

## HOMEOSTASIS AND BALANCE IN SENIUM

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### Abstract

*The body's homeostasis ensures the individual's survival in a constantly changing environment, such as changes and fluctuations of temperature, humidity, pressure, etc. The central nervous system and cardiovascular system play a priority in maintaining homeostasis. State of balance is closely related to the theory of homeostasis and homeodynamics, where the term homeostasis is characterized as the tendency of the organism to a relatively stable balance between interdependent elements maintained by physiological processes. The study is aimed on content and descriptive analysis of the context of homeostasis, homeodynamics and bio-psycho-social balance in aging in frame of the GAČR project ID 17-25710S "Basic research of balance changes in seniors". Methods of content and descriptive analysis were used as a base. There is experimental evidence that various forms of stress, especially when severe or recurrent, can induce corresponding structural and neurochemical or neurophysiological changes in the neural and glial networks. It can be assumed that many of these stress-induced structural and functional changes in the CNS may cause the development of some neuropsychiatric disorders typical of old age. According to yoga practice, it is known that many of these changes are reversible with sufficient recovery time.*

### Keywords

*Homeodynamics; Elderly; Circadian rhythms; Balance changes; Health.*

### INTRODUCTION

Homeostasis is defined as a dynamic process by which an organism maintains and controls its internal environment, even though it is disrupted by external forces. Homeostasis (from the Greek semantic foundations "homoios", i.e. the same and "stasis", i.e. duration, standing) is the functional stability of the organism. It represents maintaining the value of a quantity at approximately the same value. For living organisms, it is the ability to maintain a stable internal environment, which is a necessary condition for their proper functioning and existence, even if external conditions change. An example

of organic homeostasis is maintaining acid-base balance. It is therefore the general ability of the human body to maintain a relatively stable internal state that persists despite changes in the external environment. The concept of this balance of the organism was first scientifically described and published for biology purposes as early as 1865 by the French physician Claude Bernard (1813 - 1878). The term itself was created in 1932 by the American physiologist Walter Bradford Cannon (1871 - 1945). Maintaining the pH balance of body fluids, body temperature, etc. is a necessary condition for maintaining the life of organism. In fact, it is not just a matter of

maintaining or lasting, but of dynamic balancing - the term homeodynamics (Jandová, 2020).

The concept of homeodynamics that we introduce here offers a radically new and all-embracing concept that departs from the classical homeostatic idea that emphasises the stability of the internal milieu toward perturbation. Indeed, biological systems are homeodynamic because of their ability to dynamically self-organise at bifurcation points of their behaviour where they lose stability. Consequently, they exhibit diverse behaviour; in addition to monotonic stationary states, living systems display complex behaviour with all its emergent characteristics, i.e. bistable switches, thresholds, waves, gradients, mutual entrainment, and periodic as well as chaotic behaviour, as evidenced in cellular phenomena such as dynamic (supra)molecular organisation and flux coordination. These processes may proceed on different spatial scales, as well as across time scales, from the very rapid processes within and between molecules in membranes to the slow time scales of evolutionary change. It is dynamic organisation under homeodynamic conditions that make possible the organized complexity of life (Lloyd, Aon, Cortassa 2001).

Aging affects the ability to maintain and restore homeostasis, as some of the mechanisms used by the body are no longer as effective as in the young body, such as the mechanism of thermoregulation. Mechanisms by which homeostasis parameters are maintained to the desired extent include the action of hormones, cell activity, and action on the body. If homeostatic and homeobalance control is not possible and the values of these parameters remain outside the required limits, the organism may die.

