

STRESS - AN UNDERESTIMATED HAZARD IN WATER SPORTS

Małgorzata Remlein¹⁾, Romuald Olszański¹⁾, Piotr Siermontowski¹⁾, Zdzisław Kobos²⁾, Jacek Buczyński³⁾, Andrzej Buczyński⁴⁾

¹⁾ Maritime and Hyperbaric Medicine Department, Military Institute of Medicine in Gdynia, Poland

²⁾ Cardinal Stefan Wyszyński University in Warsaw, Poland

³⁾ University of Health Education and Social Science in Lodz, Poland

⁴⁾ Medical University of Łódź, Poland

ABSTRACT

Strong wind, low temperature, intense current and poor visibility under water are the most common stress inducing factors in individuals practising water sports. Stress is a state of agitation, which can be caused both by external and internal factors. Its objective is to mobilise one's physical and psychological capabilities, thus it is a favourable reaction especially in crisis situations when such full mobilisation enables one to cope. Psychological stress is usually evoked by the occurrence of an atypical situation, exceeding one's handling capacity. It can be induced by seeing real or imagined danger in the surroundings, as well as by external pressure related to a task interpreted as too difficult or exceeding one's capabilities. Internal pressure appears when a person feels insecure in a given situation, when they cannot solve a problem or they feel discomfort due to their inability to meet the expectations of others, for instance, to perform a particular dive, or because of the money spent on this purpose or the invested time. Physical stress is usually an organism's response to the environmental impacts. This article presents and discusses factors which have an effect on stress intensification, as well as providing a characterisation of selected psychological and medical theories of stress.

Key words: psychological stress, physical stress, water sports, diving, positive emotion, stress, panic, stressor, distress, eustress.

ARTICLE INFO

PolHypRes 2015 Vol. 53 Issue 4 pp. 7-18

ISSN: 1734-7009 **eISSN:** 2084-0535

DOI: 10.1515/phr-2015-0019

Pages: 12 , figures: 5, tables: 1

page www of the periodical: www.phr.net.pl

Review article

Delivery date: 10.09.2015r.

Date of approval for print: 22.10.2015r.

Publisher

Polish Hyperbaric Medicine and Technology Society



INTRODUCTION

In recent years water sports have become one of the main sources of income of tourist organisations. The ever shorter training and easy access to equipment, however, do not contribute to their safety. A neglected area encompasses the psychological aspects of swimming, sailing, surfing, diving and other increasingly popular sports.

Water is not a natural environment of man, and the contact with it is a source of stress in many people. Ensuring safety in sports requires understanding of psychological aspects, the emotional reactions of oneself and a possible partner and the cognitive processes related to contact with the water.

The stress syndrome in diving may be recognised and well defined only on the basis of proper assessment of the complex correlations occurring between humans, their activity, and the environment in which it is conducted. Stress is usually sudden and unexpected and surfaces when a person sees or experiences a threat to his/her life [1].

The threat may be real, i.e. connected with the diving environment, the diving equipment or one's own well-being or ailments. In individuals with poor experience, the occurrence of stress may be influenced by fear that they will not be able to behave properly in special conditions connected with the practised discipline.

In water sports, situational disorientation, deteriorating weather conditions, accompanying darkness, poor visibility, general fatigue, and, in individuals with insufficient experience, additionally the stress related to the possibility of drowning are also significant factors which may result in the occurrence of psychological tension. A general psychophysical discomfort or even limited movements induced by wrong or incorrect equipment adjustment are also elements which have an impact on stress occurrence. Irrespective of experience, physical stress is influenced by fatigue and exhaustion due to long swims on the surface, sea sickness, general poor health status, etc. In diving, stress appears when one is confronted with an unusual situation, not necessarily dangerous.

In dives that push the boundaries of an individual's skills and experience, exceeds their psychophysical comfort and/or are performed with unfamiliar equipment or in conditions where the diver does not feel comfortable, stress is always present. Uncontrolled stress leads to panic. Stress is not a reaction that one should fear, it is the panic reaction that is dangerous in water sports. Any person found in this emotional state is not capable of rational thinking, acts intuitively, and in the case of a diver will try to resurface by any means. They may forget to release air from the lungs, which will damage pulmonary alveoli through decompression.

