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HEALTH AND TRAINING-COMPETITION TAXON CATEGORIZATION OF BODY IMMERSION AND COLD WATER SWIMMING

Sebastijan Higl[1], Aleksandra Obradović[2]

Faculty of Sport and Physical Education, University of Belgrade, Serbia
Faculty of Medical Sciences, University of Kragujevac, PhD student, Serbia

Abstract
Immersion and swimming in cold water are an integral part of the human evolution, but also an element and legacy of cultural and religious heritage. It is an integral part of life practice that is becoming more and more popular due to the recognition of the benefits it provides, both in the method of training sports on land, in water and on water, as well as in terms of a person's overall health, age and lifespan. By identifying and analyzing 128 articles from four scientific databases, several areas of knowledge related to the effects of stress, cold water and swimming, i.e. the responses of organic systems and their co-adaptations, were determined. It was determined that empirical facts, theoretical generalizations, as well as practice models were established around a large number of facts of an interdisciplinary and multidisciplinary nature of knowledge (classification). In the next step, they were systematized into cognitive frameworks - taxa, as axioms rich in facts of empirical and theoretical experience. Taxa are named on the basis of the cognitive being that "dozes" in them, and that: a) respiration and circulation; b) inflammatory course; c) immune response; g) stress and anxiety; d) aging; f) training and competitive abilities; e) prophylaxis; h) rehabilitation; z) methodological challenges; i) religious customs; j) life habits. By identifying, categorizing and systematizing inter and multidisciplinary facts, a cognitive construct was created for further study and scientific affirmations, encouraging sports practice, recovery, directing life habits, as well as theories related to healthy aging and lifespan. No less important are the facts of the practice of cold water immersion and swimming for life habits, and as part of religious customs.

Key words: IMMERSION / PROPHYLAXIS / HEALTHY AGING / ANALYSIS OF THE MEANING

Correspondence with the authors: Sebastijan Higl, e-mail: sebastijan.higl@fsfv.bg.ac.rs

EVOLUTIONARY INTUITION, AFFIRMED LIFE AND SPORTS PRACTICE

The constant striving for health, as well as the concern for known and numerous public health problems, are closely related to the tendency towards a longer, better and meaningful life. Therefore, health is not only a personal, but also a social responsibility (Solberg, 2014), because the influence on the health of the individual is largely influenced by wider social and economic structures. In other words, it is a *de facto* social goal, since a healthy population contributes to sustainable socio-economic development, promoting productivity and well-being within the community. Because of this, but also for numerous other reasons, public health becomes one of the key formative elements of the development and functioning of society.

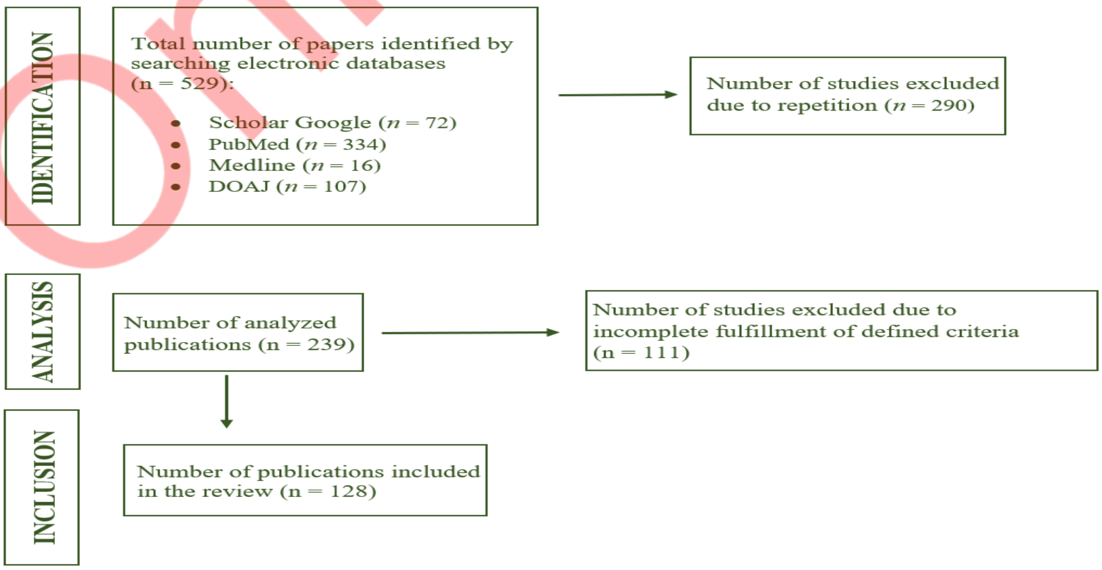
With the development of human consciousness, experience, learning and the ability to reason, in man's search for health, the originally dominant motive of survival was replaced by the motive of achieving a better life quality. However, in modern society, the aforementioned is becoming an increasingly complex and layered phenomenon, which includes collective physical, spiritual, social and mental health. Bearing in mind the above, it is clear that through various prophylactic and therapeutic actions, man continuously strives to improve the quality of his own life, to extend his health and lifespan. These efforts are contained in the concept of "healthy aging". Scientific fields dealing with healthy aging agree that one of the factors of health and longevity is physical activity (including swimming), which can be used to improve health status in a simple and affordable way. Physical activity and individual health, in accordance with the Japanese philosophy of *ikigai*, leads to benefits, both on an individual and social level.

