INTRODUCTION

Vietnam is a marine country, with over 3260 km of coastline and a sea area 3 times larger than the land area. In recent years, our country's marine economy has been flourishing and growing strongly. The Party and the State have determined that the marine economy must become a spearhead economic sector of the country with an increasing proportion. With the potential of extremely rich marine economy, the marine economy has been attracting more and more labor force including laborers working in maritime industry.

The sea transport industry (maritime industry) is defined as an important economic sector and has great development potential. However, workers in this industry often have to live and work in very harsh and very specific conditions, for examples, living conditions, training, cultural and spiritual activities are very difficult and inadequate, daily diet is unbalanced [8], [19], [20], [54], [73] ... All adverse factors of the living and working environment on the ship have affected the health, work capacity and the occurrence of specific diseases found only in seafarers.

In recent years, shipbuilding technology has made a lot of progress, working conditions on ships have improved, so what is the actual working condition on ocean liners today? And how is its impact on health and the arising of specific occupational diseases? What are the advantages and disadvantages of health care situation for crew members? In order to answer these questions, it is necessary to research the topic with the following objectives:

1. Describe the current working conditions of crew members working on Vietnamese ocean transport ships from 2015 to 2018.
2. Describe the health status, the disease structure, a number of occupational diseases and relevant factors for Vietnamese seafarers.
3. Evaluate the results of intervention solutions by training knowledge and practical skills on health care and protection for seafarers mentioned above.

New contributions of the thesis

The thesis has identified disadvantages of working conditions for seafarers. The thesis also highlighted the characteristics of health, disease structure, occupational diseases as well as the effects of the long sea journey on the health and disease incidence of seafarers. Especially, the thesis has mentioned the status of knowledge and understanding of crew members about the dangers and harms of seafarers on health, proposed solutions and successfully applied a key solution of training knowledge, practical skills so that seafarers have the ability to take care of themselves and protect their health when at sea.

Layout of the thesis

The thesis consists of 151 pages (Introduction: 02 pages; Chapter 1: Literature review 36 pages; Chapter 2: Subjects and research methods 17 pages; Chapter 3: Research results 48 pages; Chapter 4: Discussion 46 pages, conclusions and recommendations 03 pages). There are 54 tables, 12 pictures. References: 154 (Vietnamese: 51, English: 102, French: 01). The appendix includes the research form and list of crew members participating in the study.

Chapter 1
OVERVIEW

1.1. Working conditions on ocean going ships

1.1.1. Working environment on ocean-going ships

Workers are exposed to a number of environmental impacts on board at the same time not only during work but also at rest, even during sleep, which include: microclimate environment on the ship; physical factors such as noise, vibration, ship shaking, electromagnetic waves and ultra-high frequency waves; chemical elements; biological factors; sudden changes across different climates; great difference of temperature between the positions on the ship.

1.2.2 Social conditions, labor organization and nutrition on ocean-going ships

- *Micro-social conditions on board:*

+ On the sea voyage, seafarers are separated from the daily social life on the mainland. All their activities and work are confined within the narrow space of the ship.

+ The micro-social environment on board is very special (only men).

+ The organization of labor when the cruise ships at sea often follow very strict regulations like that of the military, the activities are usually monotonous, repetitive, and boring.

- *Nutritional conditions on board:* The on-board menu is imbalanced causing metabolic disorders of Gluxit, Lipit, Protit, which will increase the risk of developing cardiovascular diseases, or/and diseases relating to blood pressure.

- *On-board sanitation:* the conditions for handling and maintaining the ship's hygiene while sailing at sea are much more difficult than when the ship is docked or on land, which is a favorable condition that makes the infection rate of the crew members quite high.

1.1.3. Health care for seafarers on ocean going ship

Seafaring is a special profession, with a long time of training and maturation, while the job contains many dangerous risks. Therefore, a lot of countries have been very interested in the work of health care and protection in order to extend the working age for seafarers.

- *The care and management of seafarers' health in countries around the world:* with special attention, several countries have built a maritime medicine major with a marine health organization system which has developed widely and is fully capable of ensuring care and health protection for laborers, people and the army at sea in peacetime as well as in wartime. International organizations such as ILO, WHO, IMO and IMHA have issued many international conventions relating to the protection, care and promotion of seafarers' health.

- *The care and management of seafarers' health in the country*: there are many shortcomings (the list of drugs and equipment is still incomplete and in line with the standards of the international marine labor convention; Many ships have not yet sent officers to take courses in marine medicine for deck officers, there are no trained personnel to take over the position of medical officers on board.) However, in recent times, there have been positive changes.

1.2. Health status and research situation of some occupational diseases of crew members working on sea-transport ships

1.2.1. Health characteristics of seafarers

Workers' health is a determinant of labor completion and productivity. Many seafarers do not yet have complete health conditions (as defined by the WHO). Most studies by domestic and foreign authors confirm that the working environment and marine life are the main factors affecting the quality of health and the occurrence of diseases and diseases with crew-specific occupational characteristics [19], [21], [48], [59], [62], [107]…. According to research by Seyed Khorsow Tayebati et al. [131], only 32 - 38% of the crew members were completely healthy and the remaining crew members had functional and pathological disorders (>60%). In addition, the mortality rate due to accidents at sea is also large [76], [137], [138], [141].

1.2.2. Studies on occupational diseases of ocean-going seafarers

Diseases of the circulatory system, diseases of the digestive system, trophic, endocrine, metabolic, behavioral and mental disorders are the most common diseases of seafarers and have been recognized as ones relating to the profession of crew members in many countries around the world.