A panicked diver is a threat not only to himself but to other divers as well. A panic attack causes a person to disregard everything else in conviction that they are fighting for their life. They will pull off their rebreather and mask and climb over their partner in order to reach the surface faster. However, the techniques of coping with emergency situations under water, including instruction in how to help a panicked diver both on the surface and under the water can be learnt during a specialist course and advanced trainings with elements of rescue

procedures.

Daily performance of numerous professional activities or having a hobby, e.g. practising water sports, evokes particular emotional states the extent of which are modified by external factors (obstacles, social support, organisational structure, etc.) and internal mediators (e.g. aspiration level, self-assessment, health status, coping capabilities, etc.). In consequence, such situations most commonly produce both neutral results (absence of significant changes in one's functioning or health), as well as negative ones (undesirable changes in one's functioning or disturbances to one's health), but also, sometimes, in positive effects (psychosocial development). Stress factors can be generated both by the physical and social environment and manifest themselves in the following reactions: physiological, behavioural, mental or organisational.

The perception of risky situations and their subjective assessment depend on one's experience with these type of situations, as well as the context in which they are embedded, but also, largely, on individual predispositions. The available literature provides numerous reflections on this topic, with attempts to explain human behaviour in difficult and stressful situations.

The issue of stress in the contemporary world arouses high interest due to the omnipresence of stress-inducing factors, the commonness of its occurrence and inevitability of having to face stressful incidents. The said interest results from the utilisation of the term to depict everyday problems [2].

In psychology, stress-related theories are the best examined and coherent ones with regard to theory, but also empirical documentation, which finds practical application mainly in clinical practice.

The research on stress seeks an answer to the question of great practical significance, namely: how to effectively cope with stress situations. It is difficult to provide an explicit answer to this question. The assessment of coping effectiveness can be related to a process, strategy or style. In the case of a process, the appraisal is concerned with finding a solution to a particular stress situation and is sometimes ambiguous, as coping leading to situation improvement may involve emotional costs. Strategy effectiveness evaluation appears to be relative and context-related. It was not possible to indicate that certain strategies are better or worse. Moreover, thus far no advantage of a particular coping style was proven – despite the common belief that certain people are better or worse at coping with difficult situations [6].

The primary causes of stress occur when individuals are at their handling capacity limits or are facing challenges which are impossible to fulfil [2]. The essence of stress is in the imbalance between the demands and capabilities. The source of demands can be an external situation or internal standards. The reason for any such lack of balance may result from demands that are either too large or too small (e.g. routine, too simple professional activities). The disproportion between the demands and capabilities is accompanied by emotions, usually negative and strong. A stress situation stimulates an activity of dual functionality: restoration of balance between the demands and capabilities, and modulation of one's own emotional state.

MEDICAL DEPICTION OF STRESS

Hans Selye's theory of stress

The origins of research on stress in medical sciences are connected with a Canadian physician and physiologist, Hans Selye. He used the term "stress" to describe a non-specific reaction of an organism occurring in response to harmful stimuli (stressors), called General Adaptation Syndrome - GAS. The syndrome comprises three consecutive stages: the alarm reaction, when the defence forces are mobilised, the immunity stage, i.e. full adaptation to the stressor, and the stage of exhaustion. The last stage occurs as a result of exhaustion of adaptation energy if the stressor is strong and its impact is durable [6].

General Adaptation Syndrome encompasses non-specific and general changes. In Selye's theory, the core of stress rests in all kinds of non-specific physiological changes. The alarm reaction stage is an expression of general mobilisation of the organism's strength.

This stage is divided into two phases: (a) shock phase, consisting of the initial direct impact of a harmful factor on an organism, characterised by the occurrence of the first signals to stimulate the organism to self-defence (e.g. a drop in blood pressure or reduction in temperature), or organism damage indicators, (b) the counter-shock phase, encompassing defence reactions accompanied by changes in physiological functions (e.g. increase in blood pressure, increase in body temperature) [6].

