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Self-reported injuries among seafarers
Questionnaire validity and results from an international study

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Abstract

International surveys of occupational injuries among seafarers have so far been missing. It was the aim to test the method of self-report of injuries and length of time at risk during the latest duty period and second to study the injury incidence rate among seafarers by use of the method.

A pilot study was conducted ($n = 1068$) in Finland, Denmark, the Philippines, Croatia and Spain using self-completed questionnaires with questions about the person, the ship, the duration of latest duty period and injuries. The duration of the self-reporting duty period was in the Danish part compared with information from the crew register of the Maritime Authority. For seafarers from merchant ships in the Danish sub-study there was acceptable correspondence between the information from the seafarers and the Maritime Authority, but not when referring to ferries and non-specified types of ship. Unadjusted and adjusted injury incidence rates-ratios (IRRs) based on number of injuries per number of work hours were calculated.

Adjusted IRRs for ordinary seamen/officers: IRR = 2.43 (95% CI: 1.25–4.72); for age <35/35+ years: IRR = 1.97 (1.02–3.81); length of tour: 117 days or longer compared with <117 days: IRR = 0.46 (95% CI: 0.22–0.95); 57–70 working hours per week compared with <57 h: IRR = 1.26 (0.48–3.29), 71+ h compared with <57 h: IRR = 2.12 (0.84–5.36). Non-significant IRRs >1.00 were found for ships under 10,000 GT compared with larger ships and for own flagged ships compared with ships under flag of convenience.

In conclusion, more than 70 h of work per week was related to a higher rate of injuries for seafarers on merchant ships, but the result was not statistically significant. Self-report of the duration of the latest tour of duty is useful for seafarers from merchant ships with short-term employments, but not for ferries and other, non-specified types of ship with other or permanent employment.

Keywords: Seafarers; Injury; Accident; Self-report; Hours of work; Epidemiology

1. Introduction

This study is a part of a larger collaborative project: International Surveillance of Seafarers' Health and Working Environment with the general purposes: (1) to describe the working, living and health conditions of seafarers and the injury incidences and related determinants in an international context, (2) to raise awareness among seafarers, ship owners and their organizations about possible deficiencies in standards of occupational conditions, and (3) to achieve equal international standards for safety, work and living conditions for all seafarers.

The project has been developed since 1998 (Jensen et al., 2001). It is a surveillance system by use of self-completed questionnaires filled out by the seafarers before or after the health examination (health examinations are mandatory for all seafarers) The anonymous questionnaires contain the same questions for all, translated to the seafarers' languages. This part of the overall study concentrates on self-report of injuries within a self-reported period of being at risk.

Several papers have reported on the number of fatal occupational injuries among seafarers, but non-fatal injuries are only rarely reported in national and international publications. Among the latter are a Polish study based on self-reported questionnaires that found an annual 114.5 injuries per 1000 crew members (Tomaszunas et al., 1997). A Danish study based on crew reports to the navigator of

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Danish ships reported a monthly injury rate of 4.5% (5.7% for women, 4.3% for men) during work or leisure time on board (Kirk and Dahl, 1997). Both studies only allowed for calculation of cumulative incidence rates as percentages of injuries among the seafarers. The use of cumulative rates can only be used for a very general comparison of the injury risk between different strata of seafarers. Incidence rates based on the number of work days and hours in different strata of the population would give a greater opportunity for comparing rates over different strata (Rothman and Greenland, 1998).

In 1974 Goethe and Vuksanovic demonstrated the need for a uniform international registration of diseases and occupational injuries among seafarers (Goethe and Vuksanovic, 1995). On top of this, the ILO/WHO has pointed to the need for occupational injuries suffered on board ships to be registered internationally and for such registration also to include minor injuries that could under other circumstances have been of a more serious nature (ILO, 1993).