1.3. Interventions to improve the health and prevent occupational nature diseases for seafarers

Interventions to improve the health and extend the working age of seafarers are currently being implemented in our country as well as some countries in the world include [37], [38], [50], [90]:

- Measures for organization and management of crew members' health:

+ Entrance health checkup when recruiting, periodic health check and health check before every trip

+ Increase equipment of medicine chest and medical instruments according to national and international standards

- Professional measures:

+ Strengthen training knowledge and practical skills for deck officers (in charge of health) in health care for crew members

+ Enhance training on first aid skills at sea for the crew.

+ Increase researching to limit the harmful effects of working conditions at sea to crew members' health.

+ Strengthen health education and communication activities for seafarers, such as: integrating some contents of health care into official training programs for officers and crew members; using leaflets and posters with contents of propaganda to protect the health.

Chapter 2
RESEARCHING SUBJECTS AND METHODS

2.1. Subject, place and time of research

2.1.1. Researching subjects

2.1.1.1. Working conditions on ocean going ship

Including 10 general cargo ships of 2 companies VOSCO and Vitranschart.

2.1.1.2. Health reality, disease structure, some of occupational nature diseases of seafarers and related factors

- *Group 1*: Including 400 crew members working on ocean-going vessels of companies registered for health management at Vietnam Maritime Medicine Institute. All seafarers are men and have been worked on ship for 2 years or more.
- *Group 2:* Consisting of 230 crew members who fully participate in the voyage on the 10 ships studied above.
- *Intervention group*: 115 crew members were randomly selected from 230 crew members in group 2 and agreed to participate in the intervention study.
- *Reference group*: Including 280 workers on the mainland, all of whom are men, of the same age as the research team who are working at a number of companies, offices and enterprises in Hai Phong to come for regular health checks at Vietnam Maritime Medicine Institute. This group was examined and measured the same criteria as the studing group 1 and was used as a reference group.

2.1.2. Research location*:* on ocean-going ships calling at Hai Phong Port, Cai Lan Port in Quang Ninh and at the Department of Medical Examination and Management of Marine Labor, Vietnam Maritime Medicine Institute.

2.1.3. Research period*: From 1/2015 to 12/2018.*

2.2. Research Methods

2.2.1. Study design and sampling

2.2.1.1. Research design

- Descriptive cross-sectional research combined with analysis to determine the reality of working conditions.
- Cross-sectional descriptive research combined with analysis to assess the health status and disease structure of seafarer crew members.
- Conduct longitudinal research and compare before and after (prospective) to assess some changes in health and pathological characteristics of crew members before and after a voyage (one year).
- Intervention research: training intervention solutions to improve crew's knowledge, practical skills on health and health care issues on ocean transport ships.

2.2.1.2. Selection criteria and sample size

❖ Sample size of ships to study working conditions on:

The ocean transport fleet of VOSCO and Vitranschart company includes 32 general cargo ships operating on ocean routes. We randomly selected 5 ships in each company to survey working conditions.

❖ Sample size of actual health status and structure of diseases and some occupational diseases of seafarers

Calculated according to the formula

$$n = \frac{Z^2_{1-\frac{\alpha}{2}}}{\varepsilon^2} pq$$

Plug the number into the formula to calculate n ≈ 381. To round off the actual number, the 400 crew members were examined.

❖ Sample size of crew members changing health and morbidity before and after a cruise

We took the entire crew members to fully participate in the voyage over 10 vessels under the study of 230 crew members

❖ Sample size for intervention research

Applying formula:

$$n = Z^2_{(\alpha,\beta)} \frac{p1(1-p1) + p2(1-p2)}{(p1 - p2)^2}$$

Substituting the data into the formula, we calculate n = 75. In fact, we conducted training interventions for 115 randomly selected crew members out of 230 crew members of 10 ships who were the second target of the study and agreed to participate in intervention research.

2.2.2. Content and some research variables

- Survey on working conditions on board, including

+ Investigation of working environment on ships (including microclimate environment and physical factors of stability, vibration and shock).

+ Survey on conditions of labor, living and hygiene on board (Appendix 4.5): conditions for cultural activities, physical activities on board; living room area; fresh water level used in daily life for each crew member m^3/person; Micro-social environment on board.

+ Investigate nutritional conditions on board by direct observation and interview.

- Studying the status of crew members' health: physical indicators, physiological function indicators (including pulse, blood pressure, ECG, blood biochemical indicators), clinical examination and diagnosis of diseases, studying psychological indicators.
- Studying the morbidity and disease structure of the crew members.
- Studying changes in the incidence of general diseases and occupational diseases before and after the voyage (after one year) of seafarers.

2.2.3. Some interventions to ensure the health of seafarer crew members

+ Intervention measures: health promotion education for crew members working on ocean-going ships including the following contents: education to improve knowledge and understanding about diseases such as hypertension, metabolic disorders (diabetes) diabetes, dyslipidemia, metabolic syndrome...), mental disorders in seafarers, so that it can change attitudes, behaviors, lifestyles and activities of seafarers, contributing to reduces the incidence of disease.

+ Intervention method

- Training to disseminate knowledge about the prevention and control of a number of specific diseases of seafarers to seafarers;
- Communication and education to enhance the knowledge and practice ability of crew members on measures to prevent and treat the above-mentioned specific diseases;
- Interview to evaluate the results of the intervention after the training and after the voyage.

+ Evaluation after the intervention

- Knowledge is correct when crew members answer correctly from 70 questions about knowledge.

- Practice reached when crew members performed ≥ 70% of the skills in the checklist.

Chapter 3
RESEARCH RESULTS

3.1. Characteristics of working conditions on Vietnamese ocean-going ships

3.1.1. Survey results of working conditions on ship

- ***Microclimate environment on ocean-going ships****:* The average temperature at all positions on the ship exceeded the enable standards, especially in the engine room (37.20^0 C/25^0 C).

