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Environmental health and safety management in marine vessels on the Qeshm-Bandar Abbas route

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Abstract

Marine vessels like a public place need to comply with environmental health standards and safety standards. The Qeshm-Bandar Abbas path is considered as one of the busiest maritime routes in Hormozgan Province. Considering the high frequency of travel and the importance of observing environmental health standards, this study aims to investigate environmental health indicators related to the health of crew and passengers. Moreover, the level of compliance with the safety standards of passenger vessels on this route was evaluated. Furthermore, the environmental health and safety status of 31 vessels on the route was investigated using a self-made questionnaire. This questionnaire consisted of four parts that included the characteristics of the vessel, the crew and captain, and 59 questions about environmental health indicators, and the safety of the vessels. In order to complete the questionnaires, first, the captain and the crew were interviewed, then the checklist was completed through a personal visit. Finally, the data obtained from the checklist was analyzed with SPSS software. The results showed that as the floor of all the boats was washable, only 83.8% of them were washed daily. Besides, the safety indicators of the vessels were provided in most cases and were estimated to be quite favorable. The amount of standard provision in the presence of communication system and inspection of the floating rotating lights, were 3.90% and 8.96%, respectively. It is recommended to increase the level of environmental health indicators in the vessels, such as the type and number of sanitary facilities, and the optimal volume of waste storage containers, and also floating sewage treatment system should be reviewed and improved.

Keywords: Floating; Environmental health; Safety; Bandar Abbas; Qeshm.

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1. Introduction

Environmental health and safety management in marine vessels involves various aspects such as waste management, pollution prevention, emergency response planning, occupational health and safety measures, and continuous training and awareness programs. By properly managing these areas, marine vessels can reduce their carbon footprint, prevent oil spills or other hazardous substance releases into the water bodies, mitigate risks associated with onboard activities, protect biodiversity, and maintain a healthy ecosystem. Furthermore, effective environmental health and safety management in marine vessels also contributes to the overall reputation of shipping companies. It demonstrates their commitment to sustainable practices and responsible operations. This can lead to increased customer trust, improved stakeholder relationships, compliance with legal requirements in different jurisdictions worldwide, reduced insurance premiums due to lower risks, and enhanced competitiveness in the global maritime industry (Kristiansen, 2013).

However, it is important to acknowledge that environmental health and safety management in marine vessels is an ongoing process that requires continuous improvement. As new technologies emerge and regulations evolve over time, it is crucial for shipping companies to stay updated with best practices and adapt their management systems accordingly as also stated in even for the unmanned vessels (Lafte *et al*., 2018). Collaboration between industry stakeholders such as ship-owners/operators, crew members, regulatory bodies, classification societies, research institutions, and environmental organizations is essential for achieving effective environmental health and safety outcomes in the maritime sector.

Sea transportation is a necessary issue for security, economy, and country transfers (Hetherington *et al*., 2006). It is also the most economical way to transport goods compared to roads, railways, and airways (Butt, 2007). If any ship wants to apply the national laws of its country in international waterways, there will undoubtedly be a big obstacle to the movement of goods and passengers and the shipping industry in general (Emad *et al*., 2011). Regarding the prevention of marine environment pollution, a large number of national and international laws have been established (Lafte *et al*., 2018).

The most important international law related to sea pollution is the International Convention for the Prevention of Pollution from Shipping MARPOL (Rastgoo, 2012). These regulations include various sources of pollution caused by ships and its main goal is to eliminate intentional pollution of the environment. The sea is filled with oil and other harmful substances and reducing the discharge of such substances intentionally or unintentionally, through the application of laws and regulations on ships and ports (Ghanbari and Rastgoo, 2010; EPA, 2008). On the other hand, according to international health regulations, countries are required to take all practical measures to ensure that users of international routes maintain their route from sources of contamination and infection. The facilities in international ports are in a sanitary condition and the users are responsible for the safe removal and disposal of any contaminated water and the food from the vehicle (ship, boat, etc.) (Abuali *et al*., 2010).

