

<http://ansinet.com/itj>

ITJ

ISSN 1812-5638

INFORMATION TECHNOLOGY JOURNAL

ANSI*net*

Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Research on Seafarer Physical and Psychological Evaluation Model and Physical Activity Intervention Measures

Li, Guo-qing

Department of Physical and Teaching, Yan Tai University, Yan Tai, 264000, Shandong, China

Abstract: The man who goes to sea is a man in despair. This is still true but today's man of the sea is living a life that contains, at the least, chronic fatigue and overwork; boredom, pirates and danger. Suicide rates of seafarers are high. Many of the recognized risk factors for physical and psychosocial health problems impact on seafarers because of the nature and organization of their work. It has been shown that human misplay is the main cause of ship accident factors from the large number of maritime case analysis at internal and abroad. Therefore, it is of great significance to analyze and research the physical and psychological status. The artificial neural network theory is applied to the seafarer health evaluation, according to the seafarer health evaluation index. The corresponding BP neural network for health state evaluation established to evaluate the seafarer physical and psychological health status accurately and effectively. And the guidance and recommendations of physical activity intervention measures were given by seafarer health expert. All these research will help the seafarer to improve the level of physical and psychology health, maintain the normal life order and ensure safety at sea.

Key words: BP neural network, physical and psychological health, intervention measures

INTRODUCTION

Shipping is one of the most dangerous industries in the world. Seafarers are exposed to a higher-level risk than other shore based workers (Orr, 1995). Shipping companies have been endeavoring to make ship design, technology and safety equipment more efficient and effective in order to improve safety at sea. However, accident rate in the shipping industry is still at a high level since statistics reveal that, on average, some ships put in total loss claims and lots of lives were lost in accidents per year. Several statistical reports indicate that most maritime accidents are attributable to human error. The UK P&I Club stated in 2003 that the percentage of errors attributable to human factors was over 60% as shown in Fig. 1 (Li *et al.*, 2013). The research of human factors and ergonomics is much, but it is not much to achieve the practical application. Especially the establishment of seafarer physical and psychological health evaluation model is rarely.

This study will made seafarer physical and psychological health evaluation model for ocean shipping at sea eventually, to track and evaluate seafarer health status, take intervention measures, reduce human accidents. System frame as shown in Fig. 2. The research field of this study is in the lengthways range of red line (Li *et al.*, 2013).

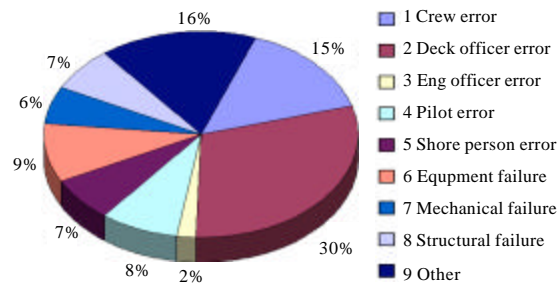


Fig. 1: Percentage of errors

THEORY OF BP NEURAL NETWORK

BP neural network trained the network using back propagation method and then network weights can be got. The main idea is modify the weight or threshold to make the error function decline along the negative gradient direction. Signal transmission and error back-propagation are two process procedures of BP neural network learning. In the forward propagation, the signal is inputted from input layer and propagated to output layer after processed by hidden layer. Each neuron only could affect the neurons state of the next layer. The error propagates back if desired output has not been got. Output error which is the basis to modify the neurons weight back propagate to input layer through hidden