Thanks to the social, educational and pragmatic value it possesses, thinking about swimming, as a broader construct, has been improved over the years and seems to have moved significantly from utilitarian and sanitary aspects to prophylactic, therapeutic, didactic, religious, as well as sports and recreational space, while at the beginning of the 20th century formative and health values receive more and more attention. In other words, although cold water immersion and swimming (colder than 15ºC, Suomen Latu Outdoor Association, 2022) are not a new practice, but a kind of religious and cultural heritage, they have recently become one of the most noticed global trends in the world of recreation and sports, that is, in the fitness and wellness industry. In this regard, there is a clear global expansion in terms of the development of methods associated with immersion / submersion, staying and swimming in cold water, according to which the identification, analysis and classification of benefits, risks and advantages of the mentioned activities consecutively become cognitive processes of importance! Bearing in mind that immersion and swimming in cold water cause different acute and chronic effects, depending on the method, frequency and duration of the exposure itself, there is also a need for precise identification of taxa (conditionally groups of theories) and their allocation into clearly determined logical-cognitive categories. The determination, classification and hierarchy of taxa will enable a fundamental scientific and practical understanding of the subject of this paper – cold water immersion and swimming, and its formation as a life and sports theory that has been studied and, according to the results of scientific facts and the affirmation of the principles of good practice, disseminated in a clear scientific context.

COLD WATER SWIMMING: A HEALTHY AND BENEFICIAL PRACTICE, A CHALLENGE OR A TREND?

Swimming in cold water introduces physiologically intact organisms into a state of multiplane stress, considering the exposure of the body to unusually low water temperatures. Despite this fact, in individuals with a good general health status, it has been observed that the aforementioned activity (if properly programmed, dosed and continuously implemented) can result in numerous health benefits for the entire system (Manolis A, Manolis S. et al, 2019). On the other hand, inadequate immersion and swimming in cold water, which most often implies uncontrolled exposure, also carries the risk of a fatal outcome, due to the initial neurogenic response to the shock that extremely low water temperature can cause on a whole range of organic systems, i.e., due to an excessive reduction in energy production, it can lead to progressive hypothermia (Knechtle, Waśkiewicz et al, 2020). Hypothermia can also be observed at relatively high water temperatures (15+°), due to exhaustion of energy sources for the functioning of the body. In this regard, it is extremely important to emphasize (and thus study) that the health benefits of submersion and swimming in cold water are the result of human capacity, both immediate accommodation (acute), and above all, chronic co-adaptation of a large number of organic systems. With continuous exposures, the capacity of co-adaptations expands, outgrowing their chronic form, which implies a significant health effect, given that they imply a dynamic, local or systemic adaptation of the organism to a (eu)stressor. On the other hand, although immersion and swimming in cold water (primarily in the winter) for many is a challenge, i.e. a means of testing one's own psychophysical limits, with the development of social networks and an increase in interest in leading a healthy lifestyle, swimming in cold water has become a global trend and challenge. Therefore, the mentioned activity, along with immersion in similar conditions, is often promoted as one of the ways to achieve a better physical appearance, longevity, but it is also a way of having fun, proving oneself, that is, expressing belonging to certain social, value, and religious circles.