Since marine vessels are considered a public place, therefore the environmental health rules are applicable for them. According to these regulations, the important things in the field of environmental health of vessels include having a health card, observing personal hygiene, providing safe drinking water for passengers, washing the bottom of the vessel, proper disposal of sewage and waste, etc., and safety includes vest, rope and lifebuoy in the boat, first aid box in the boat, fire extinguisher in the boat and such things (Environmental I.F.C., 2007; IMO, 2001).

From the very beginning, the World Maritime Organization (WMO) has put the development of international standards and help in the implementation of laws, which resulted in increasing the safety and protection of the marine environment. In the past several decades, the WMO has made many efforts to develop uniform international standards. The result of these activities was the approval of the most important international conventions related to the safety of ships, the convention for the Safety of Life at Sea (SOLAS) in 1974, as well as the most important international agreement related to the protection of the marine environment, the MARPOL Convention in 1973 (Emad *et al*., 2011). Today, the existence of hundreds of maritime accidents in all parts of the world has raised the maritime industry as the most dangerous industry in the world, which causes many human, financial and environmental losses (Emad *et al*., 2011; Ports and Maritime Organization., 2008).

Qeshm Island is a free and commercial area in south of Iran, and since the seasons of the second half of the year have good weather, this issue has made the route from Qeshm to Bandar Abbas and vice versa to be considered one of the busiest sea routes in Hormozgan Province. The statistics of passenger transportation on sea routes in recent years in Hormozgan has reached 10 million passengers per year, and this has placed Hormozgan in the first rank of sea travel in the country (Rezvani, 2014). In a study, the environmental protection of the Persian Gulf was investigated. The results of this study showed that the passage of various types of vessels and their discharge of pollutants into the Persian Gulf, the discharge of hazardous chemicals, etc., are considered to be the major factors of pollution of the marine environment of the Persian Gulf (Lotfi *et al*., 2010). In another study, the food waste produced by ships was examined. The results showed that it is necessary to pay attention to food waste management by many ships and port operators and consulting institutions (Polglaze, 2003). Furthermore, the importance of dilution in evaluating the possible effects of wastewater discharge from large cruise ships was studied. The results stated that Marine Sanitation Device (MSD) is an inefficient technology for analyzing the wastewater (Loehr *et al*., 2006).

Due to the high frequency of traveling on the Qeshm route and the importance of detecting environmental health standards in the case of passengers, as well as the records related to accidents leading to the death of passengers on this route, caused to investigate the environmental health indicators related to the health of the crew and passengers. Furthermore, an evaluation of the level of compliance with the safety standards of passengers on the Bandar Abbas-Qeshm route was designed and implemented.

2. Material and methods

In this research, the community under investigation was sea vessels on the Qeshm-Bandar Abbas route, and the sampling method in this project was a survey of all vessels on the Qeshm-Bandar Abbas route.

In order to evaluate the state of environmental health and safety status of 31 swimmers on the Qeshm-Bandar Abbas route, from a 4-part self-made questionnaire included characteristics of the vessel (8 questions), characteristics of the crew and captain (4 questions), and 59 questions for evaluating the conditions of environmental health indicators (37 questions) and the safety of vessels (22 questions). To verify the content validity of the questionnaire, five environmental health and safety experts from Bandar Abbas School of Health were carefully chosen as experts. They professionally evaluated the validity of each question in the questionnaire for the assessment of waste management of marine vessels. Correspondingly, pre-test and post-test methods were used to verify the reliability of the questionnaire. Furthermore, firstly the captain and the crew were interviewed, then the checklist was completed through a personal visit. Finally, the data obtained from the checklist was analyzed by SPSS software.

In the first stage, 10 questionnaires were completed as a pre-test, and after two months, the questionnaires were completed again. In this method, first, the variance of each question and the variance of the set of survey questions are measured. If the variability between people is almost equal, the variance of the set of measures will be less than the sum of the variance of the questions. In order to statistically analyze the qualitative indicators related to the environmental health status of vessels, these qualitative indicators were converted into quantitative values so that a general interpretation of the overall environmental health status of each vessel can be presented by summing up these quantitative values. In this quantification, nine variables "flotation washing sequence, waste container washing sequence, toilet washing sequence, sewage disposal, toilet, disinfection, number of waste containers, volume of containers and washing materials" were evaluated.