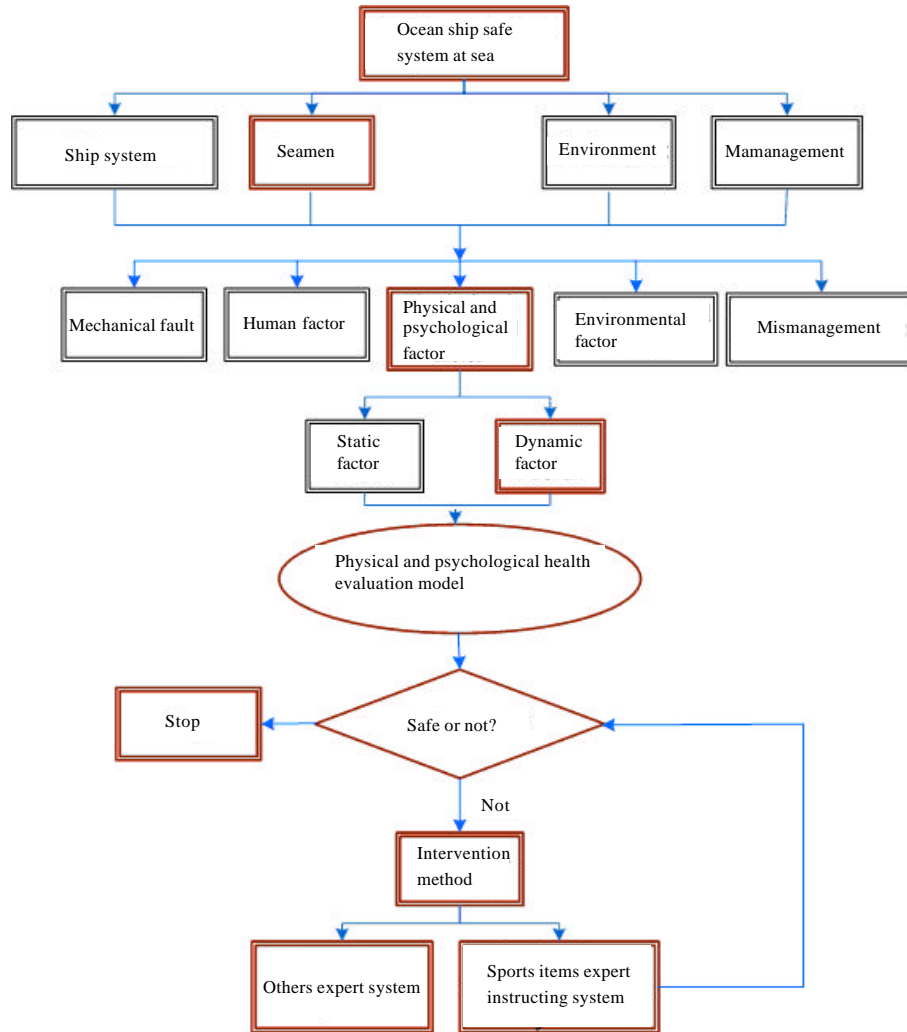


Fig. 2: System research field frame

layer, repeat until output error permitted (Costea and Nastac, 2005; Serrano-Cinca, 1997). Essentially, BP neural network is a nonlinear optimization problem issues for a set of input and output samples. It can be seen as a mapping from n-dimensional to m-dimensional. BP neural network structure is shown in Fig. 3.

SEAFARER PHYSICAL AND PSYCHOLOGICAL HEALTH EVALUATION MODEL

Definition: Research is limited in the dynamic factors of the ocean seafarer physical and psychological health evaluation index, variable factors, adjustable factors, controllable factors).

Choose characteristic index of seafarer physical and psychological health evaluation: The problems of ocean

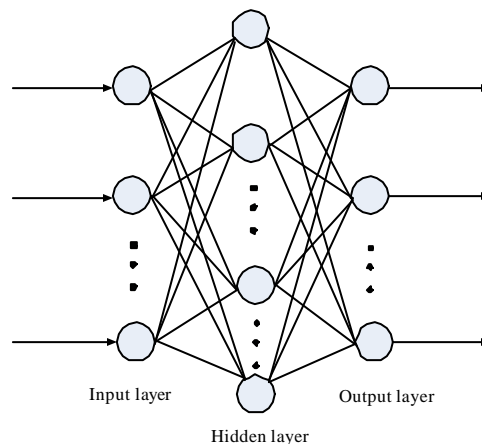


Fig. 3: Structure of neural network

seafarer physical and psychological health cannot be separated from the seafarer working and living environment and characteristics. Shaking and vibration during voyaging can cause human body some tissue and organ displacement, exacerbated the human sensory stimulation. The seafarer is easy to produce nausea, vomiting, dizziness, fatigue and other symptoms. Intensity of ship machinery noise is larger, can cause the human hyperirritability, interfere rest and sleep, as time passes can cause the plant nerve function disorders and organ system disease, such as hypertension, occupation deafness. Climate environment rapidly changed, the human body is difficult to adapt. Which easily lead to diseases of the respiratory system and nervous system. Seafarer duty system at sea is different with terrestrial, general 2 times daily duty, each time for 4 hours, in addition to the regional climate and the effects of time difference, the biological rhythm is disturbed, their physical and psychological health status is directly affected.