As a part of homeostasis, cells produce chemical signals that target other cells, altering various processes in the body. There are basically three ways to do this:

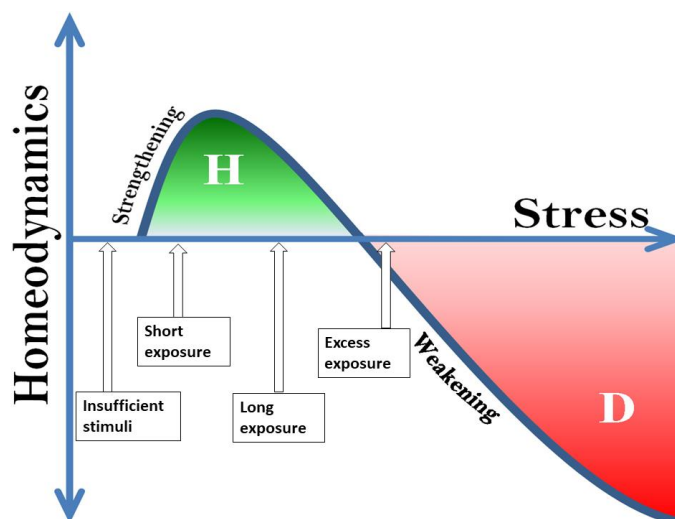
- Target cells can perform direct and individual actions, such as metabolizing more glucose.
- Cells can participate in a coordinated response in which an organ such as the heart beats faster.
- Cells can cause an immediate reaction to a certain imbalance in the body, such as feeling thirsty during dehydration.

Homeodynamic space is the determinant of an individual's ability to survive and to maintain a healthy state. The traditional conceptual model to describe this property was homeostasis. However, modern understanding of the processes of biological growth, development, maturation, reproduction and aging have led to the realization that the term homeostasis, which means "stability through constancy", fails to incorporate dynamic themes and processes, including interacting networks and complexity. Therefore, the term homeodynamics is being increasingly used to account for the fact that the internal milieu of complex biological systems is not permanently fixed, is not at equilibrium, and is a dynamic regulation and interaction among various levels of organization (Rattan 2006, 2008, 2012). A normal and healthy organism is born with intrinsic, and genetically variable, homeodynamic space, which undergoes expansion during growth, development and maturation (Rattan 2008). The three main characteristics of the homeodynamic space are: (1) stress response and buffering capacity; (2) damage repair and removal processes; and (3) constant remodelling and adaptation. There are

hundreds of genes involved in each of the above components, which comprise the homeodynamic space and its network. However, this protective survival ability is not perfect and absolute due to the complex and interactive nature of biological processes. There is a potential “vulnerability zone” around this protective homeodynamic space, the extent of which can vary among individuals depending on factors such as genetic polymorphism,

prenatal exposures, and other growth and developmental conditions (Rattan 2014). Early life events and life-style factors such as nutrition, infections, mental stimulation and physical activity affect the strength and extent of the homeodynamic space (Fig. 1).

**Figure 1** The homeodynamic ability of a biological system is affected by stress in a biphasic dose response manner, termed *physiological hormesis*. Lower levels of stress result in the strengthening of homeodynamics in a *hormetic zone (H)*, and a chronic and severe stress results in the weakening and disruption (*D*) of the homeodynamics leading to functional impairments, diseases and eventual death (Yoshida 2007)



The consequences of stress can be both harmful and beneficial depending on the intensity, duration and frequency of the stress, and on the price paid in terms of energy utilisation and other metabolic disturbances. But the most important aspect of stress response (SR) is that it is not monotonic with respect to the dose of the stressor. Rather it is almost always characterized by a nonlinear biphasic relationship. Several meta-analyses performed on a large number of papers published in the fields of toxicology, pharmacology, medicine, and radiation biology have led to the conclusion that the

most fundamental shape of the dose response is neither threshold nor linear, but is U- or inverted U-shaped, depending on the endpoint being measured - phenomenon of biphasic dose response.

Aging prevents these cellular activities. Many cells in an aging organism have lost some of their ability to perform their functions at maximum efficiency due to mutations in their DNA, generalized damage or wear. Cells may have fewer sources due to loss of efficiency and may not be able to signal or receive signals as they did before in young and middle age.

Even in situations where the signalling works well as it should, strong signals are received and the cells are less able to perform actions such as speeding up the heart rhythm or increasing the body's hydration. While aging is not the same for all people of the same age and their body, aging in general can reduce overall functionality, not just in restoring homeostasis. Aging negatively affects the body's response to homeostatic regulation. If the parameter is too high or too low, the hormones trigger cellular responses that return the value to normal. For example, too high a temperature triggers countermeasures in the skin, circulation and respiratory systems. The hypothalamus sends hormones to these systems and signals them to cool the body. Once the systems start working, body temperature tends to drop again. Homeostasis is restored (Hill, Třískala, Honců, Krejčí, Kajzar, Bičíková (2020)).