The Immunity stage is a stage of relative adaptation characterised by an organism's ability to cope quite well with harmful factors that have already been affecting it over some period of time, and its poorer tolerance of other stimuli, which were previously not considered harmful. The exhaustion stage appears when harmful factors are too intense or persistent, and the general stimulation of an organism is no longer aimed at fighting the stressor but is characterised by a loss of defence capabilities, which is revealed through abnormalities in the physiological functions.

The last stage of exhaustion may involve relatively permanent pathological reactions, which with further impact of the stressor can lead to death. The intensity of stress we experience is determined not only by the character and intensity of a stress situation, but also by how we interpret the stressor [9].

Selye describes the mechanisms of a stress reaction in the following manner: The stressor stimulates the hypothalamus which generates the production of a substance signalling that the hypophysis should excrete into the blood a greater amount of adrenocorticotrophic hormone (ACTH). Under the effect of ACTH, the external cortical part of the adrenal glands release corticoids [3]. This leads to thymus reduction and atrophy, as well as other accompanying changes, such as, for instance, atrophy of lymph nodes, inhibition of inflammatory reactions and production of sugar.

Other typical stress reactions include ulceration of the alimentary tract (stomach and intestines), which is connected with a high level corticoids in the blood and the functioning of the autonomous nervous system.

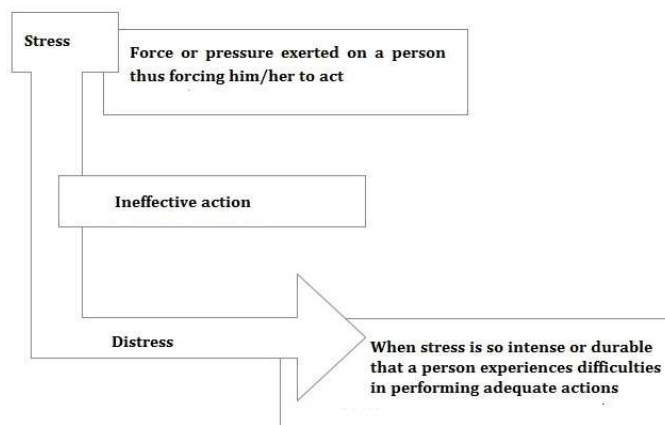


Fig. 1. Stress - distress model by Selye.

In his deliberations on stress, Selye points to its negative effects, referred to as distress. It means the stress of deprivation or overburden, occasionally leading to an illness. Nonetheless, the author also sees positive effects of a stress situation, which he calls eustress. He defines it as a state of full satisfaction or mobilisation to action.

Stress is defined according to two criteria: quantitative and qualitative. The quantitative criterion covers the stimulative value of stressors in the continuum: deprivation – stimulative overburden (hyperstress – or overstress). The qualitative criterion covers the moral value of stressors. Stressors causing

suffering and psychological disintegration are characterised as distress, whereas those motivating a person to undertake effort and work towards life achievements – eustress. This topic will recur in relation to psychological concepts of stress [3].

A doubtless accomplishment of this author consists in drawing attention to anatomic and physiological mechanisms of stress, which can be described not only on the basis of the hormonal system (hypothalamo-pituitary-suprarenal axis) but also on the neuronal system.

Typical stress reactions are induced with the involvement of hormonal and neuronal systems. The

corticotrophic hormone (CRH) released from the paraventricular nucleus of the hypothalamus is transferred with the circulatory system to the frontal lobe of the pituitary gland where it has an effect on proopiomelanocortin synthesis (POMC), the prohormone of the pituitary adrenocorticotrophic hormone (ACTH), which, on the other hand, is the beta-endorphin precursor, a peptide playing a significant role in regulating pain sensations. ACTH stimulates the synthesis and release of glucocorticosteroids from the adrenal cortex inhibiting the release of both the hypothalamic trophic hormone and ACTH.

Such feedback permanently regulates the excretory activity of the hypothalamus and pituitary gland. Small concentrations of trophic hormones maintain the activity of the pituitary gland at a resting level. The majority of stress stimuli increase the level of activity of all glands in the hypothalamo-pituitary-suprarenal axis, which according to Selye is the main cause of stress reactions. Stress stimuli going through the hypothalamus and vegetative nervous system stimulate the cells of the adrenal medulla to release adrenalin, noradrenalin and catecholamines. Catecholamines have an effect on postganglionic sympathetic neurons located in innervated tissues and, by increasing ACTH excretion, influence the release of glucocorticoids.