Sailing away from land, the seafarer is separated with family and friends, suffering from missing. The ship space is small, information is out-of-the-way, amateur life is bald. All these make feeling and perception of daily life experience serious deficient. This kind of insufficient psychological state of feeling and perception expands, may lead to fatigue, anxiety, loneliness, depression, panic or emotional stress excessive hyperirritability phenomenon. The seafarer often face many uncertain risk factors stimulation during the navigation process (such as storm, collision, fire, disease etc.), which can cause psychological disorders or mental diseases.

The key research question of this study is to abstract characteristic variable that can reflect the state of physical and psychological from the index of seafarer physical and psychological health. However it is gratified for researchers that a series of index can be adjusted for model and as the application of the model, the extraction index of evaluation system will be closer to the seafarer physical and psychological state. Embodied in the BP neural network model structure is to use the model as simple as possible to evaluate accurately the seafarer physical and mental health status.

Modeling of seafarer physical and psychological health:

The theory has been proven three layer forward feedback neural network can approximate arbitrary continuous function with arbitrary accuracy. The BP neural network of this study is three layer structures. The input signal is move the spread to the hidden layer nodes, through the transfer function then output signal of hidden layer nodes is transmitted to the output layer. Transfer function from

Table 1: Training sample set of BPNN

D	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11
d1	0.10	0.00	0.00	0.00	0.15	0.00	0.05	0.00	0.00	0.10	0.00
d1	0.05	0.00	0.10	0.00	0.10	0.00	0.10	0.00	0.00	0.00	0.00
d1	0.20	0.05	0.10	0.15	0.10	0.00	0.05	0.00	0.00	0.00	0.00
d1	0.20	0.05	0.05	0.05	0.05	0.00	0.05	0.00	0.00	0.05	0.00
d1	0.00	0.10	0.00	0.00	0.00	0.10	0.00	0.10	0.00	0.10	0.00
d2	0.30	0.30	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.15	0.00
d2	0.10	0.20	0.00	0.00	0.50	0.20	0.20	0.00	0.00	0.00	0.00
d2	0.00	0.05	0.30	0.10	0.35	0.50	0.20	0.20	0.10	0.10	0.10
d2	0.00	0.10	0.00	0.00	0.00	0.20	0.10	0.20	0.15	0.00	0.20
d2	0.00	0.10	0.00	0.00	0.00	0.15	0.00	0.05	0.10	0.15	0.15
d3	0.25	0.60	0.10	0.10	0.10	0.30	0.00	0.00	0.30	0.20	0.20
d3	0.00	0.00	0.80	0.60	0.00	0.00	0.30	0.30	0.00	0.00	0.00
d3	0.00	0.00	0.00	0.00	0.30	0.50	0.50	0.30	0.60	0.30	0.20
d3	0.60	0.05	0.05	0.05	0.20	0.15	0.15	0.65	0.75	0.25	0.40
d3	0.25	0.10	0.00	0.00	0.60	0.10	0.05	0.05	0.30	0.10	0.20
d4	0.00	0.85	0.10	0.10	0.10	0.10	0.40	0.00	0.00	0.10	0.10
d4	0.00	0.60	0.50	0.50	0.50	0.10	0.10	0.10	0.10	0.30	0.40
d4	0.80	0.30	0.40	0.30	0.10	0.60	0.15	0.25	0.60	0.20	0.20
d4	0.60	0.50	0.05	0.05	0.00	0.15	0.15	0.65	0.10	0.35	0.40
d4	0.25	0.10	0.00	0.00	0.85	0.50	0.70	0.05	0.30	0.00	0.10

the input layer to the hidden layer and hidden layer to the output layer used the Tansig function and Purelin function.

The ocean seafarer physical and psychological health at sea evaluation model chose the index of fatigue, sleep, appetite, food egestion, loneliness, anxiety, depression, panic, emotionality tension, thinking ability, self-control ability as the input of BP neural network and seafarer health level, health, sub-health, unhealthy, serious unhealthy as output. The number of hidden nodes depends on many factors such as the quantity of training sample and the rule complexity of sample contains. According to experience hidden nodes is 8. Some of the variables results of the physical and psychological health were chosen as BP neural network training set. The training samples are shown in Table 1.

Since centralized degree of the sample data is high, the data is processed by normalization. Every feature is in the 0-1 interval. The interval value indicated the degree, for example: if the sleep state is good, then the value is recorded 0.00, insomnia recorded 1.00. The state of sleep quality drop a little, but can be a good rest, recovery is perfect, recorded 0.60. Sleep quality drops badly, the recovery is bad, recorded 0.40. MATLAB software is used to train sample set.

