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INVESTIGATION ON OCCUPATIONAL INJURIES IN THE JAPANESE FISHING INDUSTRY

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Abstract The fishing industry is important for food and economics in various countries. However, many workers in the fishing industry experienced occupational injuries such as work-related musculoskeletal disorders. Thus, situations and causes of occupational injuries in the fishing industry should be investigated for preventing these injuries. The Japanese Ministry of Health, Labour and Welfare has been publishing case reports of occupational injuries in various fields including the fishing industry. Investigation of these case reports will contribute the prevention of occupational health; however, it is difficult to evaluate these case reports since these reports consist of many text data with sentences. The text mining technique is an effective method to investigate many texts. Therefore, the objective of this study is to investigate case reports of occupational injuries in the Japanese fishing industry using the text mining technique. In this study, a total of 117 case reports of severe occupational injury that required more than 4 days of recuperation in 2017 were investigated by text mining technique. The results showed several causes of occupational injuries such as loss of balance, slipping on the ship, and hand or finger caught. These results indicate that improvements in environments or strategies related to balance, slip, and operation using hands should be considered for preventing occupational injuries in the fishing industry.

Keywords: Occupational injury; fishing industry; case reports; text mining technique.

1. INTRODUCTION

The fishing industry is necessary for food and economics in various countries [1–5]. Especially, the fishing industry is important in island countries such as Japan [3–5]. In addition, the fishing industry contributes to employment in many countries [2]. However, previous studies found that many employees had occupational injuries including musculoskeletal disorders [6–8]. To prevent these occupational injuries, details including the situation and cause of these injuries should be extracted.

Japanese Ministry of Health, Labour and Welfare has been publishing case reports of occupational injuries in various fields including the fishing industry [9]. Table 1 shows examples of case reports from the Japanese Ministry of Health, Labour and Welfare (Note that sentences have been translated Japanese to English for this table). As shown in Table 1, these case reports explain situation and cause of each occupational injury. These case reports might provide important information to prevent occupational injuries in the near future.

Commonly, it is difficult to evaluate many case reports since these reports consist of many text data with sentences. Previous reviews showed that text mining technique is suitable for big text data analysis [10, 11]. In addition, text mining technique was used for investigations about occupational

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injuries in construction workers and caregivers [12, 13]. Thus, this paper uses text mining techniques to analyze case reports of occupational injuries.

The objective of this study is to investigate case reports of occupational injuries in Japanese fishing industry using by text mining technique. In addition, goal of this study is to extract effective information that can be applied for prevention of occupational injuries among workers in the fishing industry.

Table 1. Examples of case reports for occupational injuries [9].
(Note that sentences have been translated from Japanese to English for this table.)

Example	Sentence in each report for occupational injury
1	*"During the process of washing deck, worker slipped; and he hit his face on edge of ship."*
2	*"Due to a sudden big wave, while removing the net on the ship, hand of worker was caught between floating ball and ship."*
3	*"Worker fell down due to lack of balance when he boarded on the ship because ship was shook by sudden wave."*

2. METHOD

2.1. Dataset

Case reports of occupational injuries provided from Japanese Ministry of Health, Labour and Welfare [9] were used for dataset of this study. Total of 117 case reports (between 1/1/2017 to 12/31/2017) related to the fishing industry (categorized by Japanese Ministry of Health, Labour and Welfare) were extracted for this study. Occupational injuries of these case reports required more than 4 days of recuperation for patients [9].

2.2. Software

The KH Coder [14] was used for text mining technique to analyze case reports. The KH Coder is software that implemented using the R programming language and the MySQL [15, 16]. The KH Coder is allowed to validify from third parties. Furthermore, the KH Coder was used for more than a thousand academic papers. Therefore, the KH Coder was selected as suitable software for text mining technique [15, 16].

2.3. Analysis

In this study, case reports were investigated by number of occurrences for each word, the co-occurrence network, and the self-organizing map (SOM). The co-occurrence network presents co-occurred words in each case report based on Jaccard coefficient [17]. Table 2 shows conditions for

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the co-occurrence network of this study. The SOM is a kind of artificial neural network; and the SOM can be used as unsupervised machine learning technique for text mining [18, 19]. In the SOM, words with similar reports are placed in closed distance. Table 3 shows conditions for the SOM of this study.