Aging may affect the homeostatic reaction described above. The gland secreting a particular hormone may no longer be able to produce as much hormone as before and as needed. Also, if the hormone is secreted in sufficient amounts, the target cells may no longer be as sensitive to the secreted hormone. They may react less and the homeostatic reaction may be slower and weaker. The body is not able to restore homeostasis as quickly as when the organism was younger (Hill, Třískala, Honců, Krejčí, Kajzar, Bičíková, 2020).

## AIM

The aim of the presented study is focused on content and descriptive analysis of homeostasis, homeodynamics and bio-psycho-social balance in aging.

## METHODS

In the presented review, the author's team defines the problems of homeostasis, homeobalance and changes in balance in seniors, at the level of current research, which are the object of review.

The examination of the mentioned cardinal parts is also based on the authors' own research work, knowledge and empirics. Methodologically, it is based on the formulation of an identifiable and scientifically recognized methodology of the three-stage research process:

- Observation, description of established terms used, sometimes currently created and defined, followed by documentary description.
- Grouping observations into categories with determined attributes and summarized into a theoretical concept explaining how a certain set of attributes in a subsystem leads to certain resulting phenomena.
- The final resultant to the prediction of phenomena that may occur in different situations.

In the interest of the correctness of the conclusions of the author's team's scientific work, the holistic principle is respected in all chapters when examining the whole and its composition, i.e. that the properties of the parts are given by the organizational relations of the whole. Furthermore, hysteresis is taken into account, i.e. taking into account the facts that the phenomenon of wellness is influenced by the environment and its history. Methods of content and descriptive analysis were used as the base.

## RESULTS, DISCUSSION

### Reactions of seniors to imbalances from the internal/external environment

Examples of homeostatic imbalances lead to the risks of poor regulation. If one or more important homeostatic parameters remain in imbalance for too long, there is a serious risk of cell and organism damage. E.g. if the body temperature remains too high, the body may suffer from dehydration and impaired brain function because the nerve cells stop working properly. Conversely, if the body temperature is too low, bodily functions gradually slow down until they turn off, and if any part of the body is hypothermic, ice crystals damage cell membranes and tissues.

Levels of many other substances are key to cellular activity. If glucose or water levels are too high or too low, the cells cannot function normally. Glucose is an important nutrient without which cells cannot synthesize the proteins they need. In addition, a constant water level is required for cell function and the propagation of chemical signals. Homeostasis keeps these values close to their target values. If they remain too high or too low, the body will suffer damage or experience excessive stress, without the ability to adapt.

The central nervous system (CNS) is the central organ regulating stress and adaptation. The subjective perception of the state of threat then determines the subsequent behavioural and physiological reactions. Thus, stress can alter and affect self-regulatory abilities, including homeostasis, mental harmony, cognitive memory and decision-making functions, and finally human performance in general. The CNS works on the basis of neuroendocrine, autonomic, immune and metabolic systems, and mediators of these systems activate epigenetic

programs that alter the expression of genetic information of cell and organ function. While the initial active response to stressors promotes adaptation, there may be a cumulative change (e.g. body fat, hypertension) from chronic stress and the resulting unhealthy behaviour ("allostatic load"), which may lead to disease, e.g. diabetes, cardiovascular disease ("allostatic overload"). In addition to entrenched early life experiences, the strongest stressors are those that come from the social environment, which affects the CNS and thus the environment of the human body and physical health (Carnes, 2011; Fulop, Larbi, Witkowski, et al. 2010).

Socio-economic status gradients reflect the cumulative burden of managing limited resources, toxic environments and adverse life events, as well as health-damaging behaviours that lead to chronic activation of physiological systems that lead to allostatic stress and overload. From an epigenetic perspective, this chapter denies the old notion that "biology is destiny" and summarizes some of the basic cellular, molecular, and neuroendocrine mechanisms of stress on the human psychosomatic system. At the societal level, aging in a democratic society should be geared so that people, directly or indirectly, have enough relevant information and access to activities that improve their chances of living a healthy life.