BPNN evaluation model testing: After network training, the test will be carried on. The purpose of network test is to see whether the network has good generalization ability. Select 4 set of data as the network testing input, the test results are shown in Table 2. The output data is Normalization shown in Table 3.

From Table 3 we can see, the generalization ability of the network is good, we can use the following BPNN for ocean seafarer to evaluate health state.

Table 2: Test sample of network

No.	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11
1	0.04	0.15	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.20	0.00	0.00	0.20	0.20	0.10	0.20	0.10	0.00	0.00
3	0.20	0.00	0.00	0.00	0.60	0.30	0.40	0.00	0.10	0.10	0.10
4	0.75	0.50	0.10	0.10	0.30	0.30	0.50	0.10	0.25	0.20	0.20

Table 3: Test sample of network

No.	D1	D2	D3	D4
1	1	0	0	0
2	0	1	0	0
3	0	0	1	0
4	0	0	0	1

MAIN PHYSICAL ACTIVITY INTERVENTION MEASURES

The seafarer should strengthen the physical activity, learn to relax themselves. According to the ship characteristic, it is beneficial to adjust measures to local conditions to carry out some physical activity and a proper amount of entertainment activities. The health will be improved. Working state is energetic. The ability that copes with stress will be enhanced. The seafarer relaxed to control themselves when they meet pressure and feel nervous. All these mainly need the seafarer own conscious physical training in different ways.

The seafarer sports consciousness is weakness, some of them do not grasp the scientific physical activity knowledge and methods, have no physical activity habits. And the work burden is heavier during navigation, physical and mental fatigue, sports inert is larger, the necessary physical guidance and supervisory mechanism is not perfect. This research will eventually build physical and psychological health state expert system of ocean seafarer sports intervention to help them providing references and suggestions that how to choose sports items at sea.

To promote and maintain good health, seafarer will benefit from performing activities that maintain or increase muscular strength and endurance for a minimum of two days each week. It is recommended that 6-8 exercises be performed on two or more nonconsecutive days each week using the major muscle groups. To maximize strength development, a resistance (weight) should be used that allows 8-12 repetitions of each exercise resulting in volitional fatigue.

Participation in aerobic and muscle-strengthening physical activities above minimum recommended amounts provides additional health benefits and results in higher levels of physical fitness. Seafarer, should exceed the minimum recommended amounts of physical activity. In addition, to further promote and maintain skeletal health, seafarer will benefit by engaging in extra weight-bearing activity and higher-impact activity such as gangway ladder climbing or jogging, as tolerated.

Frequent physical activity is an important behavior for seafarer health. If seafarer is healthy, to promote and maintain health, seafarer had better to engage in moderate-intensity aerobic physical activity for a minimum of 20-30 min•d⁻¹ on 5 d•wk⁻¹ or vigorous-intensity aerobic activity for a minimum of 20 min•d⁻¹ on 3 d•wk⁻¹. For example, seafarer can meet the recommendation by walking briskly for 30 min twice during the week and then jogging for 20 min on two other days. Moderate-intensity aerobic physical activity, which is generally equivalent to a brisk walk and noticeably accelerates the heart rate, can be accumulated toward the 20-30-min minimum from bouts lasting 10 or more minutes. Vigorous-intensity activity is exemplified by jogging and causes rapid breathing and a substantial increase in heart rate. This recommended amount of aerobic activity is in addition to routine activities of daily living that tend to be of light intensity or last less than 10 min in duration. In addition, seafarer should perform activities that maintain or increase muscular strength and endurance a minimum of two days each week. It is recommended that 6-8 exercises be performed on two or more nonconsecutive days each week using the major muscles of the body. Such activities include lifting weights, weight bearing calisthenics or similar resistance exercises that use the major muscle groups of the body (Haskell *et al.*, 2007).

The seafarer can choose several exercises and actions that are recommended to cope with the above-mentioned Physical and psychological health problem. These sports have better effect on common physical and psychological illness. Brief introduction is as followed.

Practice deep abdominal breathing: This consists of breathing in deeply and slowly through your nose, taking the air right down to your abdomen and then breathing out slowly and gently through your mouth. Breathing deeply for too long may lead to dizziness from the extra oxygen.

Tai chi: Tai chi, which originated in China as a martial art, is a mind and body practice. Tai chi is sometimes referred to as “moving meditation” practitioners move their bodies slowly, gently and with awareness, while breathing deeply.

