M., & Pineault, M. (1993). Fatal occupational injury rates: Quebec, 1981 through 1988. *American Journal of Public Health*, 83(11), 1563–1566.
- Ruser, J. W. (1998). Denominator choice in the calculation of workplace fatality rates. *American Journal of Industrial Medicine*, 33, 151–156.
- Salminen, S. (1996). Work-related accidents among young workers in Finland. *International Journal of Occupational Safety and Ergonomics*, 2(4), 305–314.
- Salminen, S., Saari, J., Saarela, K. L., & Räsänen, T. (1992). Risk factors for women in serious occupational accidents. *Journal of Occupational Health and Safety, Australia and New Zealand*, 8(4), 341–347.
- Schelp, L., & Svanström, L. (1986). One-year incidence of occupational accidents in a rural Swedish municipality. *Scandinavian Journal of Social Medicine*, 14, 197–204.

- Schieche, C., Schmeling, A., Strauch, H., & Geserick, G. (2000). Tödliche Arbeitsunfälle in Berlin von 1990–1995 aus rechtsmedizinischer Perspektive. *Rechtsmedizin*, 10, 138–143.
- Schoemaker, M. J., Barreto, S. M., Swerdlow, A. J., Higgins, C. D., & Carpenter, R. G. (2000). Non-fatal work related injuries in a cohort of Brazilian steelworkers. *Occupational and Environmental Medicine*, 57, 555–562.
- Shannon, H. S., Hope, L., Griffith, L., & Stieb, D. (1993). Fatal occupational accidents in Ontario, 1986–1989. *American Journal of Industrial Medicine*, 23, 253–264.
- Siskind, F. (1982). Another look at the link between work injuries and job experience. *Monthly Labor Review*, 105, 38–40.
- Skov, O. (1994). The incidence of hospital-treated occupational hand injuries. *Journal of Hand Surgery*, 19B, 118–119.
- Smit, J. (1987). Bedrijfsongevallen in de metaalproduktenindustrie. *Tijdschrift voor Sociale Gezondheidszorg*, 65(6), 154–158.
- Sorock, G. S., Smith, E., & Hall, N. (1993). Hospitalized occupational finger amputations, New Jersey, 1985 and 1986. *American Journal of Industrial Medicine*, 23, 439–447.
- Stout, N., Frommer, M. S., & Harrison, J. (1990). Comparison of work-related fatality surveillance in the U.S.A. and Australia. *Journal of Occupational Accidents*, 13, 195–211.
- Stout, N. A., Jenkins, E. L., & Pizatella, T. J. (1996). Occupational injury mortality rates in the United States: Changes from 1980 to 1989. *American Journal of Public Health*, 86(1), 73–77.
- Thelin, A. (2002). Fatal accidents in Swedish farming and forestry, 1988–1997. *Safety Science*, 40, 501–517.
- Toscano, G., & Windau, J. (1993 (October)). Fatal work injuries: Results from the 1992 national census. *Monthly Labor Review*, 116, 39–48.
- Toscano, G., & Windau, J. (1994). The changing character of fatal work injuries. *Monthly Labor Review*, 117 (October), 17–28.
- Tsai, S. P., Bernacki, E. J., & Dowd, C. M. (1989). Incidence and cost of injury in an industrial population. *Journal of Occupational Medicine*, 31(9), 781–784.
- Webb, G. R., Redman, S., & Sanson-Fisher, R. W. (1992). Work injury experience at an industrial worksite. *Journal of Occupational Health and Safety, Australia and New Zealand*, 8(2), 143–153.
- Wigglesworth, E. C. (1976). Occupational injuries: an exploratory analysis of successful Australian strategies. *Medical Journal of Australia*, 1, 335–339.
- Wilkinson, W. E. (1987). Occupational injury at a Midwestern health science center and teaching hospital. *AAOHN Journal*, 35(8), 367–376.
- Wilkinson, W. E., Salazar, M. K., Uhl, J. E., Koepsell, T. D., DeRoos, R. L., & Long, R. J. (1992). Occupational injuries: A study of health care workers at a Northwestern health science center and teaching hospital. *AAOHN Journal*, 40(6), 287–293.
- Xiang, H., Wang, Z., Stallones, L., Keefe, T. J., Huang, X., & Fu, X. (2000). Agricultural work-related injuries among farmers in Hubei, People's Republic of China. *American Journal of Public Health*, 90(8), 1269–1276.

Simo Salminen received his PhD in Social Psychology from the University of Helsinki in 1997 and was nominated as an adjunct professor to the University of Helsinki in 2000. He has published over 40 peer-reviewed articles on occupational accidents and the social psychology of sport. Dr. Salminen was a researcher at the University of Helsinki in 1982–1987 and has been employed at the Finnish Institute of Occupational Health since 1988 and is now working as a senior researcher.