Herein, the variables of the sequence of floating washing, washing of waste containers, washing of toilets and wastewater disposal were coded as follows:

(1=once a week), (2=twice a week), (3=daily) and sanitation and disinfection variables as (0=does not have) and (1=has), variable number of waste containers (1=less than 3 pieces), 2 = 3 and 4 pieces) and (3 = more than 5 pieces) and variable container volume (1 = less than 10 liters), (2 = between 10 and 25 liters) and (3 = more than 25 liters) and washing materials variable was also coded as (0=water only), (1=detergents), (2=disinfectants). Finally, qualitative analysis of quantitative averages was done as (poor = less than 5), (moderate = between 5 and 16), (good = more than 16).

3. Results

In this research, 31 vessels were examined in terms of environmental health and safety. The results showed that 100% of the vessels had cabins, 48% of them were built in the

UAE, 25% of them were built in Qeshm, and the rest were made in Turkey, China, Japan, etc. The maximum capacity of the vessels was 218 and the minimum capacity was 57 people. The maximum period of using them was 17 years and the minimum period was 4 months. It was also determined that the average age of the operators of the vessels was 39 years, the average number of crew was 8, the maximum number of captains had a diploma (45%) and then a cycle (35%) and the lowest percentage of them had a bachelor's degree (3.5%). Although there were courses for the captains about safety, firefighting and personal hygiene, none of them had any information about the sanitation of the vessels' environment.

All employees of extremists had health cards and they perceived personal hygiene and were all dressed in special work clothes. The floor of all the boats was washable and 83.8% of them were washed daily. In other cases, the floating floor was washed two or three times a week. The most common detergents for the floating floor were disinfectants, powders and liquid for laundry and dishwashing. The percentage of use of sterilizers and detergents was 77.5% and 22.5%, respectively. In all the boats, there was a drinking bowl and a disposable glass, and the required drinking water was provided in the form of 20-liter purified containers from Qeshm or Bandar Abbas. Only 58% of extremists benefited from the existence of a refrigerator, approximately 42% of them were washed with water and 16% with soap and water, and in the other 42%, the sanitary conditions of the refrigerator were not met.

In 58% of the cases, no cooking was done in the boat, and out of 42% of the cases where cooking was done inside the boat, 35.5% did not have a special cook and the staff were responsible for cooking. The ventilation system was centralized in only 13% of cases and the rest of us used two-piece coolers for ventilation. 93.5% of the vessels had usable toilets, 75.8% of them had one toilet and 22.2% had two toilets. Toilets were washed daily in 74% of the cases and once or twice a week in the rest. Also, 96.5% of toilets contained liquid soap.

During the investigations, it was found that all vessels discharge their sewage into the sea and this was done daily in 84% of cases. The maximum amount of waste production was 40 liters and the minimum amount was 8 liters, which were collected and stored in plastic containers with different volumes. Moreover, 96.8% of the vessels' waste containers were washed that of which 51.6% was daily washed and 45.2% was washed twice a week. However, they were disinfected after each emptying in only 32% of cases. Generally, in 65.5% of the vessels, there was no person responsible for waste collection, and the rest of them had not received any training on waste management.

The results indicated that in all the vessels, lamps and electrical devices were disposed along with normal garbage. The garbage was stored in the storage place only one day before transportation and then all of them were delivered to the wharf. At the wharf, waste was stored in 50-liter containers, but no recycling was done on them. Besides, these containers were transported and disposed daily by the service forces of the free zone (42%) in Qeshm and the municipality (58%) in Bandar Abbas.

The evaluation of the safety indicators of the vessels was carried out with the 100% existence of the following parameters:

- Educated boards
- Warning boards
- Life jackets
- Vests for different ages
- Life rings
- Life ropes
- First aid boxes
- Sufficient supplies in the container
- Fire extinguisher
- Communication system
- Inspection of floating rotating lights
- Lifeboat
- Navigation light
- Sound production device
- Water extraction device
- Insulation of electrical system
- Ventilation of fuel tank
- Accident report

In two cases, the presence of communication system and inspection of floating rotating lights, the amount of standard supply was 3.90% and 8.96%, respectively. In two cases, the rules of the delivery of a vest upon arrival, and the requirement to use a vest upon arrival, were not observed in any of the vessels, therefore, zero percent was assigned to these indicators.