The stress reactions of organisms are correlated with its moral system, whose ultimate addressee is the adrenal cortex, or the mixed nervous-hormonal system, with the last link being the adrenal medulla. The significance of a stress reaction for an organism is determined by nervous centres situated in the cerebral cortex, thalamus and limbic system (hypothalamus).

The adaptation to stress is connected with the intensification of catabolic transformations and autosomal transport processes, anti-inflammatory reactions, vascular lesions, as well as the stimulation of muscular tension and the nervous system [3]. By reference to Selye's General Adaptation Syndrome it should be added that its third phase of general exhaustion involves pathological lesions in tissues (e.g. ulceration of various organs, lowering of the body's immunity threshold, sclerosis, hypertension, rheumatoid arthritis, alopecia, etc.) and, occasionally, death.

Susceptibility to stress, both in the stress adaptation and general exhaustion phase, is characterised by high individual variability manifested in some with an increase in adrenal hormone levels and general exhaustion (death), and in others only with an organism's mobilisation to act [3].

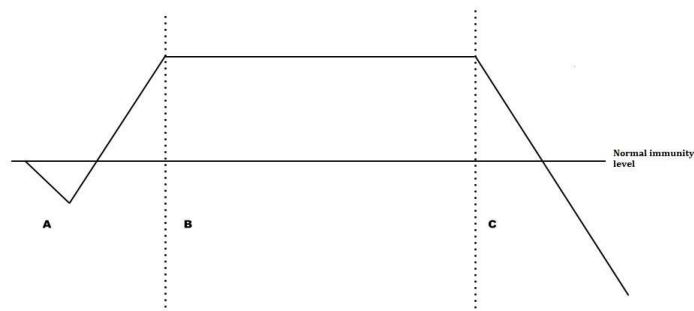


Fig. 2. The three phases of General Adaptation Syndrome (GAS) according to H. Selye: A – alarm reaction, B – stage of immunity, C – exhaustion stage.

PSYCHOLOGICAL DEPICTION OF STRESS

We distinguish three main trends in the psychological defining of stress: stimulus-based stress, depicting stress as an exterior circumstance with specified properties, reaction-based stress, where stress is understood as an emotional negative reaction, and relational trend. The latter, where stress is seen as a relation of disturbance or the possibility of disturbing the balance between the demands of a person, is the dominant theory in modern psychology [2].

The first concept, which will be presented in this article is the cognitive – transactional paradigm of stress and coping (Lazarus and Folkman) attributing the fundamental meaning to cognitive assessment. The next described depiction is the environmental theory and Hobfoll's model of stress based on resources. The last concept is a modified version of Lazarus's and Folkman's model, developed by Folkman and taking into account positive emotions and their role in coping with stress.

The theory by Richard Lazarus and Susan Folkman

The presently dominant concept of psychological stress consists in the interactive concept [7]. In the transactional theory of stress by Richard

Lazarus and Susan Folkman the authors define psychological stress as a particular type of a relationship between man and the environment, which is assessed by man as taxing or overexploiting their resources or endangering their welfare [3]. Such a depiction of stress accounts for human behaviour under the influence of numerous harmful factors within the social, material and natural environment, etc.

According to Lazarus the essence of psychological stress rests in the capability to anticipate, i.e. plan and predict future events. The author refers to psychological stress as a certain internal state induced by external factors. This researcher was firstly interested in individual differences in coping with stress and the diversity of hazards. The primary psychological mechanism responsible for the said differences consists in cognitive appraisal of danger understood as a mechanism that assesses, raises awareness and interprets events.

Lazarus distinguishes two types of cognitive appraisal, primary and secondary. Primary appraisal is a process which determines whether the stimulus reaching the brain is a stressor or not. The stimuli assessed as harmless, positive or neutral are not classified as stressors and the conducted appraisal activates proper resources in the organism [3]. Primary appraisal decides on the intensity and type of an emotional reaction to any

transaction. The favourable-positive appraisal leads to a positive emotional reaction (e.g. joy, love, satisfaction, relief).