The conceptual link between aging and psychological stress is a constructive "allostatic burden" - the notion that repeated and cumulative disruption of homeostasis can lead to certain syndromes that are caused by dysregulation of the chronic stress response. By summarizing the markers of this hypothetical process in the primary, secondary and tertiary stages, with special regard to brain mechanisms that are directly related or even facilitate such



dysregulation, we get pathological consequences, as cumulative stress and allostasis are highly correlated with chronological age. For this reason, we present an example of yoga for the statistical isolation of such mechanisms from the generic effect of age. Yoga includes a number of techniques and various aspects of a healthy lifestyle (e.g. a specific plant-based diet, low in saturated fat; adequate exercise regime, etc.), which correspond to the latest medical knowledge about oxidative stress, acid-base balance, i.e. about the interconnectedness of the components of physical, mental, social and moral health for the protection of human health in general.

When individuals are confronted with stressors, they adapt their behaviour and physiology to deal with the situation. Reactions to stress are not reflexive. Their nature depends on the assessment of the development situation along the dimensions of novelty, uncertainty and controllability. For example, menopausal transition is characterized by higher levels of stress in the vast majority of women. It is not clear whether the menopausal transition leads to stress due to the increased symptoms associated with this period or the potential susceptibility to fluctuations in hormonal levels. There may also be an increase in stressful life events in women who coincide with the menopausal transition, thus contributing to increased mental anxiety. Few studies have focused on what women find stressful during the menopausal transition and on strategies to help them cope with this period.

Coping, balancing and harmonization strategies are associated with various forms of behavioural responses, especially depending on the ability or inability to control the situation. The social environment is often perceived as a source of stress leading to agonistic

behaviour. However, stress can also be alleviated by the various forms of social support available in the social environment. Successful coping strategies reduce physiological imbalances, as measured by cortisol and catecholamine levels in the blood. Stress does not necessarily come only from the outside. It can also come from within, due to the requirements to which seniors are exposed, depending on the characteristics of the personality. A very serious phenomenon in European countries is the general increase in psychotic disorders, mood disorders, and neurotic and anxiety disorders. It is a continuously advancing process in the last twenty years, which modern medical care cannot prevent by its own possibilities. There is a need for conceptual education in the field of mental hygiene in various age groups of the population aimed at the practical implementation of the necessary mental hygiene habits into everyday life, in our case seniors over sixty-five years of age and older (Krejčí, Psotta, Hill, Kajzar, Jandová, Hošek, 2020).

Environmental factors are social or economic conditions that affect exposure to stressors. The stress process model is widely used as a conceptual framework for understanding how environmental factors affect exposure to a variety of stressors. The three main environmental determinants of stress are social status, social roles and the environment. In general, cognition is essential, through which one is aware of and gets to know the world and oneself, and the authentic experience of phenomenological reduction, which does not serve to describe the world, but to concentrate on the moment of pure experience and gain opportunities to be aware of oneself in modern concepts of "mindfulness" programs based on the original yoga

techniques of yoga. Psychological imbalance is caused by social stressors and stressors resulting from the physical qualities of the environment, which limit the adaptive abilities and resources of the organism in senior age. These circumstances represent an extremely wide and diverse range of different situations that have common and specific psychological and physical attributes.

The challenge for the theory, research and practice of the research project GAČR ID 17-25710S "Basic research on changes in the balance of seniors" was an abstract understanding of specific properties and characteristics of environmental exposures that most strongly cause harmful psychological and biological reactions, which in turn can lead to serious mental and physical imbalances during everyday life.

