UDC 656

ANALYSIS OF BACKGROUND FACTORS IN MARINE ACCIDENTS AND INCIDENTS CAUSED BY WATCH-KEEPER DROWSINESS IN JAPAN

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The purpose of this study was to perform a feature extraction of sleep and lifecycle characteristics among watch-keepers involved in marine accidents and incidents.

A questionnaire that included attributes of the watch-keeper, amount of sleep, problems related to sleep, fatigue, feeling hiyari-hatto incidents, and the Epworth sleepiness scale (ESS) was administered to a sample of 7,750 watch-keepers (response rate - 21.3%).

Watch-keepers have problems related to sleep, such as "once a month or more awaking while sleeping and cannot sleep afterwards", "once a month or more awaking too early in the morning and cannot sleep afterwards", "I have been told by my family and colleagues that I snore", and "I had my breathing stopped while sleeping". Some watch-keepers indicated "once a month or more feeling hiyari-hatto incidents"

The analysis of cargo ships and tankers revealed there was a notable relationship between the situation of "once a month or more feeling hiyari-hatto incidents" and the influence of each "frequency of interrupted sleep", "sleep delay", "frequency of interrupted sleep" and "early morning sleeplessness".

These results suggest that watch-keeper of each ship have problems related to sleep due to sleep and lifecycle characteristics.

Keywords : Accident analysis, Maritime Casualty, Doze, Sleep, Lifecycle

Introduction

Every year, numerous marine accidents caused by human errors occur at sea near Japan, resulting in casualties. These accidents have significant social, economic and environmental impacts. The proportion of dozing in all ship accidents is about 10% [1].Marine accidents caused by Watch-Keepers drowsiness accounts is increasing tendency.

Marine accidents that had been described to the judgment record of Japan Marine Accidents Inquiry Agency judgments between 1994 and 2003 were used for analysis [2-5].
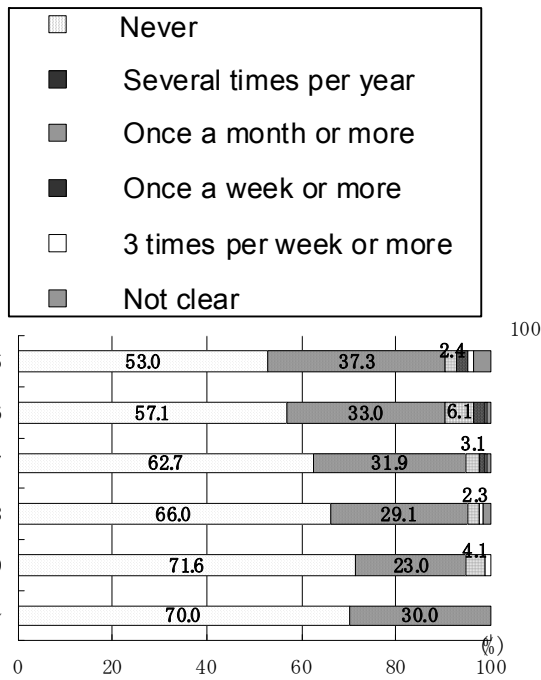
The purpose of this study was to investigate a feature extraction for occurrences of dozing among watch-keepers involved in marine accidents and incidents.

Questionnaire was administered to watch-keepers.

Methodology

A questionnaire that included attributes of the watch-keeper, amount of sleep, problems related to sleep, fatigue, feeling hiyari-hatto incidents, and the Epworth sleepiness scale (ESS)[6] was administered to a sample

Legend:
- □ Never
- ■ Several times per year
- ▨ Once a month or more
- ■ Once a week or more
- □ 3 times per week or more
- ▨ Not clear

~5: 53.0 | 37.3 | 2.4
5~6: 57.1 | 33.0 | 6.1
6~7: 62.7 | 31.9 | 3.1
7~8: 66.0 | 29.1 | 2.3
8~9: 71.6 | 23.0 | 4.1
9~: 70.0 | 30.0

(%)

of 7,750 watch-keepers (response rate: 21.3 %).