Whereas an appraisal indicating the category of stress (danger) induces negative emotions (e.g. anxiety, anger, envy, guilt) [3]. Lazarus and Folkman define coping with stress as constantly changing (dynamic) cognitive and behavioural efforts aimed at controlling particular external and internal demands assessed by a given person as burdening or exceeding the available resources.

The ability to cope with stress can take two forms of action: those aimed at fighting the stress and those of a defensive character. The common feature of the first two is their effectiveness, i.e. the fact that they are used to achieve previously established goals or balance them despite the stress. The common characteristic of

defensive reactions against stress consists in their limited effectiveness, as they usually result in abandoning one's goals under the influence of stress.

The forms of defensive reactions are varied, starting from an escape and withdrawal from a stress situation through aggressive actions (attack on the source of danger), to various symbolic activities consisting in attributing the reality with a new, non-threatening meaning. The results of coping with stress can be assessed by observing emotional symptoms, motor activities and physiological reactions [3].

The advantage of Lazarus's theory of stress is the exposition of a subjective appraisal of danger and emphasis that the said appraisal is an active cognitive process with regard to stimuli from the environment, as it is demonstrated in fig. 3 below.

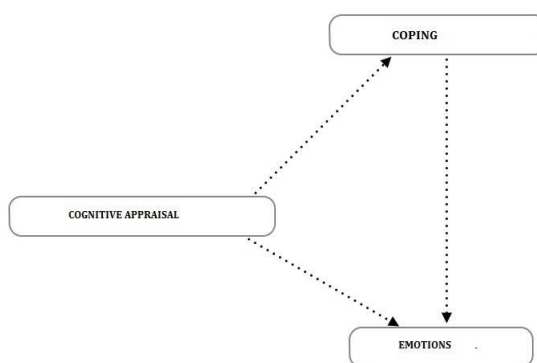


Fig. 3. Relationship between processes participating in stress transaction.

Steven Hobfoll's concept

Another psychological depiction of stress was formulated by Stevan Hobfoll on the basis of the Conservation of Resources Theory, COR. The author seeks general principles guiding the intentional actions of humans. He believes that people are mainly focused on preservation, protection and permanent reproduction of energy.

In relation to sources of human activity, Hobfoll makes an assumption that there is a general purpose of obtaining, maintaining and protecting valued objects defined as resources. Resources are defined as objects, conditions, personal belongings and forms of energy, which themselves are valuable for survival or serve to attain objects that possess such a property [4].

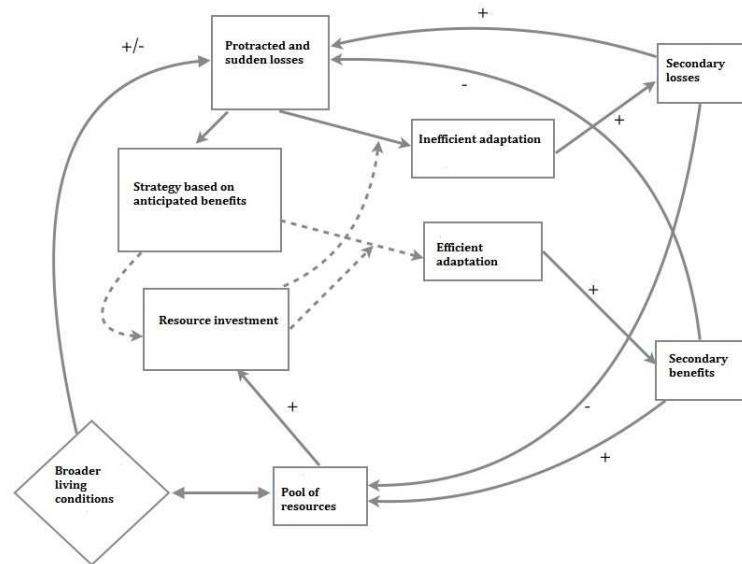
Hobfoll argues that the potential or real loss of valued resources, which constitutes the cause of stress, can be understood only if one considers the relationship between the invested resources and recovered ones. The author emphasises that not only the perceived but also the actually existing loss is treated as a source of stress [5].

