

# Occupational injuries to fisheries workers in Norway reported to insurance companies from 1991 to 1996

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Fisheries work is one of the occupations at highest risk for occupational accidents in many countries. It is necessary to understand the injuries in order to prevent them. This study of occupational injury claims by fisheries workers in Norway made to insurance companies from 1991 to 1996 analysed the workers' age, time of injury, injury type, part of the body involved, injury event and cost. The highest injury incidence rates were among the younger fisheries workers and during the winter months. Bruises and fractures were the most frequent injury types, and fingers and hands were most often affected, whereas falls and accidents related to machines were the most common causes. Safety measures should be taken on board to prevent falls and machine-related injuries, and young fisheries workers should have better on-the-job training.

**Key words:** Fisheries workers; incidence rates; occupational injuries.

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## Introduction

Fisheries workers (fishers) are reported to have one of the most risky occupations in many countries, regarding both fatalities and serious injuries [1–5]. In a study ranking job groups in Norway based on the occupational injuries reported to insurance companies, fisheries had the third highest annual cost per worker. The amount was \$269 (£180) versus a mean \$44 (£29) for all occupations [6]. The occupational death rate for Norwegian fisheries workers was 101 per 100 000 working years from 1980 to 1989 [7], versus 53 in Canada, 89 in Iceland, 143 in Australia, 170 in the UK, 200 in Alaska and 260 in New Zealand [1]. The time periods included in these studies varied, so the figures should be compared with caution. The occupational death rate for fisheries workers in the USA was estimated to be 40 times the national average in 1996 [8]. The number of fatal fisheries accidents decreased in Norway from 1970 to 1990, whereas serious accidents causing disability increased [7]. This increase was assumed to result from enhanced mechanization and increased economic pressure causing operations under

more severe conditions than before. This occurred despite increased attention to preventing injury, with the establishment of compulsory safety courses and occupational health services for fisheries workers.

Injuries among Norwegian fisheries workers are so numerous that measures should be taken to reduce them. An intervention was implemented among fisheries workers in Alaska, and the case-fatality rate fell from 24% in 1991 to 2% in 1994 [9]. The number of vessels lost remained constant, and the number of fisheries workers dying decreased dramatically [10]. This resulted from the use of immersion suits and life rafts that kept workers afloat and warm until they could be located via emergency radio beacons.

Intervention studies are most successful when the knowledge about the subject is adequate. The aim of this study was, therefore, to characterize the occupational injuries to Norwegian fisheries workers with regard to age, time of injury, type of injury, part of the body injured, injury event and cost so that preventive measures can be implemented where they are needed most.

## Methods

An occupational injury in Norway is defined as an injury,

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disease or death caused by a sudden or unexpected work-related accident. The insurance companies in Norway report occupational injuries and diseases to the Association of Norwegian Insurance Companies, where claims exceeding 500 Norwegian kroner (NK; about £37) have been gathered in the Daysy database since 1991. The public authorities cover the basic expenses of occupational injuries, such as health care and sickness benefit. Any further expenses, such as loss of future income and expected expenses from the injury in the future, are covered by private occupational insurance. The injuries included in the database are thus a selection of the more serious ones. Injuries for the period 1991–1996 were included in this study. Later years were excluded because of a delay in the statement of claims. The amounts are presented in GBP, and the exchange rate used is 1 GBP = 13.34 Norwegian kroner (4 April 2001).

Occupational groups were classified according to the Nordic Occupation Classification based on the 1958 version of the International Standard Classification of Occupations. Statistics Norway provided the number of fisheries workers and other work groups used in the denominator for calculating the incidence rates [11]. The figures for 1996 were not available because the occupational classification system was being revised. They were therefore extrapolated from the figures for 1995 plus 2.5%, which was the percentage increase in the total number of workers from 1995 to 1996. The numbers of fisheries workers in different age groups and the catches for various months were ascertained from *Fishery Statistics 1995–1996* provided by Statistics Norway [12]. The figures for age were limited to 1995 and 1996, and those for catches to 1995, and the analysis of data from Daysy was limited to the corresponding year(s) for these two variables. The injury rate for each age group was calculated by dividing the number of injured employees (numerator) by the number of fisheries workers (denominator) for each age group. The catch was used as the denominator in calculating the injuries per million tons of fish caught each month, to reflect the seasonal variation in workload. The Daysy database does not report the day of the week, and this parameter was therefore calculated

from the injury date using a conversion function in the SPSS statistics program (SPSS Inc., Chicago, IL).

The differences in injury frequency between age groups, between various days of the week and between various compensation groups were calculated using  $\chi^2$  tests. Incidence rates were calculated by dividing the number of occupational injuries for fisheries workers and other workers by the number of employees in these groups. The relative risk with 95% confidence intervals was estimated by comparing the rate of injuries between the fisheries workers and all the other occupations grouped together.