Occupational injury reporting to maritime authorities and insurance companies is expected to be fraught with some under-reporting. The degree of reporting injuries in shore-based industries varied from one industry to the other by 13–83% (Reilly, 1985). In the fishing industry only some 25% of the reportable injuries were actually reported (Jensen, 1996). Some of the major shipping companies register all injuries themselves and routinely calculate incidence ratio in proportion to the number of hours worked at sea. However, no common standard governs which injuries are included and how the time at risk is calculated. Seafarers are treated at hospitals all over the world and hospital registers can therefore hardly be used for international studies of seafarers' injuries. Highly different administrative routines for injury reporting are also not useful for comparable studies in international injury studies. Several studies have therefore resorted to the use of self-reported questionnaires (Jensen et al., 2001; Tomaszunas et al., 1997; Parker et al., 1994; Currie et al., 2002). Such studies have established risk periods retrospectively, e.g. injuries suffered during the last 3 years, the last year or the last week (Jensen, 1996; Braun et al., 1994; Zwerling et al., 1995). However, seafarers have most variable number of working days per year, and use of the latest period of duty would therefore provide a more precise picture of the time at risk.

A central issue of safety and health in seafaring is the relation between fatigue and human error. It is a widespread impression that a majority of injuries and vessel casualties are related to human error but recently it has been proposed that the link in the chain of events leading to an injury is fatigue (Baulk and Reyner, 2002). This relation has not been documented directly as an increased number of injuries with long working hours (McNamara et al., 2000). In a study of injuries in seafaring it is therefore natural to look for the option to study the relation between injuries and working time. And for this purpose injury rates based on weekly hours worked seems to be useful. The research questions in this study was: (1) to develop and evaluate a method for self-reporting of the injuries and self-reporting of the risk period during their latest tour of duty and (2) to test the hypothesis of a supposed relation between number of work hours per week and risk of injury (McNamara et al., 2000).

2. Material and methods

This study springs from an international comparative survey of seafarers' working conditions undertaken in collaboration between Denmark, Croatia, Finland, Spain and the Philippines (Jensen et al., 2001). The Danish data were collected over a 6-month period (1 February 1999 to 1 August 1999), the data for the other four countries over a 10-month period from 1 October 1999 to 1 August 2000. Inclusion criteria: All seafarers (fishermen not included) with at least one period of duty irrespective of type of ship. Data were collected from medical clinics randomly chosen within each of the five participating countries. The seafarers who came to get their mandatory health examinations were asked to fill in a short questionnaire while waiting for their examination, or as an exception after their examination. Anonymity was guaranteed by delivering the questionnaires to the consultation in a closed box before the health check. For registration of non-responders, those who refused to participate were asked to place the blank questionnaire in the same box as those who wanted to participate.

2.1. Data collection

The questionnaire, originally written in Danish, was translated into English, Finnish, Croatian and Spanish. Information obtained about the latest tour of duty included: age, gender, working hours per day and days per week (number of weekly working hours in the Danish part), ship type, flag state, tonnage, main work area, occupational position, duration of the latest tour of duty (dates of signing on and off plus duration in whole months and days) and whether the seafarer had suffered any injuries during this period. The length of the latest tour of duty was primarily calculated on the basis of the dates for signing on and off, and, where such dates were missing, on the basis of the duration in months and days as specified by the seafarer. Where both time indications were available, e.g. 3 months and/or 91 days, we used days for calculation of the duration of the tour.

If the seafarer had been injured, he/she was asked to give more definite information in terms of when the injury happened (date), where on the ship it happened, activity when injured, mechanism of injury (hit something, squeezed, etc.), type of lesion and injured body part. To estimate the degree of seriousness, there were questions on number of days with incapacity for work, treatment on board and/on shore and if he/she was still suffering discomfort.

2.2. Validation of duty period

A Danish sub-study was designed to assess the criterion validity about the information on the duration of the tour. Questionnaire data were compared with data covering the period 1 October 1996 to 18 January 2000 (to include long contracts) drawn from the crew registry of the Danish Maritime Authority (DMA) which contains up-to-date information on all signing on and signing off dates, ship registration letters and civil registry numbers supplied by the ship master or the shipping company. The civil registry numbers were used as the key to extract data on the duration of the latest duty period. When a single civil registry number matched with several duty periods, we used the duty period that best matched the period stated by the seafarer.