- Noise level on ocean ships while being at the ports and in voyage at sea: In all positions are measured, only in the engine room is exceeding the enable standard, even when the ship are at ports is 94.21 ± 8.3 dBA and when cruises at sea (101.49 ± 8.81 dBA).

- The vibration level of the ship while being at ports and in voyage at sea: The vibration level of the ship when the ship are at ports is within the enable standards. When ship in voyage at sea, vibration level at engine room position is beyond the enable standard, vibration velocity at engine room is (13.23 ± 1.52) $x10^{-3}$(m/s).

3.1.2. Characteristics of living conditions of seafarers

- The living conditions such as accommodation, cultural and spiritual activities of seafarers are more difficults on mainland.

- Seafarers diets have a higher energy value than the energy standards for Vietnam's heavy labor. But the energy rate between foods is imbalanced (Lipids and Protein, Glucids is high, but fresh vegetables are very lacking). The majority of seafarers had a diet of excess energy and especially lack of fiber (79.25%).
- Up to 56.5% of seafarers smoke from moderate to severe level; 100% of seafarers drink alcohol, beer, of who 57.75% drink from moderate to high level; 51.25% of seafarers do not have physical training routine, the remaining 48.75% of seafarers have physical training but not regular.

3.2. Reality of health, disease structure of Vietnamese ocean-going seafarers

3.2.1. Characteristics of research subjects

- The average age of seafarers is 36.05 ± 7.65, the professional age is 12,69 ± 6,76.
- Distribution according to career titles: deck group 42%, engine group 37%, other groups (kitchen, catering) 21%.
- Distributed according to hierarchy: officers 34,75%, seafarers 65,25%

3.2.2. Characteristics of some physical criterias of the research subjects

- All physical criterias of seafarers (Height, weight, bust, waistline, BMI) are higher than labor group on mainland.

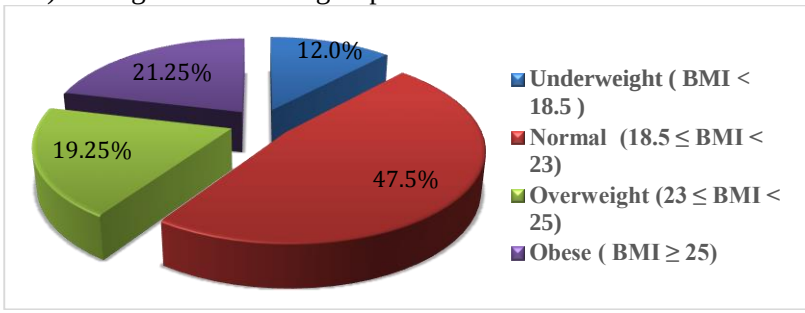


Figure 3.1. Classification according to BMI of research subjects

Note: The research results in Figure 3.1 show that only less than 50% of seafarers have BMI within normal limits; meanwhile, the percentage of seafarers with BMI ≥ 23 is up to 40.5%

3.2.3. Some physiological criterias of seafarers of ocean going ship

Table 3.1. ***Results of blood lipid measurements of seafarers***

Researching Results / R.criteria		Seafarers (n = 400)		Workers on land (n = 280)		p
		n	%	n	%	
Cholesterol	Normal	201	50.25	163	58.21	> 0.05
	High limit	129	32.25	75	26.79	> 0.05
	High	70	17.50	42	15.00	**0.043**
Triglycerid	Normal	163	4.75	149	53.21	**< 0.001**
	High limit	148	37.00	55	19.64	**0.019**
	High	71	17.75	73	26.07	**0.045**
	Very high	18	4.50	3	1.07	> 0.05
HDL – C	Low	96	24.00	25	8.93	> 0.05
	High	304	76.00	255	91.07	**< 0.001**
LDL - C	Optimal	127	31.75	67	23.93	> 0.05
	Near optimal	131	32.75	105	37.50	> 0.05
	High limit	95	23.75	84	30.00	**0.03**
	High	38	**9.50**	16	5.71	**0.045**
	Very high	9	**2.25**	8	2.86	> 0.05
Common dyslipidemia		256	**64.00**	99	35.35	**< 0.001**

Note: The research results in Table 3.1 show that the rate of seafarers having dyslipidemia is significantly higher than that in the labor group on land.

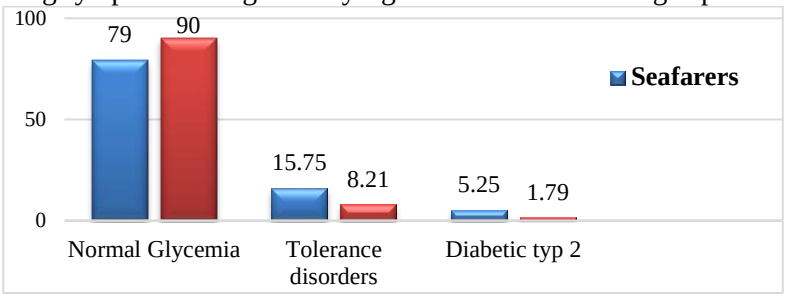


Figure 3.2. ***Results of quantifying the blood sugar of seafarers***

Note: The research results in Figure 3.2 show that the rate of seafarers with glucose tolerance and diabetes is higher than the labor group on land, this difference is statistically significant (p <0.05).