Hobfoll distinguishes four types of resources. The first group is constituted by objects such as having a place to live or a means of transport, whereas the

second by conditions, such as a permanent job or a good marriage. The third group consists of personal resources, i.e. interpersonal skills and a sense of personal efficiency. The last group includes energy resources, for instance, money and knowledge.

Highly reactive individuals, who in comparison with their counterparts have at their disposal a smaller pool of resources, are mainly focused on their protection. Using the supportive style of action, they perform more auxiliary activities. Thanks to such activities they avoid a stress situation or reduce its value, which in consequence results in resource protection. This style of action enables the avoidance of failure and the maintenance of a proper efficiency level in task performance in conditions of strong stimulation [5].

Hobfoll emphasises that inter-individual differences are visible in the efficiency of use of one's personal resources. And not all individuals have equal amounts of resources, due to biological and socio-economic reasons. Hence the differences in coping with stress related to everyday problem-solving, performance of professional activities or pursuit of hobbies.



Legend:
 "+" means positive correlation
 "-" means negative correlation

Fig. 4. Conservation of Resources Theory . Source: Heszen Irena, Psychology of Stress. Favourable and adverse effects of stress. Warsaw: Wydawnictwo Naukowe PWN; 2013; 18-56.

Susan Folkman’s modified theory of stress

In consecutive studies on the theory of stress carried out in the following years, the aforementioned Susan Folkman modified her model of stress transaction taking into account coping mechanisms directed at meaning, and enriched it with the share of positive emotions. In the said model the author pays special attention to the distinction of "coping concentrated on meaning". In this depiction, coping is activated by distress resulting from an unfavourable outcome and has a fundamental meaning for further process course.

The emotions have a reverse effect on coping concentrated on meaning, for example by facilitating the perception of there being benefits of a stress situation. The author highlights that positive emotions also influence the two remaining functions of coping

concentrated on a problem and on emotions, thus supporting both of them. In this place we may also speak of the motivational role of emotions. Positive emotions also restore resources diminished in the coping process [2].

The new depiction of the classical model provides more room for the role of cognitive factors due to the distinction of coping concentrated on meaning. The model modified by Folkman with regard to stress transactions takes into account the important aspect of coping in the form of positive emotions and their role in coping as well as referring to multiple theories of modern psychology, such as the human search for sense and meaning of events.

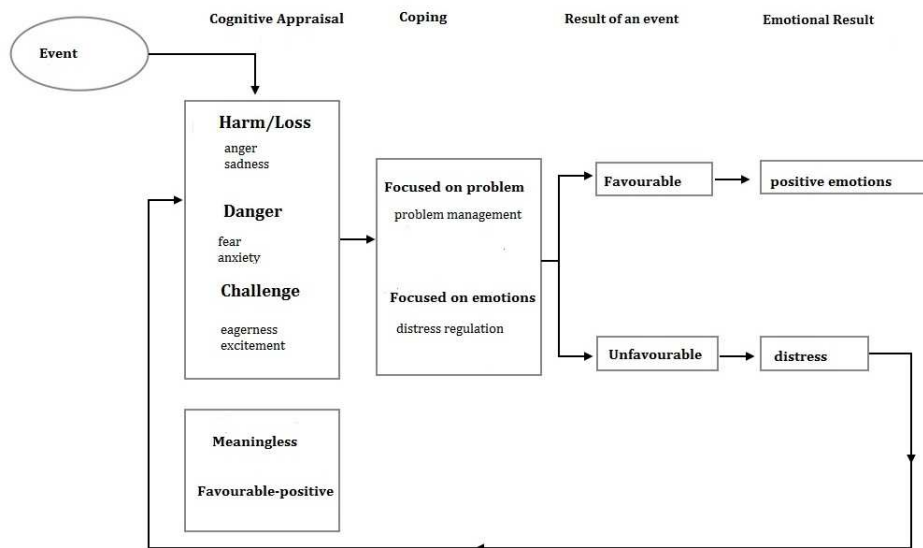


Fig. 5. Stress transaction. Source: Heszen Irena, Psychology of Stress. Favourable and adverse effects of stress. Warsaw: Wydawnictwo Naukowe PWN; 2013; 18-56.