2.3. Statistical analysis

All injuries were included in the analysis except those cases where the informed date of injury was outside the informed tour of duty period. Poor correspondence between self-reported data and register data called for exclusion of passenger ferries and other kinds of ships in calculation of incidence ratios. Injuries reported to have been suffered during non-duty periods were excluded. Unanswered or wrongly ticked off questions were always analysed as missing values. Data were processed using Spss and Epi-info. Incidence rates for each stratum were calculated as IR = number of injuries/number of working hours during tour. Incidence rate ratios and 95% confidence intervals were calculated as: $IRR = IR_1/IR_2$ by use of Stata 7.0 for unconditioned incidence rate calculations. Multivariate analyses adjusting IRRs for co-variates were performed using Stata 7.0 for Poisson regression analyses (Stata Press, 2001).

The Poisson regression model has been found useful to model the number of counts of an event like occupational injuries during a given time interval, controlling for multiple risk determinants by use of the maximum-likelihood method (Rothman and Greenland, 1998; Hansen et al., 2002; Hoidrup et al., 2000).

In the Poisson regression model, a group of independent variables ($x_1, x_2, \ldots$) can be tested to see how well they, when put together, explain the dependent variable (like number of injuries in a sample). Looking at the time exposure x, taking K other exposures into account ($x_1, \ldots, x_k$), the expected value of the dependent variable INJ (number of injuries) is given by:

$$X e^{(\beta_0+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_k x_k)}$$

where X is the time exposure and x_1–x_k are other exposures whose influences on the dependent variable are estimated by use of $\beta_0, \ldots, \beta_k$. With other words, the incidence rate associated with the exposure $x_1, \ldots, x_k$ is:

$$e^{(\beta_0+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_k x_k)}$$

Consequently, the IRR for a one-unit change in x_j holding all other x's in the model constant is calculated by (Stata Press, 2001):

$$\frac{e^{\beta_0+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_j (x_{j+1})+\beta_k x_k}}{e^{\beta_0+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_j (x_j)+\beta_k x_k}} = e^{\beta_j}$$

In this study, the variables are: dependent variable = INJ (whether the seafarer had an injury during his/her latest tour of duty). X = the time exposure (total working hours during latest tour of duty).

In order to use independent variables with strong explanatory power in the multiple regression, only variables ($x_1, x_2, \ldots$) with a P-value <0.20 in the univariate analysis were included as co-variables in the multivariate analyses. These were: ($x_1, x_2, \ldots$) = occupational position, age, ship's tonnage, flag state, ship type, working hours a week, length of tour of duty in days, seafarer's nationality.

Table 1
Completion rates of the questions related to the length of the latest tour of duty, working hours and injury experience among seafarers from five countries[a]

	HR (n = 199) (%)	DK (n = 314) (%)	FI (n = 61) (%)	PH (n = 199) (%)	ES (n = 295) (%)	Total (n = 1068) (%)
Starting date (A)	90	74	80	93	94	86
Closing date (B)	89	73	77	95	81	84
A + B	87	72	74	92	80	81
Months (C)	92	55	8	97	58	54
Days (D)	79	71	67	71	39	62
C + D	76	41	3	70	32	37
C or D or both	95	86	72	98	64	83
Days, week (E)	87	–	77	90	93	86
Hours, day (F)	97	–	97	98	97	97
E + F	86	74[b]	75	90	91	84
Injured, yes/no	99	99	93	94	99	96

[a] HR = Hrvatska = Croatia, DK = Denmark, FI = Finland, PH = Philippines, ES = Spain.
[b] Specific question on number of weekly working hours in the Danish study.

Table 2
Agreement of the seafarer's information and the information from the crew register in the Danish Maritime Authority about the length of tour of duty by use of the day, month and year for signing on and off

	Total	Differences exceeded 10 days or more		Differences exceeded 1 month or more[a]	
		Number	(%)	Number	(%)
Container ship	39	2	5	6	15
Dry cargo ship	15	2	13	1	7
Bulk carrier	5	1	20	1	20
Ro/ro-ship	6	6	100	6	100
Passenger ship	25	21	84	19	76
Reefer	5	2	40	1	20
Tanker	15	5	33	3	20
Other vessel	52	24	46	25	48
Total	162	63	39	62	38

[a] Only month and year in the respective signing on and off dates were used.

