VIA MEDICA

ORIGINAL ARTICLE

Int Marit Health
2019; 70, 3: 180–186
DOI: 10.5603/IMH.2019.0028
www.intmarhealth.pl

ISSN 1641–9251

Development of physical training smartphone application to maintain fitness levels in seafarers

Gopi Battineni[1], Marzio Di Canio[2], Nalini Chintalapudi[1], Francesco Amenta[1, 2], Giulio Nittari[1]

[1]School of Pharmaceutical Sciences and Health Products, University of Camerino, Italy
[2]Studies and Research Department, International Radio Medical Centre Foundation (C.I.R.M.), Rome, Italy

ABSTRACT

Background: *In recent years, the prevention of non-communicable diseases represents one of the main problems of preventive medicine. Significant risk factor for these diseases is sedentary lifestyle; in other words, lack of physical activity. It is happened, especially in seafarers, since they do not have much facilitates to do physical exercise on board. The present study is designed to develop a simple user-guide mobile application to conduct activities with available equipment on board a ship.*

Materials and methods: *We held two pilot tests for app evolution. In the first phase, we selected members (n = 13) and produced a questionnaire related to usability, feasibility, and accessibility of the app. Based on the responses from users, we developed the second version of the app and provided to (n = 15) random seafarers for testing and operating.*

Results: *On average, 93.3% of seafarers mentioned that app was easy to use, while in the first phase it was equal to 84.6%. At the same time, 89.9% of users were satisfied with feasibility, and we had accomplished 95% satisfaction rate in the second phase. Ultimately, we had achieved better responses in the second evolution phase when compared with the first phase.*

Conclusions: *This app is made for planning a quality physical activity program for seamen that allows a seafarer to choose the adequate activity in line with his physical characteristic, fitness level, and motivations.*

(Int Marit Health 2019; 70, 3: 180–186)

Key words: physical training, internet, mobile applications, fitness levels, body mass index

INTRODUCTION

In recent years, the prevention of non-communicable diseases represents one of the main problems of preventive medicine. These diseases, like cancer, diabetes, cardiovascular, and chronic respiratory diseases, are responsible for most of the deaths, and around 35 million deaths every year globally [1]. The leading causes can be attributed to various factors such as consuming alcohol and tobacco, hyperactive calorific diets, hypertension, and elevated blood cholesterol levels [2–3]. Another important risk factor for these deaths is sedentary lifestyles; in other words, lack of physical activity. Unfortunately, on board a ship opportunities for sport and fitness are limited [4]. Ships do not have sufficient space for conducting physical education or sport facilities. Especially in seafarers, continuous work hours and strict organization of work does not allow having time for exercise [5].

Physical fitness is an essential element of a healthy lifestyle. Physical activity or exercise can improve health and reduce the chance of getting type 2 diabetes, cardiovascular diseases (CVD), and cancer [6]. Substantial interest and workout will have instant and long-term health benefits. Spending little time on physical activity can allow a person to become more active and fit. Most importantly, regular exercise can improve individual fitness levels. Based on the World Health Organization (WHO) suggestions, adult men (18 to 64 years) should spend at least 150 minutes per week doing moderate aerobic activity (such as brisk walking or running in moderate speed) [2–7], or at least 75 minutes per week doing intense aerobic exercise (such as vigorous running), or a combination of both. These kinds of activities are easy to perform for everyone and can be optimized without effort. People exercise for many reasons:

Gopi Battineni, PhD Student in E-health and Telemedicine, Telemedicine and Telepharmacy Centre, University of Camerino, Italy, e-mail: gopi.battineni@unicam.it

work, health, recreation, competition, or for their appearance. The amount of training depends on starting point, goal to achieve, time, age, personal abilities, and preferences. If a seafarer can take obligation for their health inside the working environment and operating surroundings, there are full-size fitness benefits [8].