## Results

A total of 7459 occupational injuries were registered in the Daysy database for the years 1991–1996; 707 of these were among fisheries workers, and eight of these injuries involved women. This gives a rate of 7.6 injuries per 1000 workers per year. The highest injury rate was found in the 20–29 years age group, using the age distribution for 1995 and 1996 and the corresponding data from Daysy for these 2 years (Table 1). The injury rates decreased progressively with age above 30 years.

The highest numbers of injuries occurred from November to March and in May (Table 2). The injuries per million tons of fish caught showed the same seasonal pattern. They were dispersed relatively uniformly over the days of the week, but the fisheries workers had a higher proportion of the injuries during the weekends than did the other occupations (Table 3). Injuries were also dispersed more evenly over the hours of the day for fisheries workers than for other occupations (data not shown).

Bruises, fractures, cuts and sprains were the most frequent injuries among the fisheries workers. Bruises and cuts represented a higher proportion of injuries compared with the other occupations, as was the case for cardiac arrest as well (Table 4). Injuries to fingers, hand or wrist and chest or abdomen were much more frequent among the fisheries workers than among the other occupations (Table 5). Falls were clearly the most frequent injury event, with about the same relative frequency among

**Table 1.** Rates per 1000 working years and numbers (*n*) of occupational injuries for various age groups of fisheries workers calculated from injuries registered in the Daysy database for 1995–1996<sup>a</sup>

	Age group (years) <sup>b</sup>							Total
	16–19	20–29	30–39	40–49	50–59	60–66	67–69	
Injuries per 1000 working years	12.0	15.5	12.8	11.8	9.7	4.2	1.1	11.1
<i>n</i>	13	140	103	95	74	19	2	446

<sup>a</sup>A total of five (0.01%) were missing data for age.

<sup>b</sup>The difference in rates between the age groups was statistically significant ( $\chi^2$  test,  $P < 0.0001$ ).

**Table 2.** Number of injuries per month calculated from injuries registered in the Daysy database for 1995 and number of injuries per million tons of fish caught according to month<sup>a</sup>

Month	Number of injuries	Tons of fish caught	Injuries per million tons of fish caught
January	21	227 872	92
February	20	220 771	91
March	23	249 204	88
April	13	253 212	51
May	23	243 894	94
June	15	194 240	77
July	12	150 689	80
August	11	175 116	63
September	19	244 366	70
October	17	260 180	65
November	21	187 597	112
December	10	116 557	86

<sup>a</sup>No data were missing for this analysis.

fisheries workers as the other occupations (Table 6). The two injury events 'handling failure or loss of control of machine or vehicle' and 'caught in or lost grip of object' had a considerably higher frequency among the fisheries workers than among the other occupations. There were 63 (9.1%) injuries among fisheries workers with non-machinery tools in the category 'products involved in occupational injuries' versus 77 (1.5%) for the other occupations.

The incidence of injuries was higher among fisheries workers in all four groups of costs, but the relative distribution of costs differed significantly between fisheries workers and the other occupations. A higher proportion of injuries to fisheries workers were low in cost and a lower proportion were high in cost.

A significantly higher relative frequency of the injuries among fisheries workers were in the category of total costs less than £5000 and, correspondingly, a lower relative frequency in the category above £25 000 (Table 7). The total compensation paid or allocated for fisheries workers from 1991 to 1996 was £13 730 400, the mean was £19 000 and the median was £4600. For the other occupations, the total was £235 654 000, the mean £37 700 and the median £9900.

## Discussion

This study has shown that injury rates decreased with age for fisheries workers above 30 years, injuries were most frequent during winter months, and were more dispersed over the hours of the day and the days of the week than in other occupations. Falls and machine-related accidents were common, resulting most often in injuries to hands and fingers, chest and abdomen.

The decrease in injury rates with age is somewhat in

**Table 3.** Number of injuries and corresponding percentages according to the day of the week for fisheries workers and other occupations calculated from injuries registered in the Daysy database for 1991–1996<sup>a</sup>

Day of the week <sup>b</sup>	Fisheries workers		All other occupations	
	No. of injuries	%	No. of injuries	%
Monday	110	16	1272	19
Tuesday	123	17	1244	18
Wednesday	104	15	1219	18
Thursday	102	14	1160	17
Friday	103	15	1069	16
Saturday	88	12	421	6
Sunday	77	11	362	5
Total	707	100	6747	100

<sup>a</sup>A total of five (0.1%) were missing data.