Table 3.2. ***Some psychological characteristics of seafarers***

Research targets	Psychological change			
	Yes	**%**	**No**	**%**
Worry about the risk of accident or disaster	364	91.00	36	9.00
Stress due to noise, vibration, petrol vapor	364	91.00	36	9.00
The feeling of loneliness tormented	261	65.25	139	34.75
Sexual emotional stress	284	71.00	116	29.00
Harsh marine working environment	262	65.50	138	34.50
Economic burden	219	54.75	181	45.25
Worrying too much about family	224	56.00	176	44.00

Note: The results of the table above show that 91.00% of seafarers are worried about the risk of an accident or disaster and have nervous tension due to noise, vibration, petrol vapor in the environment; followed by feelings of loneliness (65.25%), sexual emotional stress (71.00%) and economic burden (54.75%).

3.2.4. Disease structure and characteristics of some occupational diseases of seafarers

Table 3.3. ***General morbidity among seafarers (n = 400)***

Disease group name	Number	%
Certain infectious and parasitic diseases	52	13.00
Neoplasms	6	1.50
Diseases of the blood and blood-forming organs	6	1.5
Endocrine, nutritional and metabolic diseases	**263**	**65.75**
Mental and behavioural disorders	**93**	**23.25**
Diseases of the nervous system	11	2.75
Diseases of the eye	**95**	**23.75**
Diseases of the ear	16	4.00
Diseases of the circulatory system	**182**	**45.50**
Diseases of the respiratory system	**135**	**33.75**
Diseases of the digestive system *Including constipation disease*	**242** ***236***	**60.50** ***59.00***
Diseases of the genitourinary system	39	9.75

Diseases of the skin and subcutaneous tissue	9	2.25
Diseases of the musculoskeletal system and connective tissue	1	0.25
Injury, poisoning and certain other consequences of external causes	3	0.75

Note: The research results in Table 3.3 show that the most common pathology group in seafarers is endocrine, nutritional and metabolic diseases (the highest incidence rate is 65.75%).); followed by diseases of the circulatory system, diseases of the digestive system, respiratory diseases and eye diseases.

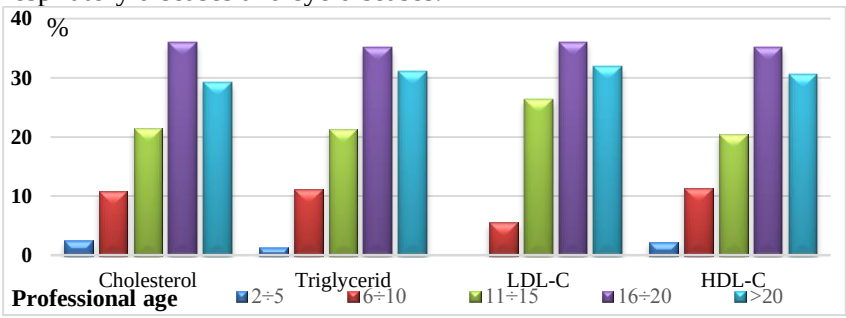


Figure 3.5. ***Relation between professional age and incidence of lipid metabolic disorders of seafarers***

Note: From the research data obtained from Figure 3.5, we can see that the incidence of seafarers lipid metabolism disorders tends to increase with age of seafaring and this trend is statistically significant with p <0.05.

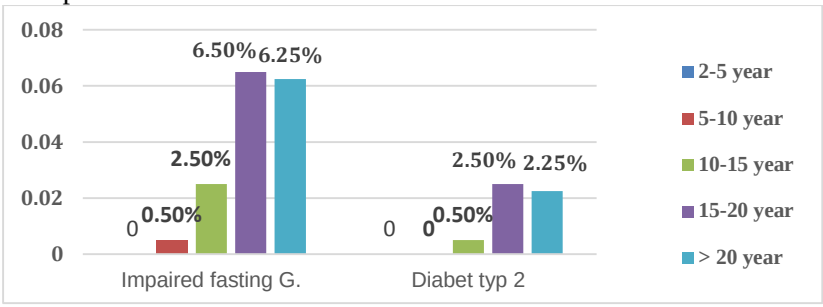


Figure 3.6. ***Relation between age and incidence of glucose metabolic impairment of ocean seafarers***

Note: From the research data in Figure 3.6, we can see that the higher the professional age, the higher the rate of fasting glucose tolerance disorder and type 2 diabetes also tend to increase. This trend is statistically significant with p <0.05.

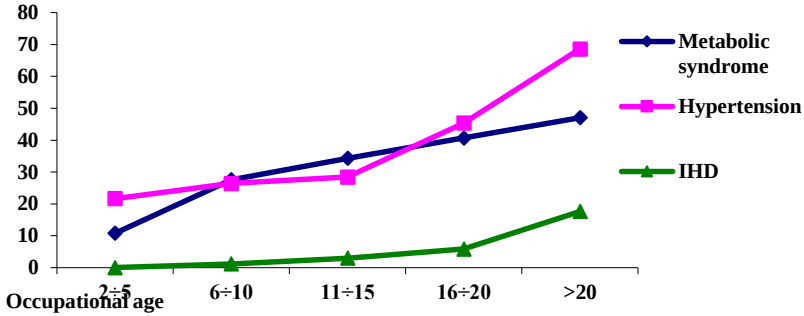


Figure 3.8.The incidence of metabolic syndrome and some cardiovascular diseases by Occup. age

Note: From the research results in Figure 3.8, we can see that the incidence of cardiovascular diseases (hypertension, ischemic heart disease) as well as metabolic syndrome of the seafarers tend to increase with professional age.

3.3. The effects of voyages on the health and disease transformation of seafarers

3.3.1. The affect of voyages on the health status of seafarers

- The content of glucose and blood lipid components of seafarers increased significantly after 1 year of voyaging.