Recently, possibilities for encouraging occupational health and wellbeing among seafarers have become an essential topic in the maritime community [9]. Shipping companies and government bodies started to cooperate to achieve this goal. Seafarers stay on board for four weeks or longer at a time; therefore, it is important to provide them with the opportunity to incorporate physical activity into their daily routine on board. The environments for conducting physical activities are different at workplace and home, concerning the time and facilities provided. In addition, the lack of motivation and seasonal factors such as cold or hot weather influences the level of physical activity [10]. Thus, to give physical training to seafarers, it is essential to design a simple and user-friendly mobile application.

The mobile app "wellness on a ship (WOS)" has the objective of directing the sailor to a healthy lifestyle through physical activity. The sailors who participated in the project could improve their physical fitness through exercises, tailored exclusively for them, based on their physical fitness and characteristics. The improvement of lung, heart, and muscle capacity are the objective of the training plan suggested. The seaman is continuously monitored by update reports, and the training program will be modified according to seaman's achievements. Also, seafarers do not have much access for the internet; mentioned app designed that aim to work on offline as well.

MATERIALS AND METHODS

The "wellness on ship" app was designed to provide individually tailored physical training for seafarers according to their body mass index (BMI). It was developed based on the following instructional model design: Analysis, Designing, Development, Implementation, and Evolution.

PHASE 1. ANALYSIS

An insight review of available smartphone fitness apps that were relevant to seafarer's physical education was conducted to find out similar apps. Conducted search yielded many apps about fitness and bodybuilding for people ashore. Our search could not identify the other apps that related to seafarers physical education, and no single app is available that can work offline.

PHASE 2. DESIGNING

The objective of the study is to design a user-friendly app for seafarers that can provide physical education based on their BMI values. Generally, BMI is derived from the height and weight of the person [11]. It is calculated as body mass (in kg) divided by a square of height (meters) and expressed in kg/m^2. We developed a code for BMI calculator with the help of Html and CSS programming languages. Body weight was classified into four types based on BMI metrics as:

— underweight: BMI < 18.5,
— normal weight: BMI = 18.5–24.9,
— overweight: BMI = 25–29.9,
— obesity: BMI ≥ 30.

PHASE 3. DEVELOPMENT

Several tasks were performed in this phase.

Database collection. Complete list of exercises and instructions how to perform them were obtained from MySQL database at Centro Internazionale Radio Medico (C.I.R.M.), Rome (International Radio Medical Centre). The database contains information about workout names and exercise instructions with images that specially designed by our trainer.

Trainee group categorization. Personal fitness level means the body's ability to withstand a physical workload (how much) and to recover promptly. The fitness level of a person can be assessed through exercises and activities that accurately measure person ability to participate in aerobic, or cardiovascular, training as well as muscular strength, endurance, and joint flexibility. Therefore, we broadly categorized trainees into the following three distinct groups:

— Beginners are either completely new or at least somewhat new to physical training. People who did not perform physical exercise on a regular basis (3 times a week) for the last 6 months were considered as beginners;
— Intermediates present a higher level of physical fitness than the beginners. A seafarer who did physical training consistently for (at least) the previous 6 months most likely qualifies as an intermediate trainee.
— Advanced is the highest level of physical fitness. Seafarers who trained consistently for the last 24 months or more most likely qualify as (at least) advanced trainees.

Build seafarer workout routine. A severe workout program should be developed around a person's biology, age, goals, diet, free time, etc. This workout is created for all seafarers who are willing to build a workout routine in three simple steps that had shown in Figure 1.

Workout list. As mentioned, trainee classification was done into three groups. Based on trainees' fitness level and BMI values, we designed workouts, and each workout consists of different exercises specially designed for seafarers. These exercises are elementary and easy to do with available equipment on the ship.