Sending of questionnaire:

(a) Fishing vessels Sent to Japan Fisheries Cooperatives (2,284 copies)

(b) Cargo ships, Tankers, other types of ship Sent to 383 offices (4,617 copies)

(c) Pleasure boats Sent to 703 owners of boat (Cooperated with Japan Sailing Federation)

Contents of questionnaire:

1. Property of Watch-keeper Age, Exercise times, Smoking, Alcoholic drinking

2. Situation of work Sea experience, Number of crew, Tonnage of ship, Shift of watch, Time of operating ship per day

3. Feeling hiyari-hatto (near miss) incidents (a situation deemed to bear the risk of marine accident occurring) by drowsiness in the past a year

4. Problems due to sleep duration of sleeping hours, Sleep delay, Frequency of interrupted sleep, Early morning sleeplessness, Snoring, Sleep apnea

5. The Epworth Sleepiness Scale (ESS)

The cross tabulation for the questionnaire results was conducted by the correlation analysis using Spearman's rank correlation coefficient, Pearson's chi-square test, Wilcoxon's rank sum test and Kruskal–Wallis test.

Results

Fig.1 shows "Near miss incidents in the past year and sleeping hours per day". The horizontal line represents rate of near miss incidents frequency. A
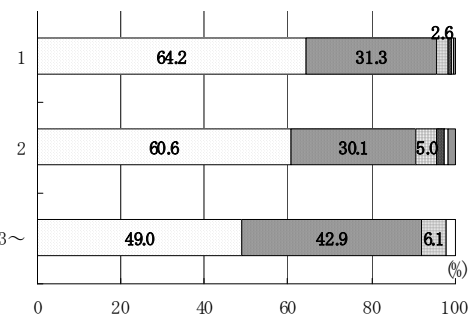
1: 64.2 | 31.3 | 2.6
2: 60.6 | 30.1 | 5.0
3~: 49.0 | 42.9 | 6.1

(%)

Fig. 2. Near miss incidents in the past year and frequency of sleep per day

~10: 64.4 | 30.5 | 2.1
11~30: 63.4 | 30.7 | 4.0
31~59: 58.1 | 30.8 | 5.7
60~120: 51.6 | 38.5 | 6.6
121~: 50.0 | 33.3 | 8.3

(%)

Fig. 3. Near miss incidents in the past year and sleep delay

Rarely: 69.3 | 26.7 | 2.0
Several times per year: 59.6 | 35.1 | 3.7
Once or twice a week: 63.1 | 30.7 | 4.0
Once or twice a week: 54.9 | 33.6 | 6.5
3 times per week or more: 46.7 | 37.7 | 7.4
Nearly every day: 61.0 | 31.7 | 6.1

(%)
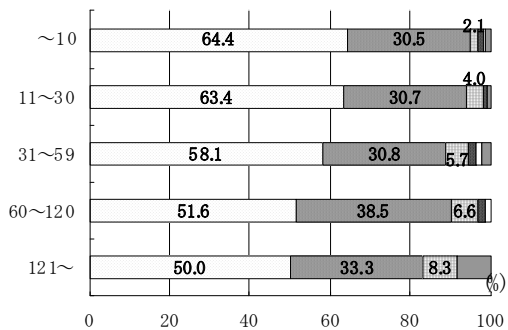
Fig. 4. Near miss incidents in the past year and frequency of interrupted sleep

legend of Fig.1 is applied in Fig.2-Fig.11.The vertical line represents duration hours of sleep per day яhours/1day).

As shown from this graph, the longer the duration of sleep, the fewer near miss incidents occur (p<0.01).