3. Results

A total of 1119 eligible seafarers were identified in the five countries and 1068 of these filled in the questionnaire. The degree of questionnaire completion varied extensively between nationalities for questions concerning dates and number of months/days; Spanish data on months/days being particularly sparse (Table 1). Questionnaire completion varied from 74 to 98% for the other questions.

The Danish study showed acceptable agreement between the seafarers' and the Authority's information about day, month and year of signing on and signing off duties on ocean-going cargo ships, but discrepancies exceeded 10 days for seafarers employed on board ro/ro-ships (roll-on/roll-off ships with the cargo in trailers), passenger ferries and other kinds of ships in more local traffic ("other vessel") (Table 2).

Table 4
Mean values and standard deviations of hours of work per week and length of the latest tour in days for seafarers on cargo ships and tankers

Country	Length of tour (days)		Working hours per week			
			Officers		Non-officers	
	n	Mean (S.D.)	*n*	Mean (S.D.)	*n*	Mean (S.D.)
HR	149	165.6 (88.6)	86	74.6 (14.3)	44	62.9 (14.6)
DK	127	96.3 (97.5)	73	65.0 (21.9)	25	61.6 (13.2)
FI	9	34.7 (29.6)	5	68.0 (10.9)	3	71.3 (12.1)
PH	153	303.3 (159.2)	41	67.0 (14.3)	55	59.7 (15.4)
ES	177	121.7 (120.2)	114	66.5 (14.9)	59	66.4 (13.8)
Total	615	171.0 (144.1)	319	68.4 (16.8)	186	63.0 (14.5)

Participating countries differed significantly in terms of distribution of most of the variables (Table 3). Moreover, the duration of the working week and the length of the latest duty period also varied much between nationalities and positions on board (Table 4).

3.1. Incidence calculations

A total of 91 of 1068 participants had suffered an injury during their latest tour of duty. In 36 out of 61 cases (59%) where information was available, the injury resulted in 1 or more days of inability to carry out work (Fig. 1). Exclusion

Table 3
Characteristics among seafarers from five countries (in proportions)

		HR[a] ($n = 199$)	DK ($n = 314$)	FI ($n = 61$)	PH ($n = 199$)	ES ($n = 295$)	Total ($n = 1068$)
Gender	Women	0.00	0.05	0.50	0.00	0.06	0.06
Age	<40	0.46	0.42	0.46	0.75	0.37	0.48
Flag state	Study country[b]	0.34	0.95	0.92	0.05	0.69	0.59
Type of ship	Cargo	0.56	0.36	0.12	0.44	0.37	0.40
	Tanker	0.21	0.08	0.03	0.36	0.29	0.21
	Passenger ship/ferry	0.19	0.33	0.83	0.10	0.23	0.26
	Other vessel	0.05	0.24	0.02	0.10	0.12	0.13
Tonnage	<1000 GT	0.10	0.19	0.10	0.07	0.11	0.11
	1000–10000 GT	0.48	0.40	0.26	0.36	0.50	0.44
	10001–100000 GT	0.39	0.40	0.39	0.47	0.30	0.38
	>100000 GT	0.04	0.02	0.26	0.10	0.10	0.07
Position[c]	Officers	0.62	0.64	0.21	0.35	0.61	0.56
Main duties	Deck	0.49	0.43	0.17	0.46	0.50	0.45
	Engine room	0.37	0.30	0.08	0.32	0.30	0.31
	Service[d]	0.12	0.20	0.68	0.18	0.17	0.20
	Other	0.02	0.07	0.07	0.04	0.02	0.04
Injured ?	Yes	0.14	0.08	0.11	0.05	0.08	0.09

[a] HR = Hrvatska = Croatia, DK = Denmark, FI = Finland, PH = Philippines, ES = Spain.
[b] "Study country" is the country where the questionnaire was collected.
[c] Two possible categories: officers and non-officers.
[d] Including catering.