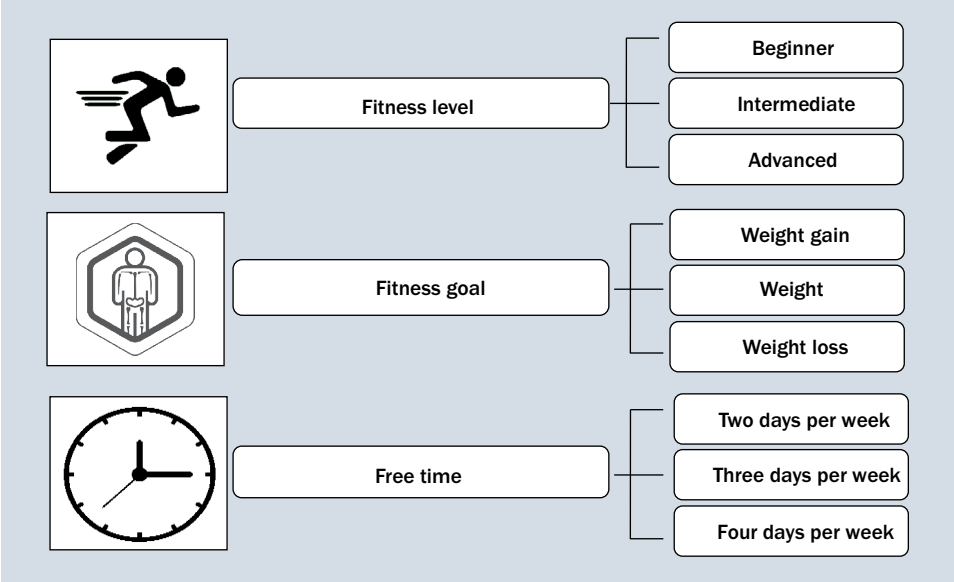


Figure 1. Creating a seafarer's workout routine

Table 1. User response table that explores the usage and recommendations of the app

Parameter	1st trial N (%)	2nd trial N (%)
Usage		
Is it easy to use?	11 (84.6)	15 (100)
Are you satisfied with the images?	12 (92.3)	14 (93.3)
Are you satisfied with theme selection?	10 (76.9)	13 (86.6)
Feasibility		
Does the app provide all workout information you need?	12 (92.3)	15 (100)
Does the app quickly respond?	9 (75.0)	13 (86.6)
Is the app quickly searching the workout?	13 (100)	15 (100)
How satisfied are you about gym manual?	12 (92.3)	14 (93.3)
Acceptability		
I felt comfortable during the usage	9 (75.0)	13 (86.6)
I would recommend this app to my friends	12 (92.3)	14 (93.3)

PHASE 4. IMPLEMENTATION

In the first trial, we provided the app to five staff members in C.I.R.M. and eight Camerino University students. We asked them to give feedback on the usage of the app and register their response based on the questionnaire. Participants were asked to use the app about a week and keep tracking the problems that they had encountered while using the app. With the inputs from the respondents, we updated the app by adding new features. In the second trial, we asked another 15 random selected seafarers to test the app and to note down the problems they had encountered during usage. Written informed consent was obtained from the participants of the two trials.

PHASE 5. EVOLUTION

After using the app for 2 weeks, all participants filled out the questionnaire and scores were assigned to participants' responses. We designed a survey assessing usability, feasibility, and satisfaction based on the Likert scale (0 — very unsatisfied and 5 — very satisfied). Some participants were interested in writing their responses on notes. We gathered all the answers and made qualitative data analysis using ATLAS tool with open coding method. Highlighted and similar codes were grouped at the end to identify critical opinions expressed during the implementation phase.

RESULTS

IMPLEMENTATION, FIRST TRIAL

In the first phase, among 13 participants, most of them were satisfied with usage functionality (on average 85%). From Table 1, it is evident that 11 members agree that the mentioned app is easy to use. Twelve members ultimately decided that training images provided adequate information