Body joints, muscles and bones will each pull, press and be diastolic, when playing Tai Chi. Massage effect will be in Visceral due to abdominal breathing and it is beneficial for intestinal peristalsis with increasing of diaphragmatic upper and lower amplitude. In addition, Tai Chi exercise has obvious effect to reduce hypertension.

Some studies show that blood pressure may drop 10–20 mmHg after a set of Tai Chi. As the long sea voyage process is long, the seafarer has lots of spare time and are prone to anxiety and irritability. It is beneficial for them to practice Tai Chi at sunrise or sunset on the spacious deck in the vast sea. Tai Chi can train the seafarer to be happy and pleased with themselves and be in a calm mood.

Ear action practice: The helix covers the ears when doing exercise, rub the ear hole with the root of palm (i.e., massage ear hole that be covered by helix), Rub to the ear feel itch, when the blood circulate to the ear. It is help to relief tinnitus.

Sit-up: The sit-up is an abdominal strength training exercise commonly performed to strengthen the abdominal muscles. It is similar to a crunch but sit-ups have a fuller range of motion and condition additional muscles. Sit-ups target the Hip flexors, rectus abdominus and also work the iliopsoas, tensor fasciae latae, rectus femoris, sartorius and, to a very small degree, the obliques. Lie down on the floor placing your feet either under something that will not move or by having a partner hold them. Your legs should be bent at the knees. Place your hands behind your head and lock them together by clasping your fingers. This is the starting position. Elevate your upper body so that it creates an imaginary V-shape with your thighs. Breathe out when performing this part of the exercise. Once you feel the contraction for a second, lower your upper body back down to the starting position while inhaling. Repeat for the recommended amount of repetitions. Seafarer physical training in 1 min to do sit-ups, no much more than 30, no requires speed. The faster the abdominal muscle is smaller. Correct methods should try to slow down. Compared with other sports, sit-ups is easy, but also need the progressive exercises (Brown, 2000). At first seafarer can try 8-10/ group, after each exercise once more, when added to 15-20/ group can try a group and gradually achieve each exercise completed three groups.

Squats: Squats are one of the best lower body exercises seafarer can do. One reason is that squats are multi-joint exercises which target all the muscles of the hips, glutes and thighs. This activity, which requires no weights or equipment (other than a chair) is great for seafarer. Place a chair just behind you and stand in front of it with feet about hip- or shoulder-width apart. Contract the abs and keep them tight as you bend the knees and slowly squat towards the chair. Keep the knees behind the toes as you sit down on the chair for a few seconds. Contract the glutes and hamstrings to lift up out of the chair and begin extending the legs. Fully extend the legs until you're back to standing position (Kellis *et al.*, 2005). Repeat this

for 1-3 sets of 15-20 repetitions. To progress, squat down until you're just hovering over the chair, but not sitting all the way down. Always keep the knees in line with the toes.

Barbell practice: To hold a dumbbell as you squat, which is a great way to add intensity without putting any extra load onto the spine. Stand with feet hip- or shoulder-width apart. Hold a medium-heavy dumbbell in front of your body with arms straight and elbows slightly bent. Bend the knees and lower into a squat. Stop when your knees are at 90 degree angles or before you lose the natural arch of your back. Contract the glutes and legs while stabilizing your body with a strong torso. Slowly stand back up without locking the knees and repeat for 1-3 sets of 15-20 repetitions. Always keep the knees in line with the toes!

The seafarer can choose another version of the dumbbell squat involves holding two dumbbells. You can either hold them at your sides, or just above the shoulders. Holding dumbbells is just one more way to add intensity to your workouts and build muscles in the glutes, hips and thighs. Stand with feet hip- or shoulder-width apart. Hold medium to heavy dumbbells in each hand just outside the thighs or with arms bent above the shoulders. Bend the knees and lower into a squat. Stop when your knees are at 90 degree angles or before you lose the natural arch of your back. At the bottom of the movement, make sure you take your hips back, as though you're about to sit in a chair. Avoid bending the knees so that they go beyond the toes. Contract the glutes and legs while stabilizing your body with a strong torso. Slowly stand back up without locking the knees and repeat for 1-3 sets of 15-20 repetitions.