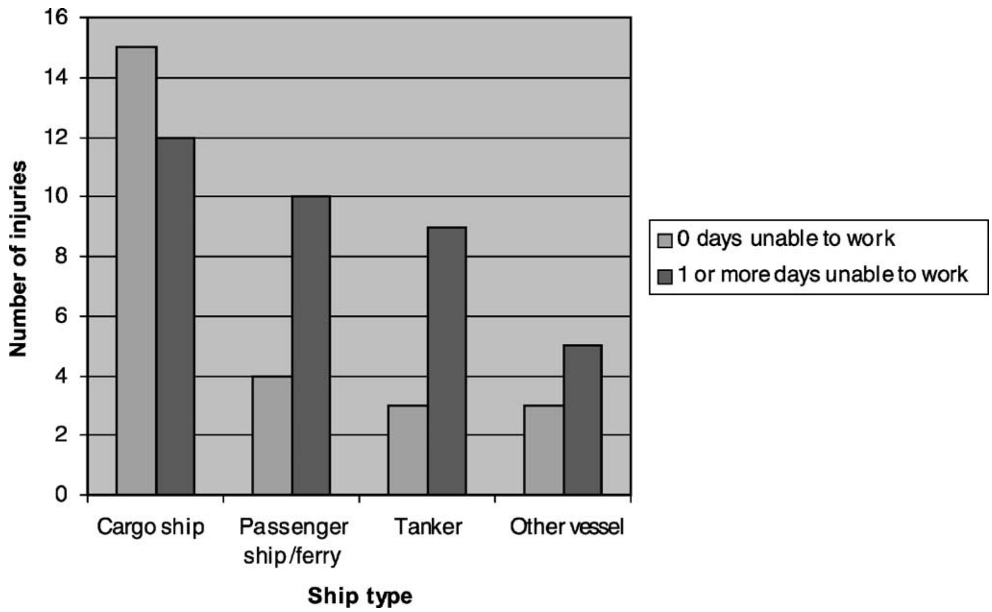

Fig. 1. Severity of self-reported injuries among seafarers expressed as number of days unable to work by type of ship (61 injuries).

of crew employed on passenger ferries and "other vessels" left 625 participants with 56 injuries. For 8 of these 56 cases, the informed date of injury lay outside the informed tour of duty period, leaving 48 injuries for the analysis of the injury incidence.

Among the 48 injuries available for analysis, 79% (35/44) had been treated on board or ashore and 30% (14/46) still suffered some sequela of the injury. The injuries included 11 contusions, 9 wounds, 6 sprains, 3 back injuries, 6 broken bones, 3 eye injuries, 5 other injuries (e.g. teeth or spectacles), and 5 injuries were not specified. Injuries were incurred during work in 41 cases, during leisure time on board in 2 cases, under other circumstances in 4 cases and 1 case was unspecified.

Tables 5 and 6 show the injury rate-ratios. Multivariate analysis showed increased incidence rate ratios (IRRs) for

Table 5
Unadjusted incidence rate-ratios and adjusted incidence rate-ratios by Poisson regression analysis relating main variables to seafarers' reports of having been injured during latest tour of duty

	Working hours	Observations	Injury cases	Unadjusted			Adjusted			
				IRR	95% CI	*P*-value	Observations	IRR[b]	95% CI	*P*-value
Position										
Officer[a]	431631	307	21							
Non-officer	311935	174	21	1.38	0.72–2.66	0.15	361	2.43	1.25–4.72	0.01
Age										
>34[a]	500270	340	24							
<35	305812	161	20	1.36	0.71–2.58	0.16	361	1.97	1.02–3.81	0.04
Area on ship										
Machine[a]	261843	180	14							
Deck	430445	263	25	1.10	0.54–2.26	0.41	321	0.79	0.38–1.64	0.53
Service	97201	44	4	0.77	0.18–2.45	0.27	155	0.77	0.18–3.26	0.72
Ship's GT										
>10000[a]	405212	250	19							
<10000	386576	226	24	1.32	0.70–2.56	0.18	361	1.39	0.70–2.77	0.35
Flag state										
Own flag[a]	230879	219	20	2.29	1.08–5.01	0.01	361	1.56	0.69–3.53	0.29
FOC-ships	343790	182	13							

Rates are based on seafarers' reported number of days and total hours of work on the latest tour. Passenger ships and unspecified types of ships are not included. Inclusion of co-variates in regression analysis if $P < 0.2$ in unadjusted analysis.