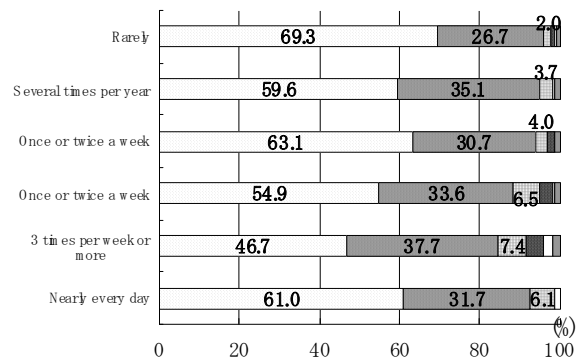Fig.2 shows "Near miss incidents in the past year and frequency of sleep per day". The vertical line represents frequency of sleep per day (times/1day).

As shown from this graph, the greater the frequency of sleep, the more near miss incidents occur (p<0.05).

Fig.3 shows "Near miss incidents in the past year and sleep delay". The vertical line represents sleep delay that is duration from going bed to sleep (min).

As shown from this graph, the longer the sleep delay, the more near miss incidents occur (p<0.01).

Fig.4 shows "Near miss incidents in the past year and frequency of interrupted sleep". The vertical line represents frequency of interrupted sleep.

As shown from this graph, the more frequent the occurrence of interrupted sleep, the more near miss incidents occur (p<0.001).

Fig.5 shows "Near miss incidents in the past year and frequency of early morning sleeplessness". The vertical line represents frequency of early morning sleeplessness.

As shown from this graph, the more frequent the occurrence of early morning sleeplessness, the more near miss incidents occur (p<0.05).

Fig.6 shows "Near miss

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incidents in the past year and snoring". The vertical line represents snoring frequency.

As shown from this graph, a higher frequency of snoring among watch-
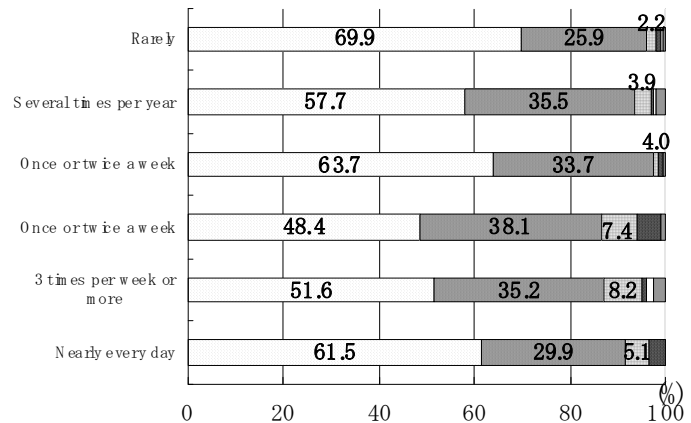

Fig. 5. Near miss incidents in the past year and frequency of early morning sleeplessness
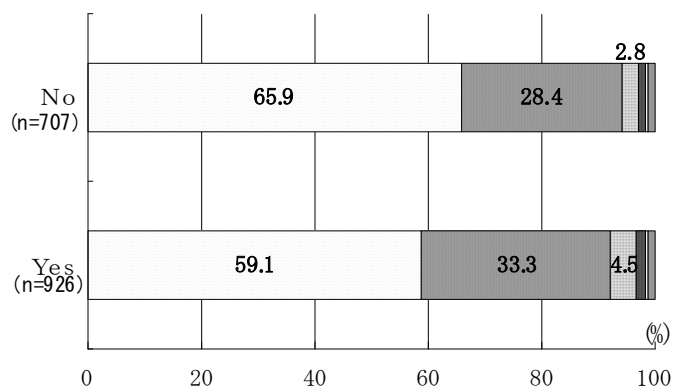