Content analysis and deduction of relevant conclusions resulted from researching of four online directories, namely: PubMed, Google Scholar, MEDLINE, DOAJ, according to different combinations of keywords listed in the abstract. Five hundred and twenty nine (529) papers were initially selected from the databases. After detection and elimination of duplicates, 239 publications were included in the process of further analysis. The criteria for including the publication in the review included the following conditions: 1) the publication refers to immersion or swimming in water of different temperatures, 2) the research was conducted on a human sample, 3) the paper was published in the period 2008-2025. year, 4) the key words according to which the search was performed are found in the title of the publication. Due to the incomplete fulfillment of the defined criteria, 111 publications were excluded from the analysis, which means that the final literature review included 128 publications (scheme 1), processed and presented through several separate groups of knowledge, taxa.



Scheme 1. Study identification and inclusion procedure aligned with recommended guidelines for reporting in systematic reviews and meta-analyses (*PRISMA flow diagram*)

It is clear that cold water swimming and immersion is more than a physical activity; it is a complex practice that offers significant health benefits, while at the same time presenting a challenge to the body and mind, which also carries certain risks that require caution, which once again indicates the importance of determining reaction agents, their classification, shaping them into groups of knowledge (taxa) and a complete theoretical-practical construct. In a way, the theoretical foundation is followed by a didactic and methodical framework that translates immersion and swimming in cold water into a safe and prophylactic activity. The cognitive concept of this analysis and deduction, opened the process of systematics. The translation of empirical facts into theoretical generalizations and practice models was established around a large number of facts of an interdisciplinary and multidisciplinary nature of knowledge (classification). In the next step, systematization was carried out into cognitive frameworks - taxa, as axioms that make up rich empirical and theoretical experiences in which high cognitive capacity "doze", namely:

Cardiovascular and respiratory system taxon

Numerous studies have recognized the positive effect of immersion and swimming in cold water on the respiratory and cardiovascular systems, but also on cardiovascular risk factors, primarily on blood pressure and lipid profile (Kralova Lesna, Rychlikova et al, 2015; Gibas-Dorna, Chęcińska, Korek et al, 2016; Checinska-Maciejewska, Miller-Kasprzak et al, 2017). The core of the response of the mentioned systems to exposure to immersion and swimming in cold water are the consequences of increased activation of the sympathetic nervous system, caused by exposure to low temperatures, the most noticeable of which are vasoconstriction and activation of thermogenesis (Shattock, Tipton, 2012; Srámek, Simecková, Janský et al, 2000). In addition to the above, a significant increase in blood pressure (Mishra, Manjareeka et al, 2012; Baranova et al, 2023), heart rate and cardiac output (Shattock, Tipton, 2012), as well as a decrease in cerebral blood perfusion (Mantoni, Belhage et al, 2007), an increase in the level of fibrinogen in plasma (Esperland, de Weerd, Mercer, 2022) etc. was noticed. One of the most recent studies that observed the effects of swimming in extremely cold water indicated that winter swimming promotes positive changes in both the morphology and rheology of blood cells (Teległów, Frankiewicz, Marchewka, 2025). However, it is very important to emphasize that people who suffer from various cardiovascular diseases (and for whom swimming is often advised as a suitable physical activity) may be significantly more susceptible to the harmful effects of exposure to cold water, which primarily involve the provocation or worsening of arrhythmias, i.e. various types of life-threatening heart rhythm alterations (Manolis et al, 2019).