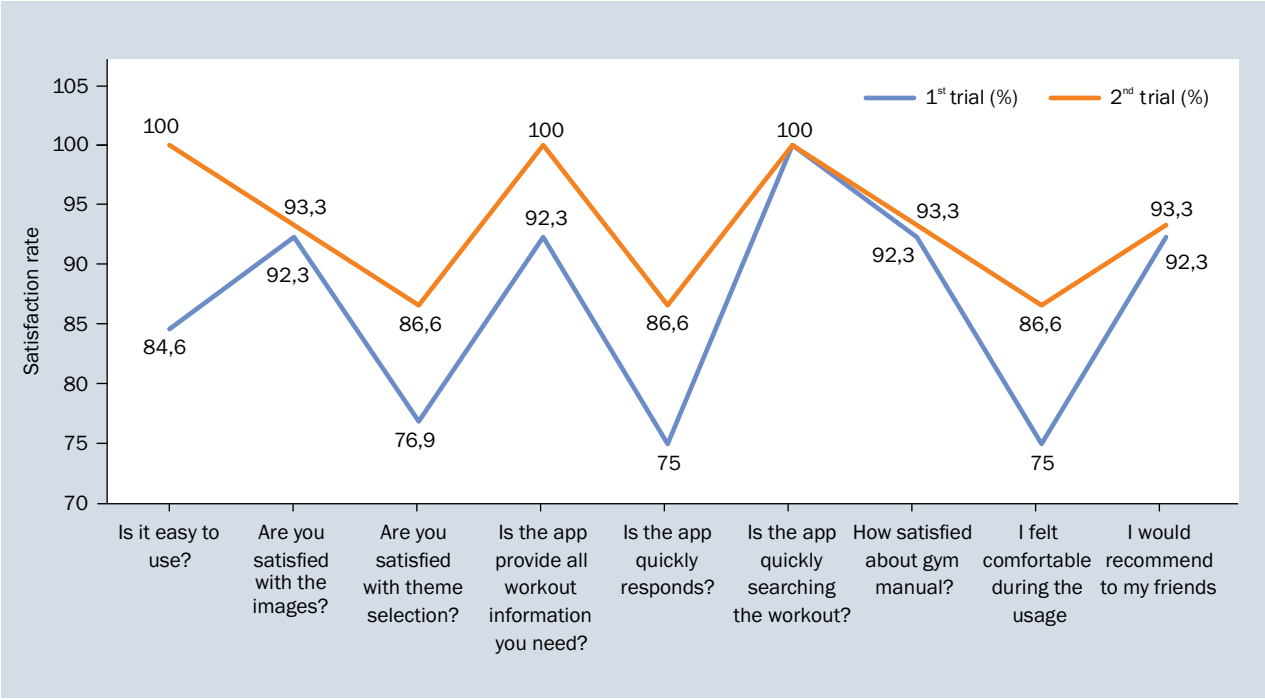


Figure 2. Comparison of satisfaction rates between two pilot tests

how to do exercises, and ten members were satisfied with theme selections.

In the questionnaire about feasibility, 12 (92.3%) members provided consent on availability of workout information in app and satisfaction on gym manual that was attached with the app. All members were satisfied with the workout search menu, and 9 (75%) members agreed that the app is responding quickly. Nine users felt comfortable while using the app, and 12 members decided to recommend this app to their colleagues.

IMPLEMENTATION, SECOND TRIAL

Based on the report from the first trial, we revised the app and offered it to 15 random seafarers. In the second test, we found that the app is more usable (100%), and thanks to adding some extra workouts, seafarers were satisfied (100%) with the exercises provided and the app responded quickly (86.6%). The acceptance rate was gradually getting higher (86.6%) when compared with the first pilot test. The enlarging of Table 1 is explained in Figure 2.

APP FUNCTIONALITY

To access the application, seafarer will sign up into the app by email. Application functionality mainly designed with BMI metrics, and with corresponding workout lists.

BMI calculation

Seafarer will enters weight and height using standard or metric measures on our dedicated page (Fig. 3), and BMI will appear in our mobile app. For confirming the situation of overweight and obesity, we strongly suggest measuring also waist circumference. Waist circumference is an assessment tool that can complement the BMI measurement for the assessment of overweight and obesity (Table 2). Excess fat located in the upper abdominal region is associated with a higher risk than fat found in other areas.

Workout list

We can treat this page as the heart of the app. According to their fitness level, goal (based on BMI), and free time, seafarers can choose their perfect workout (Table 3). Once a seafarer chooses the fitness level, the app will display all the workouts designed by the trainer (Fig. 4). Depending on seafarer's choice, the app will view an exercise list along with instructions.