Fig. 6. Near miss incidents in the past year and snoring
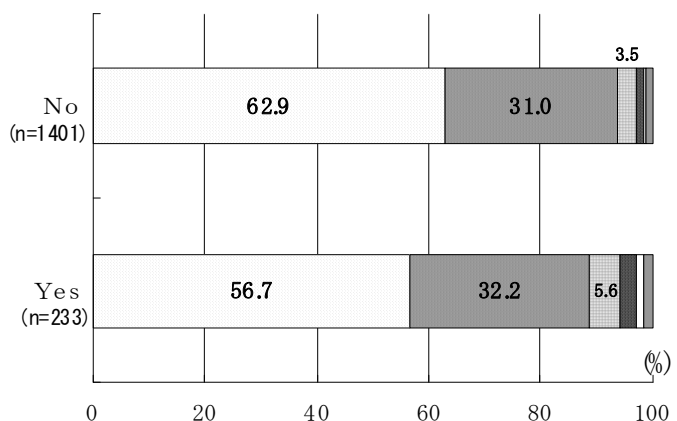

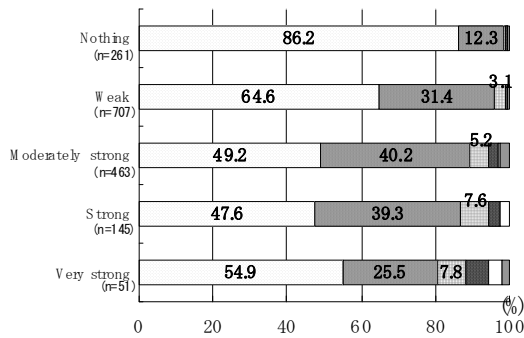Fig. 7. Near miss incidents in the past year and sleep apnea

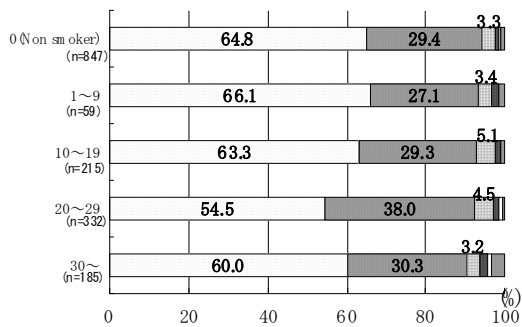Fig. 8. Near miss incidents in the past year and degree of tiredness

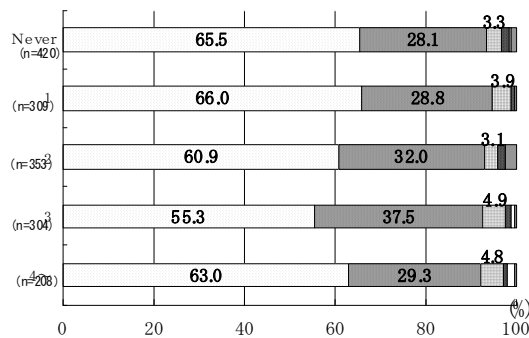Fig. 9. Near miss incidents in the past year and amount of smoking per day

Fig.10 Near miss incidents in the past year and amount of alcoholic drinks per day

keepers is associated with a greater number of near miss incidents ($p < 0.01$).

Fig.7 shows "Near miss incidents in the past year and sleep apnea". The vertical line represents sleep apnea frequency.

As shown from this graph, a higher frequency of sleep apnea among watch-keepers is associated with a greater number of near miss incidents ($p < 0.05$).

Fig.8 shows "Near miss incidents in the past year and degree of tiredness". The vertical line represents degree of tiredness.

As shown from this graph, the more frequent the occurrence of strong tiredness, the more near miss incidents occur ($p < 0.001$).

Fig.9 shows "Near miss incidents in the past year and amount of smoking per day". The vertical line represents amount of smoking per day.

As shown from this graph, the greater the amount of smoking, the more near miss incidents occur ($p < 0.01$).

Fig.10 shows "Near miss incidents in the past year and amount of alcoholic drinks per day". The vertical line represents amount of alcoholic drinks per day. Consumption of alcohol based on 1 drink = 350 mL beer.