When it comes to the respiratory system, it is known that exposure of the system to cold water causes a series of physiological reactions, including a significant increase in the frequency of breathing, i.e. changes in its speed (Datta, Tipton, 2006). Through the gasp reflex, which is also the initial part of the automatic response to exposure to cold water, the body manifests a tendency to reduce heat dissipation by modifying respiratory patterns and activate mechanisms that ensure greater breathing efficiency (Mekjavić, La Prairie, Burke, Lindborg, 1987). Also, one of the more recent publications indicated that cold water stimulates thermoreceptors in the skin, which leads to an increase in the rate of breathing, with the aim of improving the overall oxygenation of the system, i.e. the supply of tissues with oxygen (Ntoumani, Dugué, Rivas, Gongaki, 2023). In healthy adults, especially those with asthma, or other respiratory conditions, it has been observed that exposure to cold water can cause bronchoconstriction, where the cold air combined with swimming in cold water causes the airways to narrow, which further leads to difficulty breathing, the manifestation of asthma attacks (or individual symptoms, such as constant coughing, wheezing, etc.) (Diversi, Franks-Kardum, Climstein, 2016), and in some cases to pulmonary edema (Lund, Mahon et al, 2003; Hohmann, Glatt, Tetsworth, 2018; Paz, Mallah et al, 2020; Hårdstedt, Seiler et al, 2021; Czarnecka, Korczak et al, 2024). Also, in individuals who actively swim in winter conditions, a 40% reduction in the incidence of upper respiratory tract infections was observed (Lipińska, Kowalczuk et al, 2024; Czarnecki, Nowakowska-Domagała, Mokros, 2024). The application of various breathing techniques, which are often applied with different modalities of immersion and swimming in cold water, opens a series of questions related to the development of the ability to control breathing by controlling these agents, which could be especially useful for people with reduced respiratory function, caused by various health problems.

Stimulation of hormone synthesis and secretion taxon

Bearing in mind the fact that immersion and swimming in cold water represent a unique type of stress to which the body is exposed, it is reasonable to expect changes in the synthesis of hormones that play a key role in stress regulation and adaptation of the body to extreme conditions. In this regard, catecholamines, insulin, thyroid-stimulating hormone (TSH), adrenocorticotropic hormone (ACTH) and cortisol stand out, in the reviewed publications, as hormones with a pronounced reaction to stress induced by the mentioned agents (Knechtle et al, 2020). The same tendency was noted in studies that examined the levels of dopamine in the striatum and cortex, which is considered an integral part of the response to the so-called "cold shock" (Beley A, Beley P et al, 1976), as well as research focused on serotonin levels (López-Ojeda, Hurley, 2024). The effect on insulin metabolism is particularly interesting, although at first it seems to be a gender determined mechanism (Gibas-Dorna et al, 2016). In one of the most famous studies that observed the mentioned problem, thirty swimmers engaged in ice swimming / winter swimming, were followed during six months, with the main observed parameters being their morphology and insulin sensitivity (Gibas-Dorna et al, 2016). Subjects who swam in cold water showed, as expected, tendencies towards a higher percentage of body fat, with noticeable differences between the genders, compared to the control group. In subjects with a lower percentage of body fat, regardless of gender, an increase in insulin sensitivity was observed, but also a total decrease in insulin secretion (Gibas-Dorna et al, 2016). In a group of subjects who swam in 0–3°C water for 20 seconds, three times a week, for 12 weeks, a significant increase in ACTN, cortisol and norepinephrine levels was observed (Leppäluoto, 2008). Also interesting are recent studies that examined the effects of cold water swimming on pregnant women, which concluded that regular, properly programmed exposure to cold water leads to the suppression of corticotropin-releasing hormone (CRH) levels in the circulation, which consequently affects the reduction of chronic stress (Gundle, Atkinson, 2020). Chronic stress, to which pregnant women are exposed, is often associated with complications such as low birth weight of babies, as well as premature birth. Accordingly, swimming and immersion in cold water of appropriate quality, under controlled conditions, can potentially affect the reduction of stress levels in pregnant women, i.e. better outcomes of childbirth itself (Gundle, Atkinson, 2020; Shawe, Felton, Harper et al, 2025).