DISCUSSION

For better or worse, not many 21st-century seafarers fill their exercise quotas in the workplace. As recently as the 1850s, about 30% of all the energy used for agriculture and manufacturing in the United States depended on human muscle power [12]. In our society, we have replaced stairs with escalators, brooms with vacuums, and a lot of other things, also in the maritime industry [13]. Freed from physical work, people have used mental work to create a society of enormous convenience and comfort. In the process, though, we have created a hidden energy crisis, not

Figure 3. Body mass index interface in the second version of the app

Table 2. The goal of the activity, according to body mass index (BMI) and waist measurement

BMI	BMI status	Waist measurement	Final status	Objective
> 18.5	Underweight	< 94 man < 80 woman	Underweight	Increase muscles
18.5–24.9	Healthy Wt. Range	< 94 man < 80 woman	Healthy Wt. Range	360 approach
25.0–29.9	Overweight	< 94 man < 80 woman	Healthy Wt. Range	360 approach
30.0–34.9	Obese	< 94 man < 80 woman	Healthy Wt. Range	360 approach
35.0–39.9	Extreme Obesity	< 94 man < 80 woman	Healthy Wt. Range	360 approach
> 18.5	Underweight	> 94 man > 80 woman	Overweight	360 approach
18.5–24.9	Healthy Wt. Range	> 94 man > 80 woman	Overweight	Lose weight
25.0–29.9	Overweight	> 94 man > 80 woman	Overweight	Lose weight 2
30.0–34.9	Obese	> 94 man > 80 woman	Obese	Lose weight 3
35.0–39.9	Extreme Obesity	> 94 man > 80 woman	Extreme Obesity	Lose weight 4

a shortage of fossil fuels, but a lack of the physical activity the human body needs to ward off disease and reach its full potential.

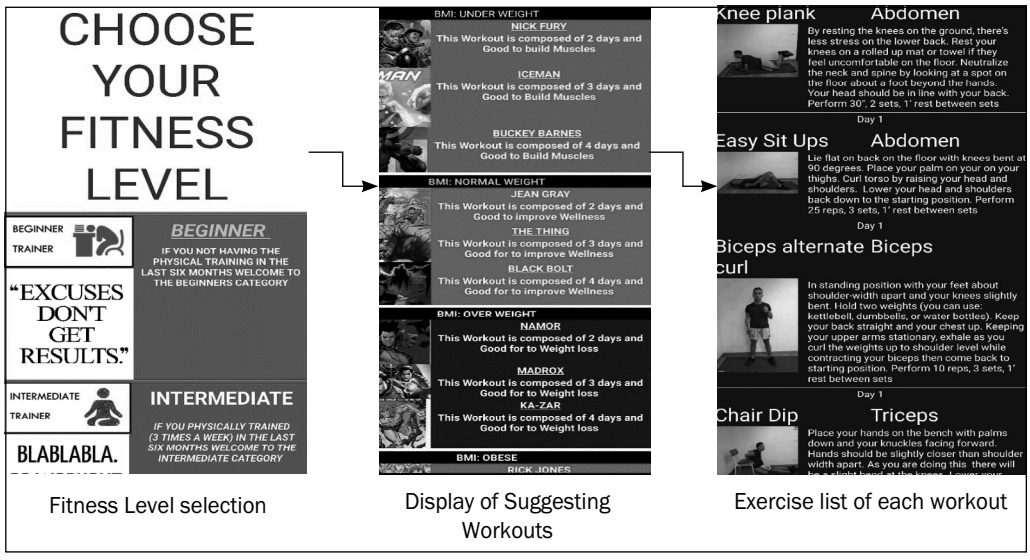
Seafaring is a particular profession in which workers are usually exposed to several stressors that are related to the different duties on board ships [14, 15]. Seafaring is still associated with relevant mental health risks, but exercise is also one of the most effective ways to improve mental health. Regular exercise can have a high impact on depression, anxiety, and more. It also relieves stress, improves memory, and helps to sleep better [14–16]. The "wellness on ship" app was designed to provide physical education for seafarers. It is user-friendly and can work without internet, since it getting access to internet may be difficult while traveling on the ship [17].