As shown from this graph, the greater the consumption of alcohol, the more near miss incidents occur ($p < 0.05$).

Fig.11 shows "Near miss incidents in the past year and Epworth Sleepiness Scale (ESS)". The vertical line represents Epworth Sleepiness Scale (ESS) score category.

As shown from this graph, the greater the degree of sleepiness, the more near miss incidents occur ($p < 0.001$).

The vertical line represents type of operating ship (Fig.12-Fig.15).

Fig.12 shows "Frequency of sleep per day and type of operating ship". The horizontal line represents rate of frequency of sleep per day (times/1day).

As shown from this graph, about 70% of watch-keepers on Cargo ships and Tankers sleep two or more times per day ($p < 0.001$).

Fig.13 shows "Sleep delay and type of operating ship". The horizontal line represents duration of sleep delay (min).

As shown from this graph, about 40 or 50% of watch-keepers on Cargo ships and Tankers report sleep delay more than 31 min ($p < 0.001$).
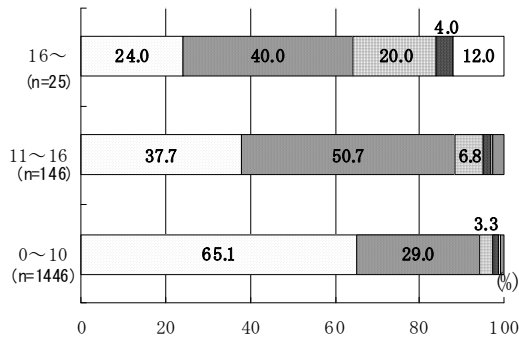
65

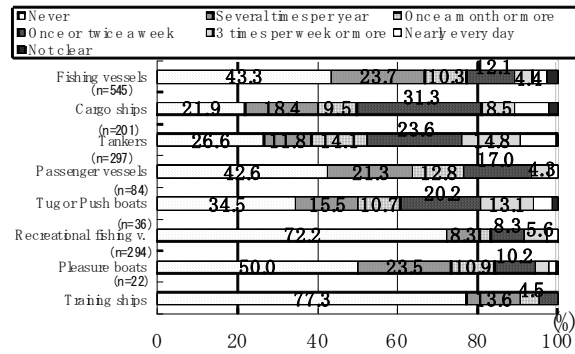Fig. 11. Near miss incidents in the past year and Epworth Sleepiness Scale (ESS)

Fig.12 Frequency of sleep per day and type of operating ship

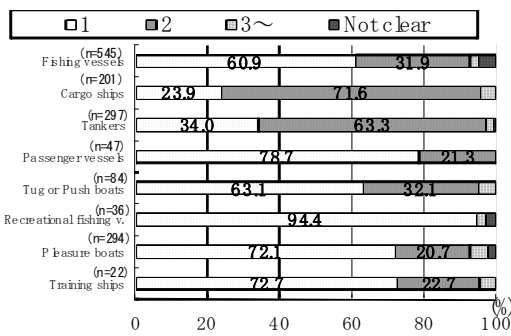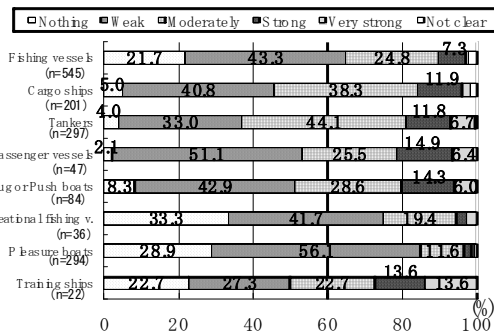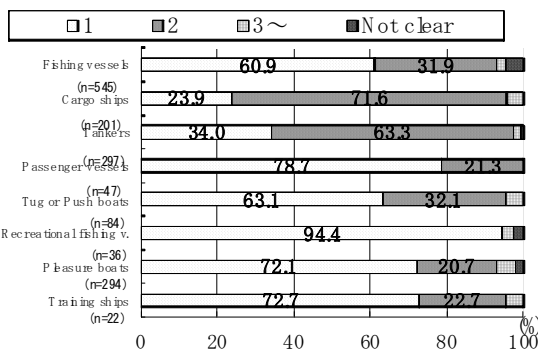**66**

Fig.13 Sleep delay and type of operating ship

Fig.14 shows "Frequency of interrupted sleep and type of operating ship". The horizontal line represents frequency of interrupted sleep.