A taxon of morphological, anatomical and physiological conversions of light to dark adipose tissue

In the human body, there are two dominant types of adipose tissue that have antagonistic functions: white adipose tissue (WAT), which stores excess energy obtained from food in the form of triglycerides (and releases it according to the body's energy needs), and brown (dark) adipose tissue (BAT), determined to release energy through thermogenesis (Saely, Geiger, Drexel, 2012). Research has shown that disturbances in BAT metabolism plays a key role in the pathophysiology of obesity and multiorgan insulin resistance (Saito et al, 2009; Schrauwen, van Marken Lichtenbelt, 2016; Scheele, Nielsen, 2017; U-Din, de Mello, Tuomainen et al, 2023). Consequently, and due to its unique ability to convert excess energy into heat, dark adipose tissue is considered a new potential "target" in the determination of physiological assumptions in the fight against preclinical and clinical obesity, which accompany the so-called metabolic diseases (Cypess, Kahn, 2010; Huo, Song, Yin et al, 2022). It is also important to point out that BAT is innervated by both sympathetic and sensory nerves, and that it is characterized by the presence of multilocular lipid droplets, a large number of mitochondria and significantly increased expression of the mitochondrial protein UCP1 (Nicholls, Locke, 1984). When activated, the aforementioned protein separates the processes of mitochondrial respiration and ATP synthesis (Lowell, Spiegelman, 2000), which means that it consequently affects the increase of proton leakage through the inner mitochondrial membrane, releasing energy in the form of heat (Ikeda, Yamada, 2020). Regarding exposure to cold temperatures, studies shows that structural changes in lipid metabolism due to exposure to cold, such as immersion and swimming in cold water, may have an important function in the thermogenesis of BAT, and thus potentially improve metabolic health, with the aforementioned adaptations observed already after the third day of exposure (Faber, Zhu, Castellino et al, 2014; Meikle, Summers, 2017; Sustarsic, Ma, Lynes et al, 2018; Mika, Sledzinski, Stepnowski, 2019). Dark adipose tissue is especially present in newborns, i.e. in the organisms of young mammals, where it has a key role in thermoregulation, i.e. survival at low temperatures. Although for a very long time it was considered that it is not present in the system of adults, or that it has almost no significance, recent research increasingly proves that adults also possess metabolically active dark adipose tissue, which can play an important role in maintaining energy homeostasis in the body (Saito, Okamatsu-Ogura et al, 2009; Saely et al., 2012). Light adipocytes, derived from the BAT, accordingly share many features with dark adipocytes, such as multilocular lipid droplets, increased mitochondrial density, and high levels of UCP1, in addition to increased capacity for oxidation and thermogenesis (Seale, Bjork et al, 2008; Wu, Boström et al, 2012; Kiefer, 2017; Perez Valgas da Silva, Hernández-Saavedra, White, Stanford, 2019). Also, it is interesting to point out that agents such as cold, i.e. exercise - swimming in cold water, are important inducers of the conversion of light adipocytes into dark ones (Petrovic, Walden, Shabalina et al, 2010; Stanford, Middelbeek, Goodyear, 2015), since the conversion initiated by exercise and cold increases the number of metabolically active cells in BAT, which essentially represents one of the newer effective strategies to combat clinical obesity and T_2DM (Ishibashi, Seale, 2010; Gibas-Dorna et al, 2016; Vargas-Castillo, Fuentes-Romero, Rodriguez-Lopez et al, 2017; Tayebi, Motaghinasab, Eslami et al, 2024). A review of available publications also observed a connection between exposure to cold and the genesis of BAT through batokine signaling, i.e. stimulation of interleukin 6, neuregulin 4 and FGF21 (Fisher, Kleiner et al, 2012; Christian, 2014; Villarroya, Cereijo et al, 2017). Considering that swimming and exposure to cold, individually, can positively influence the management of body composition and insulin sensitivity, it is clear that a careful combination of the mentioned methods could potentially develop a new approach aimed at combating obesity, which could act within a population at high risk for the development of T_2DM and other metabolic disorders. This, in a practical sense, represents an unequivocal expansion of the theoretical framework of swimming physiology in the area of immersion and cold water taxa, but also in the area of swimming prophylaxis by stimulating the metabolic capacity and function of adipose tissue as an organ.