Table 2. Conditions of the co-occurrence network.

Specification/Parameter	Status/Value
Number of occurrences for each word	at least 5
Index for co-occurrence	Jaccard coefficient
Threshold of Jaccard coefficient for mapping	more than 0.2
Clustering	Ward method (Jaccard coefficient-based)

Table 3. Conditions of the SOM.

Specification/Parameter	Status/Value
Number of occurrences for each word	At least 5
Index for distance between words	Euclidean distance
Clustering	Euclidean distance-based
Neuron	Hexagon
Number of nodes for each edge	20

3. RESULTS

3.1. Co-occurrence network

Figure 1 shows the co-occurrence network obtained from analysis for all case reports (Note that words of this network have been translated from Japanese to English for this figure). Cluster including “fall accidents”, “slip”, and “foot” indicates the possibility that fall accidents due to slipping are descripted in case reports of occupational injuries. In addition, cluster including “wave”, “balance”, and “lost” suggests the possibility that lack of balance due to wave is the cause of occupational injury in the fishing industry. Furthermore, there are words related to injuries such as “injured”, “injury”, “pain”, and “disconnect” in several cluster including “hand” or “finger”. These clusters indicate that there are injuries on finger or hand in the fishing industry.

3.2. Self-organizing map (SOM)

Figure 2 shows the SOM obtained from analysis for all case reports. Table 4 shows the translated words (from Japanese to English) of the SOM. Clusters of the SOM are shown by numbers in Figure 2 and Table 4. Cluster 1 and cluster 3 containing “fall accident”, “slip”, “wave”, “lost”, and “balance” indicate that slipping or lack of balance due to wave are a cause of occupational injury. In addition,

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"fracture" in cluster 3 shows that fractures were caused by slipping and fall accidents. Cluster 7 and cluster 8 containing "hand", "finger" "rope", "wire", "net", and "roller" suggest possibility that these items are cause of injury on hands.

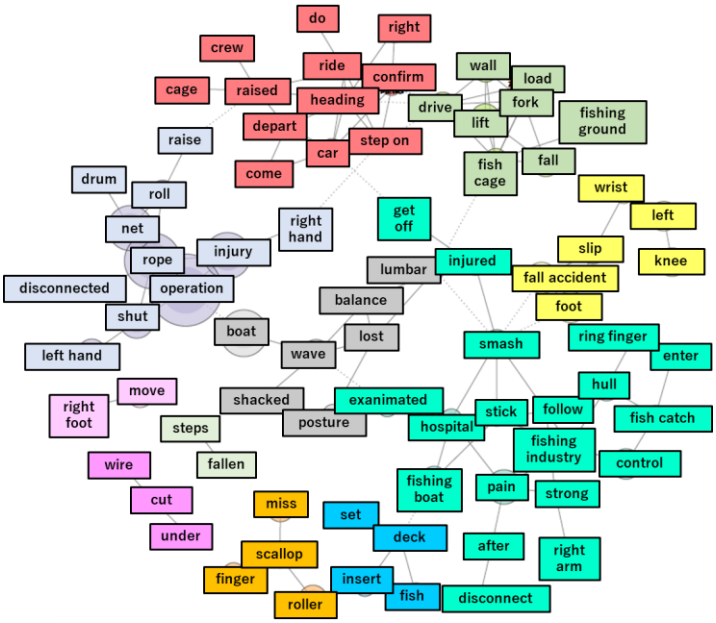

Figure 1. Co-occurrence network.
(Clusters are shown in segmented area with different color.
These words have been translated from Japanese to English for this figure.)