As a first phase of the project, we designed a navigational-based app, and it could be beneficial to seafarers who lack physical training. Based on BMI selection and waist measurements, the app automatically displays seafarers' activity levels and BMI scores. Seafarers can choose particular workout corresponding to their requirements. To the best of our knowledge, it could be the first app for seafarers that can manage physical training having the unique feature of offline working.

During the app development process, a significant challenge step design, and upload them in our database and later incorporate it into our app. We adopted the local database server to store workout list and exercise descriptions. In the first version, we displayed major workouts based on fitness levels only. In the second version, we tried to explore many workouts depending on user fitness levels, BMI metrics, availability, and focus. A comparison between the first and second evaluation of the app showed that the usability, feasibility, and accessibility rates gradually improved due to

Table 3. Designed work list and seafarers focus on body mass index (BMI) values

Workout name	Focus	Level	BMI	Days per week
NICK FURY	Build muscle	Beginner	Underweight	2
ICEMAN	Build muscle	Beginner	Underweight	3
BUCKY BARNES	Build muscle	Beginner	Underweight	4
JEAN GREY	Wellness 360°	Beginner	Normal weight	2
THE THING	Wellness 360°	Beginner	Normal weight	3
BLACK BOLT	Wellness 360°	Beginner	Normal weight	4
NAMOR	Lose weight	Beginner	Overweight	2
MADROX	Lose weight	Beginner	Overweight	3
KA-ZAR	Lose weight	Beginner	Overweight	4
RICK JONES	Lose weight	Beginner	Obese	2
MORPH	Lose weight	Beginner	Obese	3
ADAM WARLOCK	Lose weight	Beginner	Obese	4
HAWKEYE	Build muscle	Intermediate	Underweight	2
LUKE CAGE	Build muscle	Intermediate	Underweight	3
BEAST	Build muscle	Intermediate	Underweight	4
BETA RAY BILL	Wellness 360°	Intermediate	Normal weight	2
MIMIC	Wellness 360°	Intermediate	Normal weight	3
X-23	Wellness 360°	Intermediate	Normal weight	4
QUASAR	Lose weight	Intermediate	Overweight	2
HOWARD THE DUCK	Lose weight	Intermediate	Overweight	3
SHANG-CHI	Lose weight	Intermediate	Overweight	4
JUBILEE	Lose weight	Intermediate	Obese	2
ERICK O'GRADY	Lose weight	Intermediate	Obese	3
SPECTRUM	Lose weight	Intermediate	Obese	4
MOON KNIGHT	Wellness 360°	Advanced	Normal weight	3
WAR MACHINE	Wellness 360°	Advanced	Normal weight	4



Fitness Level selection | Display of Suggesting Workouts | Exercise list of each workout

Figure 4. The interface between the workout list and exercises based on seafarer's fitness level

particular incorporation of application processing interface (API) that improves app-accessibility speed.

A present study provides relevant knowledge about developing apps for seafarers that can serve as a roadmap for future app developers in the maritime sector. By conducting two pilot tests, we improved the application that is simple to use and accessible for the target audience. Besides, we designed two versions of the app based on user's feedback, and this is the first preliminary study conducted on app designed for seaman physical training. However, the app had a limitation of low sample size and lack of automatic feedback from the customer. As discussed, the designed application is not a web app, and it is a static application working on the local database. We considered this study as the first step in designing apps for seafarers, in particular with physical training sessions. In the future, we would like to develop a chatbot application using artificial intelligence (AI) that can assist sea workers in conducting exercises. They would need to select options displayed on a mobile device's screen. We are confident that this could be a significant advancement in maritime health.

CONCLUSIONS

In conclusion, the WOS app provides an essential guide to physical training for seafarers and enables individual choices of workouts depending on their BMI values and fitness levels. We conducted two pilot tests to evaluate the app and establish the final version with additional features suggested by the users. Our study proved that the app could be easy to use, feasible, and accessible by all the users. Therefore, this app can be used as a simple guide to accessing exercise information while traveling on a ship, and the exercises are designed based on simple equipment available on vessels. In the future, WOS should be tested for its effectiveness and customer follow-ups. It will make sure to prevent sea workers from not exposed to diabetes and other chronic diseases that developed by lack of body workouts.