Oxidative stress taxon

Swimming and immersion in cold water, in terms of local and systemic oxidative stress (OS), may have a dual role; Although swimming in extremely cold water can be a significant factor in the genesis of OS, especially in the case of untrained and unadapted individuals (Kierzenkowska, Woźniak, Boraczyński et al, 2012; Knechtle et al, 2020), it can also stimulate the body to increase the production of antioxidants, which help to fight it (Wesołowski, Kierzenkowska et al, 2023). Also, bearing in mind that swimming, as a form of physical exercise, has a positive effect on the antioxidant protection system (Siems, Brenke et al, 1999), i.e. that it does not lead to a significant acute increase in the level of oxidative stress in the plasma of the exposed individual (Obradović, 2024), it is important to emphasize that short-term exposures to cold water (cold water immersion or swimming), can also induce a number of positive adaptive responses, including increasing levels of antioxidant enzymes, which help both in neutralizing free radicals and reducing inflammatory responses (Siems et al, 1999; Ptaszek, Podsiadlo et al, 2024; Shawe et al, 2025). In other words, long-term observed, regular and controlled swimming in cold water, as well as immersion in the same conditions, can affect the reduction of OS levels, but also the general improvement of the capacity and quality of the antioxidant system, which can prevent numerous pathologies associated with its increased concentration. Also, in addition to common pathological conditions, oxidative stress is, according to one of the numerous theories, also related to biological human aging (Dröge, 2003). In accordance with the fact that the life expectancy of the population has been significantly shortened after the COVID pandemic, it is not difficult to conclude that the listed and other benefits of immersion and swimming in cold water can be used as a medium of health management, affirming factors that, to a certain extent, can influence the genesis of conditions and diseases that positively correlate with aging (Liguori, Russo, Curcio et al, 2018), but negatively affect the quality of life. In other words, one of the imperatives of modern societies that strive for a healthy population is certainly the development and implementation of various healthy aging strategies, which suppress - slow down the factors that affect it. Part of one of them is cold water swimming, which has a positive effect on cardiometabolic risk factors, stimulates the conversion of fat tissue, contributes to mental health, the quality and quantity of sleep of elderly people, etc (Kunutsor, Lehoczki, Laukkanen, 2024).

Taxon of mental health and cognitive efficiency

Immersion in cold water has a significant impact on mental health, as it affects the relief of symptoms of stress, anxiety and depression (van Tulleken, Tipton et al, 2018; Oliver, 2021; Pound, Massey, Rosenel et al, 2024; Pound Massey et al, 2024a). Also, in one of the more recent studies, it was noticed to lead to an improvement in the general mental status of patients with rheumatoid arthritis, fibromyalgia or asthma (Lipińska et al, 2024). Publications that observed the effects of cold water swimming on mental status, pointed to the fact that subjects who regularly swam in cold water four times a week, for four months, showed significantly less symptoms of tension and general fatigue, compared to the control group. In addition to the above, a better general mood, better memory and a higher level of energy during the day were observed (Kelly et al, 2022; Hjorth, Løkke, Jørgensen et al, 2022; Yankouskaya et al, 2023; Cain, Brinsley et al, 2025, Ono, Wahl et al, 2025). Research conducted in Finland, where swimming in cold water is part of cultural heritage, highlights it as a form of exceptional support for general health, self-confidence, and positive self-perception (Airo, Lehtonen, 2023). Also, when it comes to cognitive efficiency, numerous studies highlight the positive impact that repeated immersion in cold water has on reaction time, attention, logical reasoning and information processing (Jones, Bailey, Roelands et al, 2017; Shoemaker, Wilson, Lucas, Machado et al, 2019; Falla, Micarelli et al, 2021; Kunutsor, Lehoczki, Laukkanen, 2024).