Table 3.4. ***Change neurological type of seafarers (via Eysensk test) before and after the voyage***

Research creteria	Research results (n = 230)				p
	Before voyage		After voyage		
	n	%	n	%	
Melancholy	53	23.04	89	38.70	< 0.001
Impatient	27	11.74	41	17.83	> 0.05
Grunting	40	17.39	53	23.04	> 0.05
Vivacious	110	47.83	47	20.43	< 0.001

Note: The research results from Table 3.4 show that after the voyage all types of melancholy nerves increased significantly compared to before the voyage with a statistically significant p <0.001, in which the type of neuropathy vivacity was reduced from 48. 5% to 20.43% of seafarers.

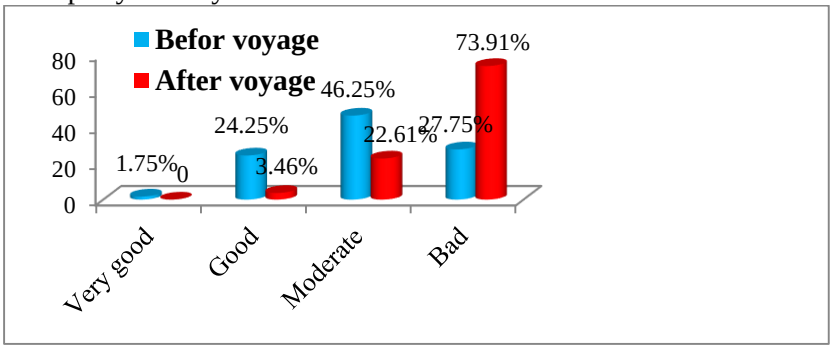


Figure 3.9. ***Attention ability assessment of seafarers before and after the voyage***

Note: The research results in Figure 3.9 show that the proportion of seafarers who have the ability not good attention concentration is significantly increased after the voyage compared to before the voyage, while the group with the ability attention concentration is of good type, fair and medium are significantly lower than before.

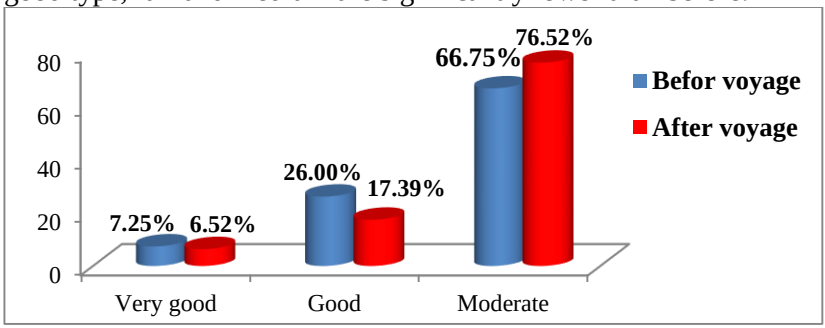


Figure 3.10. ***Thinking ability of seafarers before and after the voyage***

Note: The research results in Figure 3.10 show that the proportion of seafarers who are able to think at an average before the voyage is 66.75% has increased to 76.52% after the voyage; and the group with

good thinking ability decreased significantly compared to before the voyage. This difference is statistically significant with p <0.05).

3.3.2. The effect of the voyage on the sea to change the rate of some diseases of seafarers

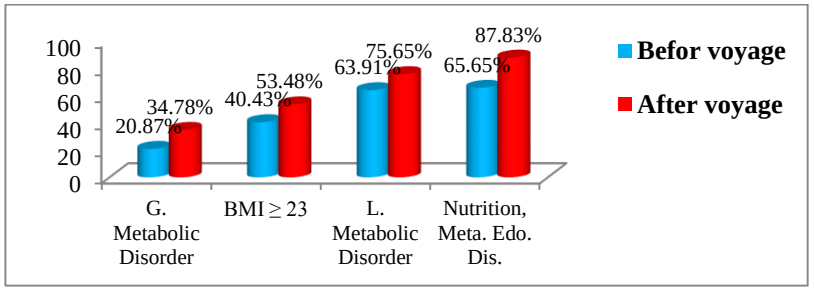


Figure 3.11. ***Changes in the incidence of nutrition, endocrine and metabolic diseases among seafarers before and after voyages (n = 230)***

Note: The research results in Figure 3.11 show that the rate of seafarers general disorders of metabolic disorders and lipid metabolism, Glucose increased significantly after this long voyage; The percentage of overweight and obese seafarers increased from 40.43% to 53.48%. The difference is statistically significant (p <0.05).

Table 3.5. ***Changes in the rate of some cardiovascular diseases of seafarers before and after the voyage (n = 230)***

Research results / Disease	Before voyage		After voyage		p
	n	%	n	%	
Arrhythmia	91	39.57	96	41.74	> 0.05
Ischemic heart disease	10	43.50	14	6.09	> 0.05
Hypertension	82	**35.65**	127	**45.36**	0.039
Hypertension grade 1	48	**17.14**	50	**17.86**	> 0.05
Hypertension grade 2	*37*	***13.21***	*51*	***18.21***	< 0.001
Hypertension grade 3	*13*	***4.65***	*26*	***9.29***	< 0.001

Note: Research results from Table 3.5 show that among the diseases of the circulatory system of seafarers working on ocean-going ships, hypertension is the highest proportion, mainly degree 1 and 2, followed by arrhythmia. The incidence of these diseases also increased significantly after the voyage (p <0.05).