Sensitivity to bio-psycho-social stressors is subject to individual differences in different age periods, which can change the impact and adverse consequences of such environmental exposures, which also requires a discussion of these mitigating effects. E.g. Pain is a complex, multidimensional experience that varies by individual and condition. Living with chronic pain is stressful and is associated with increased morbidity and mortality. Chronic pain is difficult to treat and has developed into a major public health concern. It consists of sensory and affective processes and often experiences pain as a threat. Understanding the biological interface of chronic pain and related psychosocial stressors will be important because it is an effort to prevent, reduce and eliminate negative health consequences. Pain theories identify the importance of psychological and stress factors in the perception and persistence of pain. Numerous neurobiological and biological evidence indicates altered and

dysregulated functioning with chronic pain. Further basic research into changes in the balance of the elderly needs to lead to the analysis of chronic pain and perceived stress, to a better understanding of the biological burden and also to the determination of goals for the prevention and treatment of chronic pain (Holliday, 2006; Krejčí, Psotta, Hill, Kajzar, Jandová, Hošek, 2020)

Control over aversive experiences is a central construct of stress research and can come in many forms, from behavioural control through a source of stimulation, through the perception of control to cognitive control as a form of coping response. Control modulates the neurobiological and health consequences of stress exposure and can also be used in clinical and other situations to improve stress responses. Yoga techniques make it possible to penetrate to the equilibrium state of "selfness" until the experience of a complete well-being state, which is no longer essential, is called "purnam" in yoga, i.e. stability, true wisdom. Yoga techniques thus help to rediscover what is ultimately most important in everyday life, i.e. values of a moral - ethical nature. However, yoga can also be a complex means of significantly interfering with the area of somatic, active rest and active lifestyle of seniors at the age of sixty-five. Regularly performed yoga exercises lead to the experience of a healthy, adequately trained body and strengthen the perception of self-efficacy.

The demanding events of a senior in a social environment initiate a cascade of adaptive physiological and psychological processes that create a stress response. As mentioned at the beginning of the chapter, stress responses are mediated by the joint activity of many areas of CNS and peripheral endocrine organs. There is

experimental evidence that various forms of stress, especially when severe or recurrent, can induce corresponding structural and neurochemical or neurophysiological changes in the neural and glial networks. It can be assumed that many of these stress-induced structural and functional changes in the CNS may cause the development of some neuropsychiatric disorders typical of old age. According to yoga practice, it is known that many of these changes are reversible with sufficient recovery time (Krejčí, Hošek et al, 2016).

### **Senium and circadian influences on bio-psycho-social balance**

There are a number of theories of aging in biomedicine, none of which have yet fully explained the multifactorial process of aging, such as the "Mitochondrial Theory" of aging; "Theory of the Negative Effect of Free Oxygen Radical Accumulation", which is widely discussed worldwide, and "Neuroendocrine Theory," linking neurophysiology with endocrinology and organic biochemistry. A somewhat simplistic explanation for the aging of the human body is the finding that cells of the aging human body differ from the young human body by slow mitosis, slow basal metabolism, slow biochemical intracellular processes, increased cytokine production and not entirely physiologically acting intracellular proteins, reduced receptor sensitivity, decreased antioxidant protection.

In addition, age is reported to adversely affect responses to endocrine stimuli. Receptor sensitivity and enzyme activity are reduced. In old age, due to a decrease in a number of hormones, the multifactorial regulation of glucose metabolism changes and these clinical changes are manifested by a disorder of glucose tolerance. During the aging

process, the production of antidiuretic hormone is increased and the secretion of renin and aldosterone is reduced. Also, the level of thyroid hormones may be reduced in old age, which may accelerate the onset of symptoms of degenerative brain diseases. Hypothyroidism is present in more than 5% of the elderly population over the age of 65 years. Lack of thyroid hormones causes reduced oxygen consumption in the tissues and also suppresses the metabolic activity of cells. Intact thyroid function and physiological levels of thyroid hormones are necessary for the physiological regeneration and function of muscle tissue, both striated and cardiac and smooth muscle.