Life habits and aspirations taxon

Deliberate exposure of the body to cold water has been viewed with a certain respect and fear since ancient times. Today, in the Nordic countries, but also in Poland, the Czech Republic, Russia and the Baltic states, "winter swimming" is part of everyday life, culture and tradition. In the churches of Orthodox European countries, swimming in cold water is associated with the celebration of January 19, as one of the most important Christian holidays, the Epiphany. In Russia, Belarus, Ukraine, Kazakhstan and Kyrgyzstan, the tradition consider making a cross-shaped opening on frozen water surfaces (in ice), through which, after the midnight prayer, the religious ones enter the water and immerse themselves three times. In the Serbian and Greek Orthodox churches, a similar tradition is observed, which, in addition to immersion, also involves swimming of 33m long distance, to a cross thrown into cold water. This is not a part of church dogmas, but a popular belief that those who dare to swim in cold water "will be healthy and prosperous throughout the year“. Although it seems more and more often that (self)competition is in the foreground, the spiritus movement of the mentioned tradition is reflected in the symbolization of peace, Christian love and unity in faith.

The Epiphany swimming for the Holy Cross was registered in January 2024 in the National Register of Intangible Cultural Heritage of Serbia, as an element of living heritage, from the domain of social customs and practices. In other parts of the world, especially in Finland, Sweden, Norway, Russia, Estonia, Latvia and Lithuania, various forms of swimming and immersion in cold water are part of a centuries-old tradition, and in the last few decades, they are often practiced in combination with sitting in the snow and sauna. In the United Kingdom and Ireland, cold water swimming, as a sport swimming discipline, is developing rapidly, as evidenced by the increasing number of competitions. The expansion was particularly noticeable during the Covid-19 pandemic. The same trend was observed in Slovenia, the Netherlands, Belgium and Germany during the last 15 years.

Methodological taxon

The methodological taxon, in the context of immersion and swimming in cold water, refers to structured approaches, techniques and methods that are used in the study of the physiological, psychological and metabolic effects of swimming and exposure to cold water, but also that enable an experiential understanding of the effects of cold water on the human body. In other words, it includes swimming as a form of physical activity, but also methods of exposing the body to cold water developed with the aim of researching physiological, psychological and health adaptations: controlled immersion in cold water, different forms of swimming training, techniques for mapping and monitoring system responses etc. In addition to being used in scientific research, the mentioned methods are also applied in practice, especially in the field of sports, in which immersion in cold water has a significant place in the recovery process after training and competitive loads (Xiao, Kabachkova, Jiao et al, 2023).

Training – competition taxon

Ice baths are a generally accepted agents of recovery and rehabilitation among athletes, especially among swimmers, who have been using them for a long time as one of the effective ways of recovery after intensive training and competitions. As is known, swimming requires repetitive movement patterns and explosive movements, which can easily lead to microdamage of muscle fibers, inflammation and accumulation of metabolic byproducts, such as lactic acid. Application of cold water reduces inflammation and pain due to vasoconstriction that occurs during immersion, while after the end of the exposure, progressive vasodilation occurs, which improves circulation and accelerates the elimination of metabolites (Bleakley, Davison, 2010). The described method, and its training-competition variants, help in faster tissue regeneration, reduces the risk of overtraining, enabling swimmers to recover faster and better, in order to adequately prepare for the training and competition loads to which they are exposed in a short period of time. In addition to the benefits they have on the body, ice baths also have a significant psychological effect. As highlighted by the taxon of mental and cognitive performance, exposure to cold activates the sympathetic nervous system, improves focus and resistance to stress, which can be of crucial importance in competitive conditions, where focus and mental toughness are some of the main determinants of a successful swimmer’s performance. Many elite swimmers implement ice baths in their recovery routines, as they have a positive effect in reducing muscle spasm, increasing muscle elasticity and accelerating tissue regeneration (Xiao et al, 2023) in the period between races, especially during several-days competitions. When combined with other recovery methods, such as proper nutrition, sleep hygiene, hydration, and massage, an ice bath can significantly contribute to long-term endurance and peak swimming performance.