Table 3.6. ***Depression level of research subjects before and after the voyage (using Beck test) (n = 230)***

Results / Depression level	Before voyage		After voyage		p
	n	(%)	n	(%)	
Light (14-19 score)	53	23.04	84	36,52	0.004
Medium 20-29 score)	13	5.65	29	12.61	> 0,05
Heavy (> 30 score)	0	0,.0	0	0.00	= 1
Normal (< 14 score)	*164*	*71.31*	*117*	*53.48*	*0.007*

Note: The research results from Table 3.6 show that the seafarers the mild and moderate depression level after the voyage increased higher than before. The difference is statistically significant with p <0.05.

3.4. Intervention solutions by training knowledge, skills to care for and protect the health of seafarers

3.4.1. Content of intervention:

Including contents of health improvement education solutions for seafarers working on ocean-going ships important such as: educating and improving seafarers understanding of diseases such as hypertension, metabolic disorders (diabetes, lipid disorders, metabolic syndrome ...) mental disorders in seafarers, so that they can change attitudes, behaviors, lifestyles and activities of seafarers, contribute to reduce the incidence of diseases.

3.4.2. Method of intervention:

- Organize training to disseminate knowledge about prevention and control of some occupational nature diseases of seafaring for seafarers.
- Communication and education to enhance the knowledge and practical skills for seafarers on measures to prevent and combat these specific diseases
- Interview and evaluate the results of the intervention after the training

3.4.3. Evaluate the outcome of the intervention

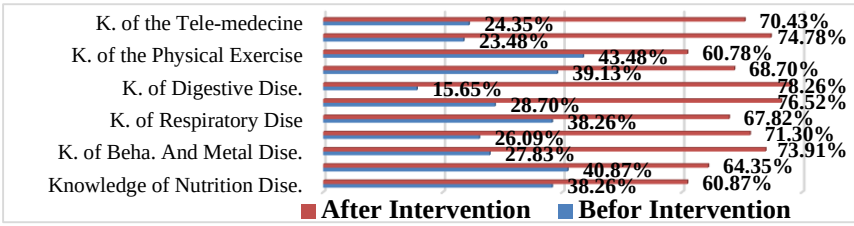
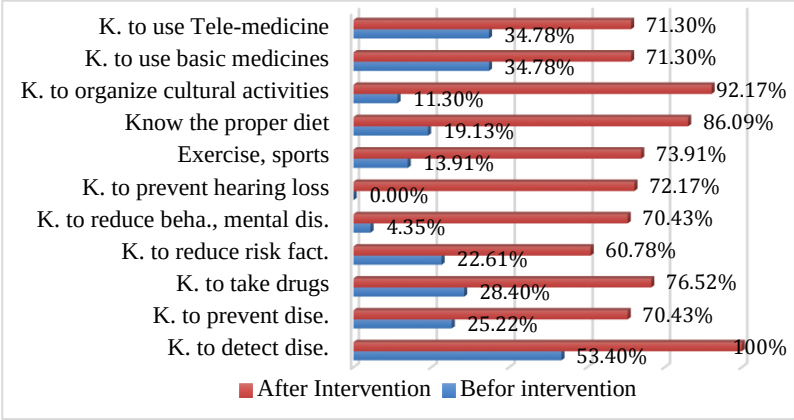


Figure 3.12. ***Results of seafarers' knowledge about health before and after the intervention***

Note: The standard knowledge about occupational diseases and nutritional, endocrine, metabolic, respiratory, cardiovascular and gastrointestinal diseases increased on average from> 30% before the intervention to 60.87 ÷ 78.26% after intervention.



Note: The ability of seafarers to detect and reduce risk factors for metabolic, respiratory, circulatory, gastrointestinal disorders, mental behavior disorders, etc is much higher than before intervention, change from average <30% before intervention to 60.87 ÷ 100% after intervention.

Chapter 4
DISCUSSION

4.1. Characteristics of working conditions on Vietnamese ocean transport ships

4.1.1. Characteristics of labor environment on ocean shipping ships

- Characteristics of microclimate on ocean transport vessels: Results of investigation of microclimate on board when the ship is docked at the port shows that only the temperature measured in the engine room of the ship exceeds the standard hygienic hygiene (37.2 ± 1.98^0C / 32^0C) (according to Decision No. 3733/2002 / QD-BYT $\leq 32^0$C) [3]. In such conditions, the workplace temperature is very detrimental to crew members' health, especially to oiler and engineer. Our research results are also the same with those of Nguyen Truong Son, Tran Thi Quynh Chi (2004) [8], Bui Thi Ha (2002) [13], Le Hoang Lan and Nguyen Bao Nam (2016) [25].

- Features of noise and vibration on ocean shipping vessels: With noise levels, vibration in excess of such permitted standards not only adversely affects hearing and easily causes bone and joint injuries, but also disrupts many other functions of the crew's body.

4.1.2. Characteristics of living conditions of seafarers

- The research results show that the average area of accommodation, living and labor of crew members on the ship is very limited; Spiritual life on the ship is also very lacking, communication is limited, especially news from family, relatives, from the mainland society. At the same time, the micro-social environment on board is unusual with only the male leading to the phenomenon of psychophysical imbalance, causing the crew members to develop a state of psycho-stress and easy to develop mental behavior disorders.

- Most of the seafarers do little physical exercise, combined with inappropriate nutrition and many unhealthy living habits (drinking, smoking), which increase the risk of cardiovascular disease, metabolic disorders [16].

4.1.3. Nutritional conditions on board

There are many differences compared to the nutritional conditions on land. The proportion of nutrients in the diet is seriously imbalanced: excess fat, glucid and protein but lack of fresh vegetables and fruits (lack of vitamins, micronutrients and especially lack of fiber). This is one of the reasons why the group of gastrointestinal diseases and metabolic disorders is always one of the highest morbidity among crew members [8], [13], [16], [133], [152].