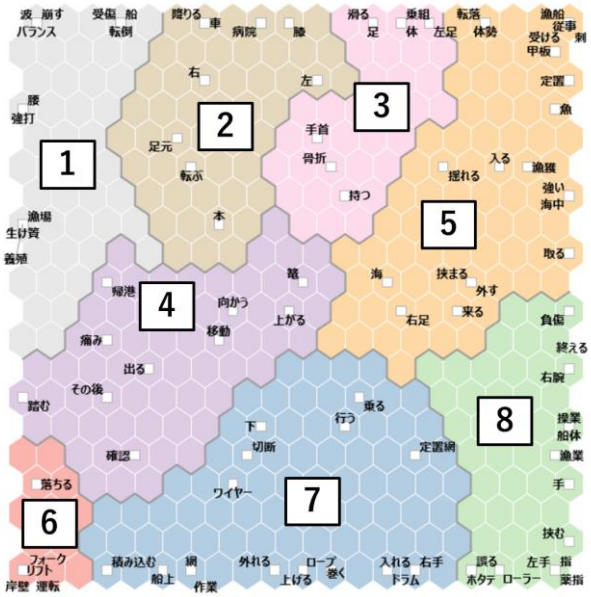

Figure 2. Self-organizing map (SOM).
(Clusters are shown in segmented area with different colors and numbers.
Translated English words of SOM are shown in Table 4.)

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Table 4. Translated words in the SOM (from Japanese to English).

	Cluster							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Words	wave	get out	slip	go back	fall	falling	under	injury
	break	car	foot	heading	posture	forklift	disconnect	end
	lumbar	hospital	body	cage	receive	wall	wire	right arm
	balance	knee	left foot	rise	fishing boat	driving	load	operation
	fishing ground	left	wrist	move	engagement		do	ship body
	smashed	right	fracture	depart	thorn		riding	fishing industry
	fall accident	fallen	handling	after	deck		fish net	hand
	injured	book	crew	confirm	shake		on ship	be caught
	ship	steps		step on	enter		net	finger
	fish cage			pain	into sea		operate	ring finger
	aquaculture				strong		be out	left hand
					get		rising	roller
					come		rope	mistake
					right foot		insert	scallop
					sea		right hand	
					get off		drum	
					set		roll	
					catch			
					fish			
					caught in			

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4. DISCUSSION

The results of both the co-occurrence network and the SOM showed that loss of balance due to wave and slipping caused fall accidents of fisherman. Fall accidents among fishermen have been reported by previous study from more than 10 years ago [20, 21]; however, the results of this study shows that these accident have not yet been improved. In addition, previous paper reported that various environments such as stair, dock area, and sandwiched between two ships have risks of fall accidents [22]. Furthermore, previous study indicated that posture and movement of workers should be improved for preventing fall accidents based on ergonomics and biomechanics [23]. Therefore, approaches for improvement of both environment and posture are necessary to prevent fall accidents among fishermen.

The results of both the co-occurrence network and the SOM indicated that finger or hand of fishermen be caught or smashed. These injuries have also been reported in previous studies [24, 25]; however, there is possibility that these injuries have not been prevented recently. The results of this study showed the possibility that injuries on finger or hand were caused by roller. Thus, future works should focus on improvement of operation with roller for preventing hand or finger injuries.

In this study, case reports of occupational injuries in the fishing industry were investigated by text mining technique. The results showed that occupational injuries among fishermen were caused by loss of balance due to wave, slipping, and operation using hand or finger. These findings of this study will contribute to prevent occupational injury among fishermen in near future.

The limitation of this study is that case reports were limited in fatal injuries such as fracture (required more than 4 days of recuperation). In the future works, other various injuries including non-fatal injuries should also be investigated and prevented for the fishing industry. For example, lower back pain due to heavy lifting and awkward postures is a kind of major occupational injury of the fishermen [26, 27]. Furthermore, the other limitation is that this study focused on only case reports for 1 years; thus, longitudinal investigations will be required for understanding trend of occupational injuries in the fishing industry. The text mining techniques were used in latest longitudinal investigations [28, 29]. In addition, previous study showed recommendation of several conditions for the text mining technique such as corpus size and document length [30]. In the future works, longitudinal investigations for occupational injuries among fishermen will be conducted based on these previous studies [28-30].

5. CONCLUSION

In this study, case reports of occupational injuries in the fishing industry were investigated by text mining technique. The results of text mining provided detail and situations of these injuries. Occupational injuries among fishermen were caused by loss of balance due to wave, slipping, and operation using hand or finger. These findings will contribute to prevent occupational injury among fishermen. In the future works, case reports of occupational injuries will be investigated longitudinally for several years. In addition, non-fatal injuries might be considered for occupational health.

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