In addition to the fact that it is used to speed up recovery in healthy athletes, the ice bath has an important place and role in the rehabilitation process after injuries. Cryotherapy ("ice treatment"), which involves treating certain injuries or conditions with ice, cold compresses or other cooling techniques, is often used in the rehabilitation of acute sports injuries, such as contusions, distensions, distortions, dislocations, tendinitis, and the like, since it affects the reduction of pain perception, but also the reduction swelling and muscle spasm (Wilcock, Cronin, Hing, 2006). Also, treating the injured area with ice (or other agents whose effects are based on low temperature), slows down metabolic processes, which helps control the inflammatory response and prevent further tissue damage. In addition to the application in the initial phase of recovery, the use of ice baths in the continuation of the mentioned process can affect the improvement of blood flow and the acceleration of tissue regeneration, allowing athletes to return to an adequate training process more quickly (Hohenauer, Taeymans et al., 2015). The continuous application of this method, under the supervision of an expert, can have a significant effect on shortening the time of recovery or rehabilitation, but also on improving the functionality of the locomotor apparatus after an injury. In sports similar to swimming, which imply that athletes often compete several times a day, and thus for several days in row, the recovery speed index is one of the key factors for maintaining competitive efficiency and, accordingly, planning a competitive strategy. Immersion in the so-called "swimming tubs", mobile installations that are placed in the competition area, is a practice that is practiced during the breaks between races, or at the end of the competition day. These protocols, which imply previous co-adaptation of organic systems, speed up the regeneration process, i.e. the organism prepares faster and more efficiently for the next performance. Accordingly, the following protocols are most often used:

- **Brief ice baths** (3-5 minutes in water 10-15°C): They are used immediately after the race to reduce localized inflammation, i.e. to slow down muscle fatigue, without excessive cooling, which could negatively affect explosiveness in the next race.
- **Contrast baths** (alternating exposures: 3 minutes of cold water + 2 minutes of warm water, repeating the process 3-4 times): Improve circulation and help eliminate metabolites without a drastic drop in muscle temperature, which can help athletes maintain optimal strength levels for subsequent performances.
- **Use in combination with active recovery**: low-intensity swimming or stretching after an ice bath can improve muscle flexibility and accelerate recovery, without negatively affecting the swimmer's performance.

After the end of the competition day or after the competition, athletes often apply longer sessions of ice baths (10-15 minutes in water 10-12°C), with the aim of promoting tissue regeneration and reducing muscle inflammation. This is especially useful for swimmers participating in final races or relays, where every second counts for success. However, it is important to emphasize that too frequent application of ice baths during multi-day competitions can temporarily affect the reduction of muscle strength, i.e. adversely affect adaptive processes, which is why it is important to adjust the frequency and duration of exposure, in accordance with the individual characteristics of the athlete and the needs dictated by the competition itself (Wilcock et al., 2006). The effectiveness of using an ice bath in the population of top athletes has been confirmed, in addition to research, by training and competition practice, which is why today it is an indispensable part of the recovery program in top sports.

SWIMMING THEORY AS A KNOWLEDGE AND PRACTICE ENTITY

By analyzing of numerous information sources at a high level of knowledge (128 publications), which were selected in relation to the key words: immersion, swimming, cold water, physiology, aging, training, competitions, sports... a large number of related references were determined, with which, more closely, it is possible to determine the multiple effects of immersion and swimming in cold water. In the next cognitive step, the analysis of selected references, which could conditionally be called discourse analysis (the text contains a meaning that can be interpreted and searched for meaning in it), the taxa of practice and research practice were determined.

Identified and described taxa of submersion and swimming in cold water, in the next cognitive step, using a constructivist approach, separated the following cognitive categories of life and health habits, namely:

- Hormetic category (predetermined by the course of adaptive responses of organic systems, with a clear outcome on health, training and benefits of lifestyle habits);
- Applied training-competition category (referring to training condition and preparation, immersion, recovery, anxiety, weight management);
- Methodological category (methods and techniques of knowledge);
- Health-applicative category (aging, inflammation, metabolic, neurocognitive conditions and diseases...);
- Religious category (as a peculiarity of the Orthodox faith, celebration by immersion in cold water).

The effects of established concepts of immersion and swimming in cold water are a current research area, but also an effective field of health conditioning and trained human abilities, athlete's skills, as well as a challenge for religious people in their relationship with God.

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ORCID authors identification (https://orcid.org/)
Sebastijan Higl: 0009-0005-4429-1756
Aleksandra Obradović: 0009-0008-6289-216X

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