4.2. Reality of health, disease structure and some occupational nature diseases of Vietnamese ocean-going shipping seafarers

4.2.1. Physical strength and some biological indicators in seafarers

• *Characteristics of physical indicators of the study subjects*

- In our research, it shows that the physical parameters of crew members on ocean transport vessels are significantly higher than those of land workers in Hai Phong with p <0, 05. Our research is also consistent with previous studies of authors Nguyen Truong Son (1996) [30], Bui Thi Ha (2002) [13], Tran Quynh Chi (2010) [8], Nguyen Thi Ngan (2007) [28].

- Our study shows that BMI of seafarers working on ocean-going ships is higher than land workers (22.62 ± 3.88 / 20.26 ± 2.47) with p <0.05

• *Some characteristics of physiological cr of crew members of ocean going ships*

The parameters of pulse frequency and blood pressure (both systolic and diastolic blood pressure) of the seafarers were statistically higher ($p < 0.05$) than the labor group on land. Our results are also consistent with some authors who have published in recent years such as Nguyen Truong Son [30], [31], [33].

According to the results of the study, the rate of crew members with impaired blood glucose metabolism (impaired glucose tolerance in fasting and diabetes) was 21%, while up to 64% of crew members showed metabolic lipid disorders. The cause is probably mainly the difference in diet high in protein, sugar, fat but less vegetables and less exercise.

The results of Table 3.23 show that 91% of seafarers have mental stress (due to noise, vibration, petrol vapor in working environment and living environment on board the ship) and worry about the risk of accident or possible disaster. Followed by the proportion of seafarers feeling lonely (65.25%), sexual emotional stress (71%) and pressure from economic burdens (54.75%) [8], [13], [55].

4.2.2. On the disease structure and characteristics of some occupational nature diseases of Vietnamese seafarers

• *Structure of general illnesses*

The research results in Table 3.24 show that in crew members, the group of diseases with the highest rate is the group of nutrition, endocrine and metabolic diseases (65.75%), followed by the diseases of the gastrointestinal system (60.5%) (including 59.00% constipation), diseases of the circulatory system (45.5%), respiratory system disease (33.75%), mental behavior disorders (23.25%) ...

The deck group has the rate of malnutrition and metabolic disease is 61.91%, digestive system disease is 59.52%, circulatory system disease is 51.78%, mental behavior disorder is 39, 88%, respiratory system disease is 40.07%, eye disease is 28.57% ...; the group of machines has the rate of malnutrition and metabolism up to 60.51%, digestive system disease is 64.19%, followed by respiratory disease 29.73%, circulatory system disease is 50 % ...; The service group on board had the highest rate of malnutrition and metabolic disorders, 73.81%, and the second-most gastrointestinal disease was 55.95%.

The morbidity rate of seafarer tends to increase with age of seafaring in a certain way, which will change the quality and arise pathologies.

• *Structure of some occupational nature diseases of crew members*
Research results show that:

- Group of diseases caused by nutritional and metabolic disorders is a group with the highest incidence (67.65%) and has quite the specific characteristics of seafarers working on ocean transport vessels. The incidence of dangerous metabolic disorders in crew members is very high: blood sugar tolerance disorder is 15.75%, type 2 diabetes is 5.25%, blood lipid disorders is 64% or syndrome. metabolism is 31.5%.

The higher the rate of crew members' metabolic disorders is that the higher their age, the higher the risk of metabolic disorders and this trend is statistically significant with $p < 0.001$.

- *Pathological characteristics of the circulatory system*

The research results showed that up to 40.5% of crew members had hypertension, of which 18.25% of crew members had moderate to severe hypertension.

Hypertension is mainly encountered in crew members of machine and deck group (39.19% and 48.48%); The incidence of hypertension among officers was also significantly higher than that of crew members with $p = 0.01$.

The prevalence of hypertension of seafarers tends to increase markedly with age. Crew members with hypertension are quite young, most of them are between 30 and 45 years old.

- *Other diseases of the respiratory system*

The incidence of respiratory diseases in seafarers is 33.75%, mainly due to working conditions at sea (high temperature at workplaces, temperature difference between inside and outside the ship, factors of goods transported on board, sudden change between different climates ...).

- *Other diseases of the digestive system*: is the group of the 2nd highest rate of crew members. The cause of this problem in our opinion is the crew's daily life, eating and working conditions, especially the abuse of alcohol, lack of green vegetables ... [108], [124], [135], [137].

- *Mental behavior disorders*

Most crew members have psychological changes due to causes such as anxiety about disaster, feelings of loneliness, worries about family, economy ... monotonous and boring work; shift working mode; lack of

recreational activities while having ample spare time; Abnormal micro-social environment on board (homosexual) ... These are favorable causes of occupational diseases which arise with high incidence and greatly affect the health of seafarers, reducing their age. This is also consistent with previous studies of Nguyen Thi Hai Ha [20], [21], Bogdan Jaremin [62].

Thus, according to our research results, the following diseases are occupational diseases of seafarers: nutritional, endocrine and metabolic diseases (67.75%), followed by is the group of pathologies of the digestive system (60.5%) (of which 59.00% is constipated), diseases of the circulatory system (45.5%), mental behavior disorders (23.25%).

4.3. Changes in health status and disease of seafarers after a cruise on the sea

The effects of the working environment on the seafarers are significant, as evidenced by the dramatic changes in the health and disease status of seafarers after a voyage at sea.

4.3.1. Impact of voyage on the health reality of seafarer

- Variation of biochemical indices

After one year at sea, biochemical indices such as average crew members' glucose and lipid content tended to increase significantly and the difference was statistically significant ($p < 0.05$). The incidence of crew members' metabolic disorders increased significantly (from 65.75% up to 87.83%) ($p < 0.05$).