Fig. 5 presents the structure of a stress transaction and mutual interconnection between its constituents. The events occurring in the course of a continuous exchange between the individual and surroundings are reflected in the form of cognitive appraisal. If one form of stress transactions is recognised, it is accompanied by suitable emotions. Such a cognitive appraisal also activates both functions of coping. Remedial activity ends with a favourable or unfavourable result [2]. Depending on this activity and a favourable or unfavourable outcome the emotions are stimulated.

A favourable result is a source of positive emotions and ends a stress episode. An unfavourable result, on the other hand, is accompanied by distress and may lead to a complete repetition of the coping cycle [2].

CONCLUSIONS

The presented stress models allow to conclude that there is a necessity to educate and popularise knowledge of stress and constructive ways of coping with it. Understanding of the necessity of being physically prepared (i.e. maintaining good condition and shape) for a given undertaking, which in itself facilitates coping in difficult situations, as well as the need for psychological

preparation, may prevent accidents in bodies of water. One's coping mechanisms along with physical fitness are developed gradually.

They are based on knowledge, experiences gathered during dives in familiar conditions, on multiple repetitions of rescue procedures and awareness of one's limitations and capabilities. Thorough equipment checks before diving and regular maintenance ensure its flawless operation, however, it will still not replace practice, knowledge of one's reactions, physical conditions and an understanding of the effectiveness of the applied solutions.

An invaluable element to coping in stressful situations is the repeated practising of scenarios in one's mind which are to provide an answer to the question: "what if" and the awareness of having analysed and practised emergency procedures, which can be applied in the case of any problems. The ability to recognise symptoms of excessive stress in time will protect the diver and the entire group from trouble and potentially serious consequences. The majority of problems and stress situations under water are avoidable thanks to proper planning and preparation on the land.

BIBLIOGRAPHY

1. Krzyzak J, Stres nurkowania. Medycyna nurkowa. Poznań: Wydawnictwo KOOPgraf s.c.; 2006; 473-486. Polish [The diving stress].
2. Heszen Irena, Psychology of Stress. Favourable and adverse effects of stress. Warsaw: Wydawnictwo Naukowe PWN; 2013; 18-56.
3. Terelak JF, Psychology of stress. Bydgoszcz: Oficyna Wydawnicza BRANTA; 2001; 17-83.
4. Heszen I, Sek H. Zdrowie i choroba w paradygmacie stresu psychologicznego. Psychology of health. Warsaw: Wydawnictwa Naukowe PWN; 2007; 141-159. Polish [A health and an illness within the psychological stress paradigm].
5. Strelau J, Temperament jako regulator zachowania z perspektywy półwiecza badań. Gdańsk: Gdańskie Wydawnictwo Psychologiczne; 2006; 155. Polish [Temperament as a regulator of behavior: After fifty years of research].
6. Strelau J, [scien. ed.]: Teoria stresu psychologicznego i radzenia sobie. Psychologia. Academic Coursebook. An individual in the society and elements of applied psychology. Gdańsk: Gdańsk: GWP; 2005; 465-492. Polish [The psychological stress and coping theory].
7. Terelak JF, Psychology of stress. Theory and research. Warsaw: Wydawnictwo Akademii Teologii Katolickiej; 1999; 12-22.
8. Strelau J, The psychology of individual differences. Warsaw: Wydawnictwo Naukowe SCHOLAR; 2002; 299-300.
9. Zimbardo PG, Johnson RL, McCann V, Psychologia: kluczowe koncepcje. Man and the environment, Warsaw: Wydawnictwo Naukowe PWN; 2010; 165-182. Polish [Psychology: Core Concepts].

Małgorzata Remlein, MA
Zakład Medycyny Morskiej i Hiperbarycznej
Wojskowego Instytutu Medycznego w Gdyni
Ul. Kmdr Grudzińskiego 4
81-103 Gdynia
gabinet@malgorzataremlein.pl
tel. 660 140 488