<sup>b</sup>The distribution of injuries according to the days of the week differed between fisheries workers and the other occupations ( $\chi^2$  test,  $P < 0.0001$ ).

contrast to former studies among fisheries workers, which found no significant age trend related to either injury rates [4,13] or fatality rates [2,3]. A study of deaths and disabling injuries among fisheries workers in Norway showed increasing injury rates up to the age of 59 years and a decline thereafter [7], whereas a study by Grinde, which included less severe injuries among Norwegian fisheries workers, showed highest injury rates among the youngest workers [14]. The age trend for occupational insurance injuries in Norway including all occupations showed an increase in injury rates with age [15]. There may be a stronger healthy-worker effect among fisheries workers than among other workers, which explains the present findings. Employment as a fisheries worker requires good health and good work function, and individuals prone to accidents because of age would probably quit this type of work.

Injuries were most frequent during winter, and this tendency persisted after adjustment for catch, a correction that reflects both work time and workload. This seasonal variation, which has also been shown by Torner *et al.* in Sweden [13], has several possible explanations. During the winter in Norway, ice may cause slippery decks, which increases the risk for falls. In extreme cases, the vessel can be covered by ice and capsized. The possibility of survival in such cases or after falling overboard is lower during winter because the water is cold, and the chances of being rescued are also often reduced by rough seas and darkness [1]. Ship motion and dimness contribute to the increased risk of injuries on board the ship as well. Practical steps to reduce injury rates caused by climatic conditions include anti-slide layers on the deck, and the fastening of ladders and safety covers on dangerous machines. These are examples of measures that were successfully implemented on a number of Swedish fishing vessels after a visit

**Table 4.** Distribution of injuries according to type with numbers, percentages, incidence rates per 100 000 working years and relative risk (RR) with 95% confidence intervals (CI) for fisheries workers compared with other occupations calculated from injuries registered in the Daysy database for 1991–1996

<i>Type of injury</i>	<i>Fisheries workers</i>			<i>All other occupations</i>			<i>RR</i>	<i>95% CI</i>
	<i>No. of injuries</i>	<i>%</i>	<i>Incidence per 100 000 working years</i>	<i>No. of injuries</i>	<i>%</i>	<i>Incidence per 100 000 working years</i>		
Bruise	206	29	221.5	996	15	8.3	26	23–31
Fracture	105	15	112.9	1211	18	10.1	11	9–14
Cut	78	11	83.9	461	7	3.8	22	17–28
Sprain	72	10	77.4	1059	16	8.8	9	7–11
Amputation	22	3	23.7	381	6	3.2	7	5–11
Cardiac arrest	21	3	22.6	37	1	0.3	73	43–124
Strain	20	3	21.5	268	4	2.2	10	6–15
Other injury types	127	18	136.6	2260	33	18.8	7	6–9
Missing values	56	8	60.2	1081	16	9.0	7	5–9
Total	707	100	760.2	6752	100	56.2	13	12–14

**Table 5.** Distribution of injuries for various parts of the body with numbers, percentages, incidence rates per 100 000 working years and relative risk (RR) with 95% confidence intervals (CI) for fisheries workers compared with other occupations calculated from injuries registered in the Daysy database for 1991–1996

<i>Part of the body</i>	<i>Fisheries workers</i>			<i>All other occupations</i>			<i>RR</i>	<i>95% CI</i>
	<i>No. of injuries</i>	<i>%</i>	<i>Incidence per 100 000 working years</i>	<i>No. of injuries</i>	<i>%</i>	<i>Incidence per 100 000 working years</i>		
Fingers	133	19	143.0	626	9	5.2	27	23–33
Hand or wrist	85	12	91.4	406	6	3.4	27	21–34
Back	84	12	90.3	1068	16	8.9	10	8–13
Ankle or foot	71	10	76.3	484	7	4.0	19	15–24
Shoulders or arms	67	10	72.0	721	11	6.0	12	9–15
Chest or abdomen	50	7	53.8	77	1	0.6	83	58–119
Hips, legs or knees	47	7	50.5	685	10	5.7	9	7–12
Other body parts	74	11	79.6	1447	21	12.0	7	5–8
Missing values	96	14	103.2	1238	18	10.3	10	8–12
Total	707	100	760.2	6752	100	56.2	13	12–14

**Table 6.** Distribution of injury events with numbers, percentages, incidence per 100 000 working years and relative risk (RR) with 95% confidence intervals (CI) for fisheries workers compared with other occupations calculated from injuries registered in the Daysy database for 1991–1996