Geriatrics takes an integrative approach to the processes of aging and old age and contains knowledge about the different reactivity of the elderly to the stressors listed below. For example, seniors usually react very sensitively to changes in the weather. Meteorosensitivity is generally reported as an innate sensitivity for 10% of the world's population, but in seniors previously insensitive to weather changes, it occurs and usually increases with increasing polymorbidity. Sensitivity increases to the transition of the front, to magnetic pulses before storms, to changes in biorhythms during the transition to summer / winter time, etc. More often, seniors with sensitive diseases of the central nervous system are sensitive, i.e. persons with conditions after encephalitis, stroke or severe brain trauma (especially if more severe residual paresis remains present in the clinical finding). Sensitive to physical factors are persons: with epilepsy, hypertension, cardiac, before thunderstorms may not quite well compensated asthmatics get attacks of bronchial asthma with dyspnoea. Seniors with degenerative diseases of the joints and spine or conditions after fractures of the bone



system are diagnosed due to pain in such affected parts of the spine, bones and joints up to 24 hours earlier, sudden changes in weather with temperature fluctuations. Many seniors also complain of headaches, dizziness and sleep disorders on the days of crossing the queues.

In general, seniors respond sensitively to the following stressors:

- Physical stressors: changes in the geomagnetic field, meteorotropic influences (e.g. crossing of queues, storms), heat or excessive cold, changes in the geological environment are accompanied by slower and more difficult acclimatization + adaptation + habituation (especially when moving a senior to another altitude or moving to other locality or state), lack of light facilitates the development of seasonal affective disease and related conditions to anxiety-depressive syndromes ("Season Affective Disorder" with the abbreviation SAD with grateful phototherapy, etc.).
- Chemical stressors: seniors tend to digest some foods more difficult, which is usually due to a decrease in the quantity and quality of gastric juices and some digestive enzymes, seniors are less tolerant of preservatives and carbonation of liquids. A well-known problem in the elderly is the disappearance of the feeling of thirst (they are very often at risk of dehydration). Manifestations of impaired enterobioma can manifest themselves only as malnutrition of nutrients, vitamins and minerals. The reduced ability to detoxify the body (after antibiotics, after chemotherapy and in other cases)

becomes a stressor.

- Biological stressors - viruses, bacteria, fungi, yeasts, parasites, etc., in seniors the resistance to infectious agents decreases, seniors have a slower and different course of immune responses to infections than younger age groups (e.g. seniors do not have febrile conditions - they have afebrile courses of severe viruses even sometimes with complicated pneumonia) In seniors, it is easy to develop complications in the postoperative course, due to the deterioration of the quality of connective tissue, there is a longer healing of wounds and inflammation. Elderly have problems with enterobioma recovery after gastrointestinal disease or abdominal surgery and are fully indicated for the use of prebiotics and probiotics from the beginning of therapy.

The above information clearly provides the basis for a new attitude towards "frailty" or fragility of seniors - a newer term used in foreign publications devoted to work with seniors. The materials draw attention to the importance of quality observation and evaluation of geriatric syndromes, to which it belongs as a priority.

### **Adequate movement regime in senium and balance intervention**

Based on the analysis of interventions and evaluation of comparisons, a model of positive "Self-transformation" was created in terms of procedural shift in personality qualities and health quality (Fig. 2), connecting the intervention areas "Relaxation - Adequate exercise regime - Nutrition - Preventive medical care -

salutogenesis "subsequently in coherent cycles, which may have different time lengths, see Fig. 4. Within the GAČR ID 17-25710S project "Basic research of changes in the balance of seniors", the model of four-week cycles was verified.

Basic research suggests that the relationship between stress and changes in food intake is mitigated by individual differences in psychological and physiological pathways, as well as the type of stressor and available foods. These differences make some individuals particularly prone to eating more energy in response to stress. Increased intake or changes in food choices may be part of an individual's response to coping with stress, although an alternative reason is that stress shifts motivational and attention sources to basic usual levels, leading to a choice of selective and "safe" foods. In any case, this stress response could expose individuals to an increased risk of being overweight. An important testing tool with excellent use in seniors over 65 years of age is the "Anamnestic self-assessment" determining the "Score E", i.e. the state of energy balance between income and expenditure and the "Score S" determining the score of social balance.