[a] Reference group.

[b] Adjusted for position, age, ship's GT (gross tonnage), flag state, type of ship, tour length, seafarer's nationality (Spain, Denmark, Croatia).

Table 6
Unadjusted incidence rate-ratios and adjusted incidence rate-ratios by Poisson regression analysis relating main variables to seafarers' reports of having been injured during latest tour of duty

	Working hours	Observations	Injury cases	Unadjusted			Adjusted			
				IRR	95% CI	*P*-value	Observations	IRR[b]	95% CI	*P*-value
Type of ship										
Tank[a]	294935	179	13							
Cargo	527137	331	31	1.33	0.68–2.78	0.19	361	1.04	0.48–2.23	0.92
Hours per week										
1–56[a]	250989	185	12							
57–70	228721	180	13	1.19	0.50–2.85	0.34	252	1.26	0.48–3.29	0.64
71+	342362	165	19	1.16	0.53–2.62	0.35	227	2.12	0.84–5.36	0.11
Length of tour (days)										
1–116	137625	240	21							
117+	334402	247	23	0.45	0.23–0.89	0.008	361	0.46	0.22–0.95	0.04
Nationality										
Philippines[a]	315903	112	6							
Spain	190292	160	10	2.77	0.91–9.26	0.02	173	0.46	0.09–2.22	0.33
Croatia	227712	135	19	4.39	1.69–13.44	0.0003	142	1.28	0.35–4.70	0.71
Denmark	85332	95	9	5.55	1.77–18.96	0.0007	88	0.47	0.00–192.3	0.81
Finland	2832	8	0							

Rates are based on seafarers' reported number of days and total hours of work on the latest tour. Passenger ships and unspecified types of ships are not included. Inclusion of co-variates in regression analysis if $P < 0.2$ in unadjusted analysis.

[a] Reference category.

[b] Adjusted for position, age, ship's gross tonnage (GT), flag state, type of ship, tour length in days, seafarer's nationality (Spain, Denmark, Croatia).

injuries during the latest tour of duty among non-offices compared with officers: IRR = 2.43 (95% CI: 1.25–4.72); age <35 compared with >35 years: IRR = 1.97 (1.02–3.81); length of tour: more than 117 days length compared with less days: IRR = 0.46 (95% CI: 0.22–0.95); working hours per week: 57–70 h per week compared with less than 57 h per week: IRR = 1.26 (0.48–3.29), 71 or more hours per week compared with less than 57 h per week: IRR = 2.12 (0.84–5.36) (Fig. 2).

Multivariate analyses also showed IRR <1.00 for work in the service area compared to work in the machine room. For ships <10,000 GT compared with larger ships and for own flagged ships compared with ships under flag of convenience IRRs were >1.00. Other nationalities compared to