Of course seafarer can choose barbell squats that require more work from the largest muscles in the body. Barbell squats are a great addition to a workout, provided you do them correctly. Adding a weight to your shoulders puts much of that load onto your spine as well, so take care when adding weight onto the shoulders. Stand with feet hip- or shoulder-width apart. Place the barbell just above the shoulders on the trapezius muscles. If you feel uncomfortable, you can use a bar pad to protect your back. Bend the knees and lower into a squat. Stop when your knees are at 90-degree angles or before you lose the natural arch of your back. Contract the glutes and legs while stabilizing your body with a strong torso. Slowly stand back up without locking the knees and repeat for 1-3 sets of 15-20 repetitions. Always keep the knees in line with the toes (Rippetoe, 2007).

Seafarer should take care when doing this exercise for the first time. Start with a light weight you can easily handle and practice.

Wall sit: The wall sit is a bit different from typical squats since you're holding a static position for a certain period of time, rather than working through an entire range of motion. This is a great exercise seafarer can do anywhere in cabin without any equipment to help them build endurance in the lower body. Stand in front of a wall (about 2 feet in front of it) and lean against it. Slide down until knees are at about 90 degree angles and hold, keeping the abs contracted, for 20-60 seconds. Come back to start and repeat, holding the squat at different angles to work the lower body in different ways. To add intensity, hold weights or squeeze a ball between the knees.

Walking on the deck: Walking exercise method is very simple, because the tonnage of ocean shipping is very large. The broad deck area is equivalent to two football fields. The seafarer can make full use of the convenient conditions, when the rising in every morning the seafarer can enjoy the beauty on the sea and walk or jog on the open deck. This sport not only may increase the cardiopulmonary function, but also can cultivate their original nature, condition psychology. Slow walking is 60-80 steps per minute, middle speed is 80-100 steps per minute, fast 100-120 steps. In order to increase effect, auxiliary action of the upper limbs expanding chest can do simultaneously. At present in China the method of 12 min walking is adopt. That means try your best to walk as far as long distance parallel in 12 min, persist in everyday. This sports mode has good effect on rehabilitation and prevention of bronchitis for seafarer.

Climbing gangway ladder: A certain number of gangways are in ship limited area. The seafarer can enhance their ability of respiratory system by climbing the gangway ladder coordinating with the movement of breath training. First suction with the nose, then narrow lips to breathe out, each climb 2 steps breathe again, this sport can be realized on every ship.

Comfortable and slow motion in cabin: The seafarer work on board for long-term, often climb cabin, so is very tired. In e course of time they will be facing lumbago and skelalgia, which can not relieve by energetic exercise but massage and do moderate exercise. For deck narrow, poor conditions of the ship, the seafarer can take other comfortable and slow motion in cabin to for rehabilitation.

CONCLUSION

The seafarer health evaluation model based on BPNN and the physical activity intervention measures

established in the study. The system can track and guide the seafarer physical and psychological health status at sea in real time. The research work has important practical significance and great practical value, which may enhance the seafarer physical and psychological health, improve work efficiency, promote the harmony and stability of the ship small environment, maintain the normal life order and ensure safety at sea. Ocean ships have no seafarer physical and psychological evaluation system in using at present. Although training data is limited to the present study training model, this study software is carried in ship will have a large number of training data and classification ability of the network will be constantly improved.

REFERENCES

- Brown, S.P., 2000. Introduction to Exercise Science. Lippincott Wims and Wilkins, USA., pp: 280-281.
- Costea, A. and I. Nastac, 2005. Assessing the predictive performance of artificial neural network-based classifiers based on different data preprocessing methods, distributions and training mechanisms. *Intell. Syst. Account. Finance Manage.*, 13: 217-250.
- Haskell, W.L, I.M. Lee, R.R. Pate, K.E. Powell and S.N. Blair *et al.*, 2007. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Med. Sci. Sports Exerc.*, 39: 1423-1434.
- Kellis, E., F. Arambatzi and C. Papadopoulos, 2005. Effects of load on ground reaction force and lower limb kinematics during concentric squats. *J. Sports Sci.*, 23: 1045-1055.
- Li, G.Q., B. Zhang, S.H. Li, W. Fang and R. Sun, 2013. The study of crew physical and psychological evaluation model and sports intervention method. *Int. J. Adv. Comput. Technol.*, 5: 20-28.
- Orr, M.J., 1995. Regularization in the selection of radial basis function centers. *Neural Comput.*, 7: 606-623.
- Rippetoe, M., 2007. Starting Strength: Basic Barbell Training. 2nd Edn., Aasgaard Company, USA., ISBN 9780976805427, Pages: 320.
- Serrano-Cinca, C., 1997. Feedforward neural networks in the classification of financial information. *Eur. J. Finance*, 3: 183-202.