Real stressors are diverse and their relationships with eating behaviour are similarly dynamic and create a challenging area for future basic research into changes in the balance of seniors. For cognitive conceptualization, stress arises when environmental requirements are perceived as potentially exceeding the capacity of a given senior and there is a threat of failure. Stress anxiety is a cognitive factor that increases vulnerability, through hypervigilant processing styles that include selective focus on threat stimuli, a biased negative interpretation of ambiguous stimuli, and a focus on adverse thoughts. Short-term

episodes of mild and moderate stress can facilitate cognitive functions, especially the coding and consolidation of memory-related stimuli, and in implicit memory or simple declarative tasks. However, high-intensity exposure exacerbates the creation and acquisition of explicit memories and cognitive processes that require complex or flexible thinking. Long-term stress permanently undermines cognitive mechanisms. This may be due to a chronic increase in glucocorticoids that inhibit neurogenesis, which impair important functions in the hippocampus and possibly in the prefrontal cortex.

Movement deficiency may be also summarized in the term "hypokinetic syndrome". These are impulsivity, irritability, decreased ability to concentrate and self-control, as well as increased psychosomatic restlessness and even manifestations of aggression. Insufficient cardiovascular and cortisol responses to acute psychological stress are associated with a number of adverse behavioural and health consequences: depression, obesity, addictive substances, and drug-induced non-subsidy addictions. These different results reflect the suboptimal functioning of front-limbic systems in the brain that regulate motivated behaviour. Insufficient stress reactivity is also associated with other manifestations of decreased motivation, including lower cognitive ability and poorer performance in motivation-dependent lung function tests. In addition, an insufficient response to stress is typical of stable behavioural characteristics such as neuroticism, impulsivity, and lack of perseverance, and is common in a variety of behavioural disorders.

In the context of basic research into changes in the balance of seniors GAČR ID 17-25710S, boredom as a stressor condition was also examined. Links have been established between the design of

activities and the optimal level of diversity and excitement, which would have a positive impact on the harmonization of psychological, emotional balance and mental health. Manifestations of hypokinesia in senior age are accompanied to varying degrees by other factors - inappropriate lifestyle, unilateral stress with a lack of proper physical compensation, family and social influences, illness, congenital or acquired defects and emotional lability. With increased mental tension, muscle tone is automatically increased, which is the initial tension for subsequent muscle contraction. Coordination and reaction times of movements are negatively affected by psychological tension. Also, various posture difficulties and disorders typical of seniors over 65 are a relatively common phenomenon. It is an example of a muscle imbalance where phylogenetically older muscle groups with a tendency to shorten predominate, either by their own increase in muscle tension or as a result of the celebration of phylogenetically younger muscle groups.

Anxiety disorders are the most common group of psychiatric disorders in the elderly population. They are also important because of their association with significant disruption and high direct and indirect costs. Anxiety disorders are often associated with depressive and substance use disorders and may have other complications. These conditions are often unrecognized, misdiagnosed or trivialized, which is unfortunate because their early detection and treatment are beneficial for the sufferers, their families and society. "Adequate movement regime" means that it corresponds to age, abilities, needs, etc. The basis is the development of dexterity, including flexibility, muscle interaction and muscle balance. Properly learned movement stereotypes lead to spontaneity in

movement, which is very important for movement relaxation. Movement relaxation leads to mental relaxation. Conversely, mental well-being has a positive effect on the body's scheme and regeneration of body tissues. Each regular adequate physical activity strengthens the skeletal and muscular system, improves the function of the cardiovascular system and strengthens lung function. It has a positive effect on a person's feelings by causing increased endorphin production.

An increase in cortisol levels after waking (CAR) results in a change in cortisol levels that occurs in the first hour after waking from sleep. It is usually assessed using salivary cortisol samples immediately after awakening and then at intervals during the next hour. CAR has emerged as an important aspect of hypothalamic-pituitary-adrenocortical axis function because it is regulated differently from cortisol production for the rest of the daily cycle. It is also related to stress, affective disorders and the risk of physical health. This chapter discusses the origin and measurement of CAR and its relationship to sleep and wake cycles, acute and chronic stress, depression, and health outcomes. The initial basis for gaining seniors for adequate physical activity is the experience of well-being, joy, then playfulness and creativity. We can move and at the same time play and create either alone or with someone else.