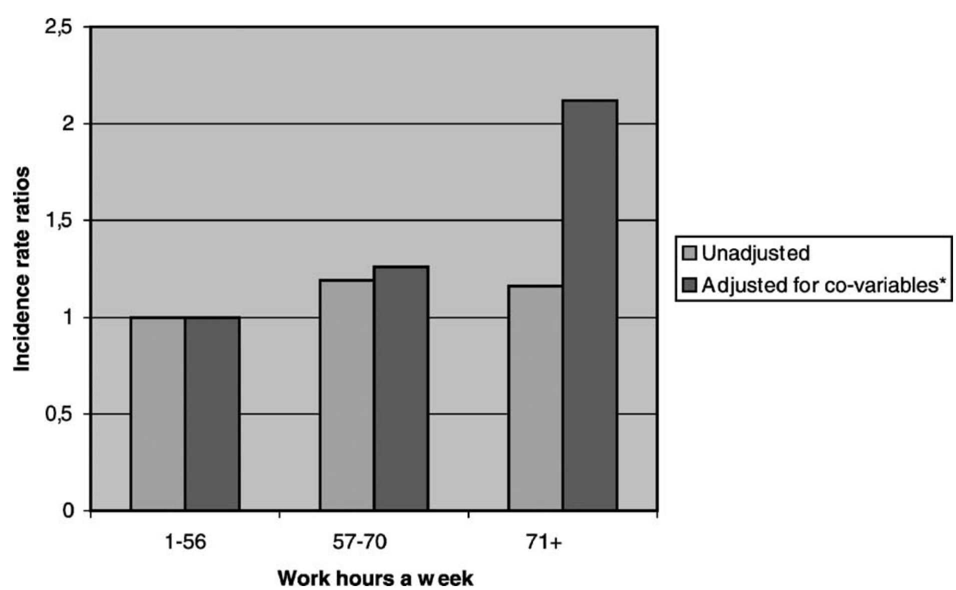

Fig. 2. Unadjusted and adjusted injury incidence rate ratios for cargo ships and tankers by weekly work hours ($N = 530$, 44 injuries). *Adjusted for: position (officer/not officer), age, tonnage, flag state (FOC/non-FOC), ship type (cargo ship/tanker), length of service tour in days and seafarer's nationality.

the Philippines differed with either higher or lower IRRs, but none of these differences were significant.

4. Discussion

This study describes the reliability of self-reported data on the duration of duty periods in a population of seafarers. Self-reporting appears to be a reliable method for measuring duty periods for ocean-going ships, but not for passenger ferries (including ro/ro-ships) and "other vessels". Increased IRRs were found for some of the variables, but the sample size of the study was too small to find out whether these effects were real. The medical clinics from the participating countries were chosen at random and we assume that the seafarers contacting these clinics constitute a random sample of the specific strata of seafarers attending the clinics. In Finland, for example, the main part of seafarers was from ferries and the sample reflects the seafarers from ferries only and not Finnish seafarers in general (Table 3).

4.1. Use of self-reported data on occupational exposure time

The self-reported period of occupational exposure was indicated in terms of dates for signing on and signing off duty and in terms of length of duty in months and days. The Danish sub-study found good correspondence between these data and register data for seafarers employed on ocean-going ships, but poorer correspondence for seafarers employed on the other ship categories included in the study. Complete correspondence, however, cannot be expected as inaccuracy may also befall data from the Danish Maritime Authority. Minor shifts in the duration of duty periods would not introduce any bias, as we expect such shifts to apply for all kinds of ships.

The poorer correspondence between duty periods for passenger ferries, ro/ro-ships and "other vessels" is expected to be rooted in these seafarers' employment, which is often on a contract basis, of a more permanent nature and with different kinds of duty rosters, e.g. 1 week on board and 1 week at home. This difference was reflected in the poorer questionnaire completion rate for duration of duty in Finland, where a large part of the seafarers were employed on board passenger ferries. Future studies will have to ask about the number of working months within the latest year for crew working on board such ships. Many seafarers employed in the Spanish commercial fleet did not sign off in connection with their health examination, which may have contributed to the poorer response rate for the duration of the duty period in this part of the population. The dates for signing on and signing off duty are listed in the discharge book or the duty contract for all seafarers and if possible the seafarers could use this information in future studies of this kind. Self-reporting on the duration of working hours has previously been found to be a feasible method in studies of occupational injuries and work-related diseases (Parker et al., 1994; Pratt et al., 1992). The clear discrepancy between the average number of weekly working hours in relation to type of ship, nationality and occupation on board (Table 4) testifies to the relevancy of computing incidences on the basis of working hours defined as time at risk.

4.2. Information on injury

All 48 injuries were used for incidence calculations, including those 10 injuries for which the date was only partially indicated. It may be difficult to remember the exact date of an injury, in particular if it was a minor injury, and a more simple method (e.g. month and year only) would therefore have to be devised for future studies.

4.3. Position and age

Non-officers were about twice as likely to suffer injury as officers and reports of similar patterns in other studies testify to the evidence of an association between risk and position on board, probably related to their different kind of work tasks. Reports filed to the Danish Maritime Authority in 1998 and 1999 showed a doubling of injuries among non-officers compared with officers (Søfartsstyrelsen, 2001). The incidence of injuries among Australian non-officers working on the deck and in the engine room was four to six times that of Australian officers working in the same areas (Patel and Wickramatillake, 1997). The results of these two studies were not adjusted for other variables, but a similar trend was found for occupational injuries reported to the Danish Maritime Insurance Company duly controlled for a number of confounders (Hansen et al., 2002).