- Some psychological changes of crew members: ability of concentration, attention and thinking ability of seafarers decreased significantly compared to before the voyage (from 27.75% to 73.91% with $p < 0.05$); negative mental types such as melancholy, impatience and taciturn also increased, in which the most increase was melancholy (from 23.5% to 38.7%).

4.3.2. Changes in the rate of some specific occupational diseases in Vietnamese seafarers after a voyage

The results of the study in Table 3.43 show that some pathological groups have the characteristics of the seafaring profession such as nutritional diseases, metabolic hormones, mental behavior disorders, diseases of the circulatory system, gastrointestinal diseases ... all tend

to increase significantly after 1 year of going to sea and the difference is statistically significant.

4.4. Regarding the results of training intervention solutions to improve the crew members' knowledge and practical skills in health care and protection

The application of health care solutions for crew members with training to improve knowledge and practical skills for prevention of diseases of a seafarer such as hypertension, metabolic disorders (diabetes, blood lipid disorders, metabolic syndrome ...), neurological disorders in seafarers helps to change the attitudes, behaviors, lifestyle, activities of seafarers, contributing to reducing morbidity rate for seafarers. The results showed that:

- Basic knowledge about common occupational diseases in crew members such as hypertension, diabetes, cardiovascular diseases, metabolic disorders, mental disorders ... after the course has increased significantly. compared to before the course with $p < 0.05$.

- Knowledge of how to prevent, non-drug treatments for these diseases also increased significantly after the course, from 15.65% before the course has increased to 78.26%.

CONCLUSION

From the research results, we have some conclusions as follows:

1. Regarding working conditions on Vietnamese ocean transport ships, there are many disadvantages to the crew members' health such as:

- The factors of temperature, noise, vibration in the engine room of the ship are always higher than the permitted hygienic standards.

- Seafarers' living conditions are much more difficult than on land; The cultural and spiritual life is very difficults as lacking information from the mainland, the mono sex-only micro-social environment, and stress wach keeping activities ... are the causes of psychological stress;

- Unbalanced diet, lack of green vegetables, fiber; excess of fat, protein, sugar, bad habits in daily life (100% of seafarers drink alcohol at different levels; 56.5% a seafarer smokes cigarette; 51.25% of a seafarer does not have any physical training on board.)

2. Characteristics of health and pathologies have occupational nature of Vietnamese seafarer to be working on ocean going shiping Companies

2.1. About health

- The physical and fitness indicators of ocean going shiping seafarers are higher than workers on mainland, but crew members have a higher incidence of overweight (40.5% / 20.35%).

- The average concentration of Glucose, blood fat are higher than workers on mainland.

- Psychological stress due to noise, vibration pollution... (91%), anxiety about accidents and disasters (91%), stress about sexual feelings 71% ...

2.2. The diseases of a professional nature of ocean going shiping seafarers

The common morbidity rate of seafarers: the highest is nutritional, endocrine and metabolic diseases (65.75%), in of them glucose tolerance disorder is (15.75%), diabetes mellitus. 2 are (5.25%), dyslipidemia is (64%), metabolic syndrome is (31.5%); followed are the digestive system (60.5%), including constipation (59%) ; diseases of the circulatory system (45.5%), in which the incidence of hypertension is (45.5%), mainly in the machine and deck group (50% and 51.79%), the rate of abnormal ECG (43.75%); mental and behavior disorders (23.25%) and eye diseases (23.75%) ...

2.3. Change the health and disease incidence of seafarers before and after voyage

Crew members' health has changed a lot after 1 year voyage at sea, the group of nutrition, metabolic endocrine diseases has increased from 65.65% (before going to sea) to (87.83%), the incidence of diseases circulatory system has increased from 45.65% to 54.35%, the incidence of mental and behavior disorders increased from 23.04% to 42.61%.

3. Evaluating the results of solutions of training on knowledge and skills for care and protection of health and occupational nuture disease prevention for seafarers in Vietnam

3.1. Change of knowledge

Seafarers' knowledge of occupational nature diseases was significantly improved after the intervention. The right knowledge about diseases of nutrition, endocrine, metabolic, respiratory, cardiovascular and digestion increased from > 30% before intervention to 60.87 ÷ 78.26% after intervention.

3.2. About practical skills

The ability of the seafarer to detect and reduce risk factors of metabolic, respiratory, circulatory, gastrointestinal disorders, mental behavior disorders, etc. is much higher than before intervention. Interventions have changed from average <30% before intervention to 60.87 ÷ 100% after intervention.

REQUEST

Inoder to improve the health condition and extend the working age of seafarers, we suggest:

- Need to rearrange the time of physical activities, entertainment, improve spiritual life for crew members during the voyage at sea

- Need to supply more dry foods that are high in fiber; increasing fiber supplement by folk remedies such as making bean sprouts, growing vegetables in foam boxes on ships; supplement fresh vegetables when the ship arrives at the port.

- Strengthen health education communication activities in combination with training courses on knowledge and skills for protect of health and prevention of occupational nature diseases for seafarers.

- Need advice and treatment for crew members are being depression, when crew members' health is fully recovered, they can continue their works at sea.

- For seafarers with melancholiac nerve type, this seafarers should not be allowed to go to work on voyage too long or can transfer them to other jobs on mainland.

- Increase training in knowledge and practical skills on marine medicine for deck officers and emergency programs at sea for seafarers working on ocean vessels to meet the implementation of STCW / 2010 International Convention. At the same time, integration of lessons to popularize knowledge for seafarers about occupational nature diseases as well as preventive measures.