<i>Injury event</i>	<i>Fisheries workers</i>			<i>All other occupations</i>			<i>RR</i>	<i>95% CI</i>
	<i>No. of injuries</i>	<i>%</i>	<i>Incidence per 100 000 working years</i>	<i>No. of injuries</i>	<i>%</i>	<i>Incidence per 100 000 working years</i>		
Fall	167	24	179.6	1680	25	14.0	13	11–15
Handling failure or loss of control of machine or vehicle	116	16	124.7	652	10	5.4	23	19–28
Caught in or lost grip of object	59	8	63.4	202	3	1.7	37	28–50
Struck by object	46	7	49.5	630	9	5.2	9	7–13
Collision	31	4	33.3	469	7	3.9	8	6–12
Other injury events	32	5	34.4	670	10	5.6	6	4–9
Missing values	256	36	275.3	2449	36	20.4	13	12–15
Total	707	100	760.2	6752	100	56.2	13	12–14

**Table 7.** Number of injuries, percentages and incidence rates per 100 000 working years according to total cost for fisheries workers and other occupations calculated from injuries registered in the Daysy database for 1991–1996<sup>a</sup>

Total cost (£) <sup>b</sup>	Fisheries workers			All other occupations		
	No. of injuries	%	Incidence per 100 000 working years	No. of injuries	%	Incidence per 100 000 working years
<5000	357	51	383.9	2315	34	19.3
5000–25 000	235	33	252.7	2066	31	17.2
25 000–50 000	43	6	46.2	764	11	6.4
>50 000	72	10	77.4	1607	24	13.4
Total	707	100	760.2	6752	100	56.2

<sup>a</sup>No data were missing in this analysis.

<sup>b</sup>The distribution of injuries according to total cost was statistically significant different between fisheries workers and the other occupations ( $\chi^2$  test,  $P < 0.0001$ ).

on board that presented a survey of injuries, including the economic consequences, combined with a safety inspection [13].

Fisheries workers at sea are on duty at all hours and during weekends, which is reflected in the dispersal of the time of occurrence of the injuries. Working hours are not regulated by law for fisheries workers as they are for workers ashore, and long working hours and lack of rest for periods during fishing are problems. Grinde showed that the fisheries workers with the longest working hours had more than three times as many injuries as those with the shortest working day [14]. Some shipowners have good experience in trying to solve this problem by using relief crews [16].

Bruises and cuts were more common among fisheries workers than among other occupations in our study, and these were also the two main types of injury in a study of fisheries workers in Denmark [4]. The high proportion of bruises is in accordance with the study of accidents in Norwegian fisheries [7], where the main causes of disabling injuries were crushing or a blow by fishing gear, machinery, etc., and falls. Falling and slipping injuries were recently analysed among fisheries workers in Denmark, where they constituted 61% of all sprains and strains and 62% of all injuries to the chest [17]. Our study showed that, next to falls, handling failure or loss of control of a machine or vehicle was the most frequent injury category. A study of serious occupational injuries in Swedish fisheries reports falls, cuts and getting caught in mechanical equipment as important hazards [18]. The frequent occurrence of injuries to hands, and fingers in particular, is typical of injuries to fisheries workers [4,14,18] and is associated with the injuries related to machines and mechanical equipment mentioned above, as well as the high incidence of injury seen in this study with non-machinery tools such as knives and fishhooks. The exceptionally high relative risk of injuries to the chest or abdomen may result from blow injuries caused by ship

motion, which also may increase the risk for machine-related injuries. Mounting handles to catch hold of at or near dangerous positions as well as emergency switches are possible preventive measures. The high risk of cardiac arrest compared with other occupations is mainly caused by drowning.

The higher proportion of low-cost injuries among fisheries workers compared with other occupations in this study may result from more frequent but less severe injuries in fisheries or, alternatively, a culture in which less serious injuries get reported more frequently. The fisheries workers still had an increased risk of injuries at all cost levels, and they are the third highest job group based on average annual insurance cost per worker and fourth in total annual insurance cost for injuries and diseases [6]. The cost of an injury is usually many times higher than the cost of the measure that could prevent the injury [13], which shows that it is economical for both the employer and society to reduce the number of these injuries.

Missing data for type of injury, body parts and injury events is a limitation for the analysis in this study. Under-reporting of injuries was a problem for the first few years after the new Occupational Injury Insurance Act came into force, but the main injury data, such as age, gender and injury type, were approximately evenly distributed over the period [15]. The numbers of fisheries workers used as the denominator in calculating injury rates for various age groups include self-employed fisheries workers, and ship's engineers and cooks, whereas these groups are not included in the numerator. These injury rates are hence probably underestimated.

In conclusion, young fisheries workers are at particular high risk of occupational injuries, which can potentially be prevented by better on-the-job training, closer follow-up of experienced workers and reduced demands for efficiency from beginners. In addition, several safety measures should be taken on board to prevent falls and machine-related injuries.

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