ACKNOWLEDGEMENTS

We would like to thank CIRM and the Department of Telemedicine and Telepharmacy at the University of Camerino, Italy.

FUNDING

C.I.R.M., Rome, and the University of Camerino supported this study.

CONFLICT OF INTEREST

The authors do not have any conflict of interest.

REFERENCES

1. WHO. Who. Global recommendations on physical activity for health. Geneva World Heal. Organ., 2010.
2. World Health Organization. Physical activity and young people. WHO, 2016.
3. Nittari G, Tomassoni D, Di Canio M, et al. Overweight among seafarers working on board merchant ships. BMC Public Health. 2019; 19(1): 45, doi: 10.1186/s12889-018-6377-6, indexed in Pubmed: 30626365.
4. Nittari G, Pallotta G, Pirillo I, et al. Evaluation of medical prescriptions and off-label use on board ships to improve healthcare quality. Eur Rev Med Pharmacol Sci. 2018; 22(13): 4392–4400, doi: 10.26355/eurrev_201807_15439, indexed in Pubmed: 30024631.
5. Guo-qing Li. Research on Seafarer Physical and Psychological Evaluation Model and Physical Activity Intervention Measures. Information Technology Journal. 2013; 12(23): 7821–7826, doi: 10.3923/itj.2013.7821.7826.
6. Huebschmann AG, Kohrt WM, Regensteiner JG. Exercise attenuates the premature cardiovascular aging effects of type 2 diabetes mellitus. Vasc. Med. 2011;16(5):378-90, doi: 10.1177/1358863X11419996.
7. 2018 Physical Activity Guidelines Advisory Committee, 2018 Physical Activity Guidelines Advisory Committee Scientific Report, 2018.
8. Linhares Pinto APM, Hausmann EF. Obesity among seafarers in an international oil logistics company: A growing concern', in Society of Petroleum Engineers - SPE International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production 2010, 2010.
9. Pearce DA, Newsham KK, Thorne MA et al Metagenomic analysis of a southern maritime Antarctic soil. Front Microbiol, 2012; 3: 403, doi: 10.3389/fmicb.2012.00403.
10. Youn IH, Youn JH, Lee JM Kim CS. Anomaly event detection for sit -to-stand transition recognition to improve mariner physical activity classification during a sea voyage Biomed Res. 2018, doi: 10.4066/biomedicalresearch.29-17-841.
11. Centers of disease control, Body mass index: Considerations for practitioners, Cdc, 2011.
12. Saunders DH, Sanderson M, Hayes S et al. Physical fitness training for stroke patients. Cochrane Database of Systematic Reviews. 2016, doi: 10.1002/14651858.CD003316.pub6.
13. Stannard S, Vaughan C, Swift O, et al. Women seafarers' health and welfare survey. Int Marit Health. 2015; 66(3): 123–138, doi: 10.5603/IMH.2015.0027, indexed in Pubmed: 26394312.
14. Lu CS, Tsai CL. The effect of safety climate on seafarers' safety behaviors in container shipping. Accid Anal Prev. 2010; 42(6): 1999–2006, doi: 10.1016/j.aap.2010.06.008, indexed in Pubmed: 20728654.
15. Nittaria G, Pirillo I, Amenta F, et al. The right to medical assistance for seafarers. Ethical and practical consequences of the introduction of telemedicine to improve healthcare on board ships. Marine Policy 2019; 106: 103525, doi: org/10.1016/j.marpol.2019.103525.
16. Hystad SW, Saus ER, Sætrevik B., Eid J.Fatigue in seafarers working in the offshore oil and gas re-supply industry: effects of safety climate, psychosocial work environment and shift arrangement. Int Marit Health 2013; 64(2): 72–79.
17. Yuen KF, Loh HS, Zhou Q, Wong YD. Determinants of job satisfaction and performance of seafarers. Transp Res Part A Policy Pract 2018; 110: 1-12, doi: 10.1016/j.tra.2018.02.006.