4. Discussion

In this study, environmental health management and safety of vessels on the Qeshm-Bandar Abbas route were investigated. As it is clear from the results, the defects on the vessels are divided into three main parts: safety, pollution of the marine environment, and pollution in the equipment.

Among the various aspects of the safety situation of the vessels, the only indicators with an unfavorable condition were the cases related to the delivery of life jackets to passengers upon arrival, and the requirement for passengers to use them when boarding the vessel. Also, since Bandar Abbas and Qeshm are considered as warm regions in terms of climate, there is no need for existence a heating system in the vessels. Therefore, in general, it can be concluded that the safety situation in the vessels of this route was favorable.

Since the protection of passengers' health and the marine environment require a plan for corrective measures to reduce or eliminate effective pollutants, environmental health factors were also investigated. The analysis of the environmental health indicators of the vessels was based on the health regulations of public places. In this regard, the results showed that the vessels were clean in terms of floor wash-ability, the way of supplying water, equipping toilets with liquid soap, proper ventilation, and the presence of a sufficient amount of garbage. The bins are washable, rustproof and equipped with garbage bags. Besides, the crews of the vessels were at the optimal level in terms of having special work clothes, observing personal hygiene and having a health card.

According to the results, all the vessels discharge the waste water from washing the floor, toilet and garbage bins into the sea daily or 2-3times a week. Therefore, the discharge of waste water into the sea can affect public health either through contact with polluted waters or the use of polluted fish. Furthermore, the discharge of untreated sewage causes long-term adverse effects on the ecology of sensitive coastal ecosystems due to the effect of nutrients and other pollutants. In this respect, they did not have favorable conditions. Due to the results obtained in the descriptive statistics section, 4.19% (6 devices) of the vessels were in average condition and 6.80% (25 devices) were in good health condition.

In order to analyze whether the amount of work experience, education of the captain or the number of crew is effective in the environmental health status of the vessel or not, a statistical analysis (Pearson Chi-Square) was performed with a significance level ($p \leq 0.05$). The results showed that there was no significant relationship between these three variables with the health status of the environment. P values, respectively, for the captain's work history with the conditions and facilities of the floating environmental health ($p=0.778$) and the captain's education ($p=0.772$) and for the relationship between the number of crew and the health conditions and facilities floating environment was ($p=0.905$). Based on these results, the environmental health status of the vessels was in good level in 80% of cases and was in average level in 20% of cases.

In order to improve the level of hygiene of vessels, correlation analysis was done between software and hardware indicators. Regarding these analyses, there is no meaningful relationship between the software indicators (captain's education, age of the captain, number of crew) with the quality of the environmental health of the vessel. Hence, in order to improve the level of environmental health of the vessels, it is recommended to use hard indicators such as: type and number of sanitary facilities, type and number and optimal volume of waste storage containers, floating sewage treatment system that should be revised.

Conclusion

In sum up, by prioritizing environmental health and safety management in marine vessels through comprehensive planning, implementation of robust systems, regular monitoring of performance indicators, continuous training programs for crew members at all levels of

hierarchy onboard ships or offshore installations - a sustainable future for the oceans is assured while safeguarding human lives at sea. In a general evaluation, the safety status of the studied vessels was estimated to be quite favorable. Since there is no significant relationship between the education of the captain, the age of the captain and the number of crew members with the quality of the environmental health of the vessel, it is therefore recommended to improve the level of environmental health of the vessels. To sum up, environmental health and safety management in marine vessels is of utmost importance for the protection of the marine environment, the well-being of onboard personnel, and the sustainability of maritime operations. By implementing effective management systems and adhering to international regulations and guidelines, marine vessels can minimize their impact on the environment, prevent accidents and incidents, and ensure the health and safety of all individuals involved.

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