As shown from this graph, Watchkeepers on Cargo ships and Tankers report a high frequency of interrupted sleep (p<0.001).

Fig.15 shows "Degree of tiredness and type of operating ship". The horizontal line represents degree of tiredness.

Fig.14 Frequency of interrupted sleep and type of operating ship

Fig. 15. Degree of tiredness and type of operating ship

As shown from this graph, Watchkeepers on Cargo ships and Tankers report a high percentage of strong degree tiredness (p<0.001).

Conclusions

Considering the circumstances mentioned above the risk factors of the near miss shows as follows, with significance level to each. Risk factors for near miss incidents are "Sleeping hours per day","Frequency of sleep per day", "Sleep delay", "Interrupted sleep", "Early morning sleeplessness", "Snoring", "Sleep apnea", "Degree of tiredness", "Amount of smoking ", "Amount of alcoholic drinks" and "Epworth Sleepiness Scale".

The analysis of cargo ships and tankers revealed there was a notable relationship between "Frequency of sleep per day" due to shift of watch and the influence of "Sleep delay", "Frequency of interrupted sleep" and "Early morning sleeplessness".

Consequently, these factors were

related to of "frequency of near miss incidents".

These results suggest that watch-keepers have problems related to sleep due to sleep and lifecycle characteristics.

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Резюме

АНАЛИЗ ОСНОВНЫХ ФАКТОРОВ, СВЯЗАННЫХ С ЗАСЫПАНИЕМ ВАХТЕННЫХ, ПРИВОДЯЩИХ К АВАРИЯМ НА СУДАХ В ЯПОНИИ

Синсукэ Урушидани, Тосики Кикучи, Тосикадзу Терасава, Юджи Сано

Проведен анализ основных особенностей режима труда, обусловленных несением вахт на судах различных типов (сухогрузы, танкеры, прогулочные суда и др.) по данным анкетирования 7750 моряков. Установлено, что вахтенные офицеры отмечают наличие проблем, связанных с различными видами нарушений сна (недостаточное общее время сна за сутки, нарушение регулярности в предоставлении времени для сна, лишение сна во время грузовых операций, прерывистый сон и др.). Показано наличие достоверной взаимосвязи между характером сна и частотой инцидентов, приводящих к аварийности на флоте.

Ключевые слова: анализ аварийности, морская авария, сон

Резюме

АНАЛІЗ ОСНОВНИХ ФАКТОРІВ, ПОВ'ЯЗАНИХ ІЗ ЗАСИПАННЯМ ВАХТОВИХ, ЩО ПРИЗВОДЯТЬ ДО АВАРІЙ НА СУДНАХ В ЯПОНІЇ

Сінсуке Урушидані, Тосіко Кікучі, Тосікадзу Терасава , Юджі Сано

Проведено аналіз основних особливостей режиму праці, обумовлених несенням вахт на судах різних типів (сухо-вантажі, танкери, прогулянкові судна та ін) за даними анкетування 7750 моряків. Встановлено, що вахтові офіцери відзначають наявність проблем, пов'язаних з різними видами порушень сну (недостатнє загальний час сну за добу, порушення регулярності у наданні часу для сну, позбавлення сну під час вантажних операцій, переривчастий сон та ін.) Показано наявність достовірної взаємозв'язку між характером сну і частотою інцидентів, що призводять до аварійності на флоті.

Ключові слова: аналіз аварійності, морська аварія, сон

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