Age specific incidence rates based on notified injuries in shore-based industries confirm a similar higher incidence for younger than for older age groups (European Agency for Safety and Health at Work, 2002).

4.4. Number of working hours and risk of injury

Although not significant, a dose–response relationship was observed with a longer working week being associated with a higher risk of injury (Table 6). No previous studies have demonstrated an association between excess risk and number of weekly working hours. A case-control study of agricultural injuries in children reported an odds ratio of 1.05 for each extra hour of work per week as expected, but it was not shown if there was an excess risk by any certain level of hours worked per week (Stueland et al., 2002). The European Community Directive on Working Time from 1993 was criticised and strongly opposed by some Member States (especially UK) due to lack of convincing evidence that hours of work should be limited on health and safety grounds (Dødelighed og erhverv i Norden, 1988). The extraordinary long work hours for seafarers compared to shore workers give the opportunity to study the effect of excess risk for injury with significantly longer work hours. More than 40% of the seafarers' total working hours during tour were spent in work schedules >71 h per week (Table 6). This may indicate a significant potential for reducing the number of injuries, based on the assumption that longer working hours is the main causal factor for reduced human alertness. But the increased risk of injury may also be caused by other factors such as quality of sleep and the work shifts. In a Finnish study the quality of sleep correlated significantly with work shifts that may indicate that the number of hours of work only explains part of the fatigue (Workload and ship safety, 1996). Assuming that the other determinants related to safety as sleep quality and work shifts are equally distributed among the different strata of working hours this will strengthen the hypothesis that long working hours have a significant impact for safety. This may probably have important impact not only for the personal safety but also for the ship's navigational safety. Similar assumptions may be extended to land transport such as truck drivers and other shore-based industries. Of 603 truck drivers, 21% reported less than 6 h sleep before their current journey, and nearly 40% reported dangerous fatigue events, such as near miss crashes that occurred on the journey (Arnold et al., 1997). Forty-seven percent of long-distance truck drivers reported that they had ever fallen asleep at the wheel of a truck and 25% had fallen asleep in the past year. Long working hours was only one of several significant predictors and reduction in the excessive work hours is only one of several relevant preventive measures (McCartt et al., 2000).

4.5. Duration of duty period

Duty periods of more than 116 days were associated with a decreased risk of injury in our study. This may to some degree be a result of underreporting due to difficulties of recalling injuries in the longer duty periods. In a recent Danish study the rate of injury decreased significantly after 15 days stay on board, but there was no clearly decrease with longer periods up to more than 90 days (Hansen et al., 2002).

4.6. Nationality

Due to high variation in the length of the duty periods among the nationalities and the following skewed memory about injuries in the past, injury rate-ratios among the four nationalities cannot be compared. Random errors in this small study have also an impact (Table 6). However, we cannot ascertain to which extent this was actually the case.

4.7. Conclusion

In conclusion this study confirmed the assumption of an association between the risk of injury and the number of weekly working hours, though not statistically significant. It confirmed that non-officers and young seafarers are at greater risk than others. The study has provided methodological insights applicable to international surveys of seafarers' occupational environment and the method of self-reported information is a feasible method. The questions used for the duration of the duty period were applicable for seafarers from ocean-going cargo ships, but not for ro/ro-ships, passenger ferries and "other vessels".

4.8. Implications for prophylaxis and future studies

The results underscore the need for paying more attention to the safety of occupational activities during long work hours that should not exceed recommended limits. The need for more attention to young seafarers' and non-officers' safety is also underscored. The relation of safety on board and weekly working hours should be studied more in detail in a large study sample. The impact of other factors such as the quality of sleep and the pattern of work shifts related to safety should be studied further. The impact of long working hours for health and social well being on board should also be studied. A specific method for measurement of the duration of duty for seafarers from ro/ro-ships, passenger ferries and "other vessels" is needed. Studies on the influence of working time for health and safety could be recommended for the land transport industry also.

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