MANAGEMENT in the sense of individual control of movement. What is simple for one can be challenging for another. Condition, age, health status, type and degree of disability, etc. play a role here. Manageability of physical activity is a very important basis for its spontaneous implementation.

SPONTANEOUS in the sense of a feeling of freedom, lightness and joy when

moving, or experiencing the "flow" effect (i.e. to be literally carried away by movement, completely absorbed). A mastered locomotor unit is characterized by spontaneity of locomotor expression, which is a prerequisite for the desired feeling of fulfillment - saturation.

**SATURATION** in the sense of a feeling of satisfaction, fulfillment during and after physical activity. It gives a feeling of self-realization and self-affirmation. Seniors tend to return to the activity repeatedly.

**REPEATABILITY** in the sense of a desire to return to a given physical activity and improve in it. At this stage, it is really possible to start increasing the load within the individual training regime.

**ADJUSTABILITY** in the sense of the volume of physical activity with regard to the health condition and body proportions of a person, his age, sex, etc. By alternating the load, there is a training effect and a certain positive dependence on the given physical activity. In practice, this dependence can "run into" the availability of physical activity for each day.

**AVAILABILITY** in the sense of the possibility of applying movement regularly, anytime and preferably anywhere every day (it depends on natural, time, financial, legal and other conditions). Here begins the selection of possible activities and their combinations (e.g. yoga, walking, swimming, etc.). This creates an adequate movement regime.

**SAFETY** in the sense of accident prevention and protection against injury when performing a given movement (possibly with the application of assistance and rescue), compliance with the principles of safety when performing physical activity. Only safe physical activity is adequate.

The purpose of this is to think about physical learning as a means of self-realization, as it also enables social balance. High levels of fatigue that disrupt daily activities are common in the elderly population, with prevalence estimates above 20%. Fatigue is a multidimensional construct with mental and physical aspects. Fatigue-related disorders (e.g., chronic fatigue syndrome) are often associated with elevated levels of psychological anxiety. Evidence suggests a two-way link between fatigue and stress. Fatigue and related constructs, such as exhaustion, can be the result of long-term stress requirements. Biological correlates of fatigue include dysregulation of the autonomic, neurohormonal and immune system, but there are no specific biomarkers of fatigue. Stress-related mental disorders (e.g., post-traumatic stress disorder and depression) have fatigue as a basic characteristic. Fatigue is also a common symptom of various medical conditions, including cardiovascular disease and cancer. The relationship between stress and fatigue may be important in the development of multidisciplinary interventions aimed at improving health-related outcomes.

Dispositional optimists expect more good things to happen to them than bad things. Optimism is associated with commitment and perseverance, and optimists tend to adapt better to stressor exposure than pessimists. Dispositional optimism is also positively associated with approach coping strategies seeking to address or manage stressors and negatively associated with coping management strategies. There is flexibility in this concept, because optimists tend to choose coping strategies depending on stress and stressor controllability. In the context of stressor exposure, there is a strong link between dispositional optimism and psychological and



physiological well-being. Some findings suggest short-term physiological costs for optimists in the process, potentially due to the continued deployment of goals and mastery of the approach. However, the short-term costs are expected to outweigh the long-term benefits, which include achieving the goals and the associated positive psychological and physiological well-being.

## CONCLUSIONS

The bio-psycho-social approach to balance can be considered as a comprehensive interdisciplinary framework for the assessment of factors influencing the balance vulnerability of seniors in clinical or health preventive practice. Specialized interventions for the integration of balance abilities in static and dynamic balance can bring overall health benefits in terms of prevention and homeodynamic principle.

The aim of the project GAČR ID 17-25710S “Basic research of balance changes in seniors” was to develop a new solution for fall prevention in older adults, taking into account a wide range of different biopsychosocial factors. The aim of the project was to develop a new fall prevention solution for seniors over the age of 65, which would reduce the costs of falls and increase the quality of life of these older people. The four-week intervention program “Life in Balance” implemented within the GACR project ID 17-25710S “Basic research of balance changes in seniors” confirmed the expected results in order to develop balance and support the quality of life of seniors.

## Conflict of Interest

There is no conflict of interest.

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