

## **SYNERGY OF PHYSIOLOGY, PSYCHOLOGY AND TACTICS: KEY TO SUCCESS IN HANDBALL**

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This article highlights the unique experience of the development of handball in Australia. The study focuses on the participation of the Sydney Uni Handball Club team in the “Europe Tour 2024”, which is an important step towards international recognition and exchange of experience with leading European clubs. The purpose of the study is to assess the relationship between physiological training, psychological stability, tactical flexibility and their contribution to the sports performance of the team. The object of study is the process of training in handball at the professional level. The subject of the study is the physiological aspects of training in the context of the specifics of the training process in handball. Research methods: theoretical analysis and generalization of scientific and methodological sources on the topic of the research, pedagogical observations. Research results. The authors analyze key aspects that influence team performance, including adaptation to new conditions, tactical flexibility, fatigue and recovery management, and the effectiveness of finishing attacks. Particular attention is paid to the impact of jet lag on the physical and cognitive functionality of the athletes, emphasizing the need to develop strategies to adapt to flights and time zone changes. The proposed measures are aimed at minimizing the negative impact of jet lag and increasing the competitiveness of the athletes at international competitions. The study highlights the role of tactical flexibility and cognitive adaptation in dynamic gaming environments. Attention is focused on how important it is for the athletes and the coaching staffs not only to develop a variety of tactical plans, but also the ability to reassess quickly the game situation and adapt to the strategies of the opponents in real time. This requires players not only to have a high level of physical fitness, but also to developed cognitive

abilities such as attention, concentration under stress, pressure and uncertainty. Conclusions. Success in international competitions requires not only a high level of technical, tactical and physical preparation, but also the development of effective recovery strategies, adaptation to various competition conditions and psychophysiological stress management. The study contributes to the understanding of how little-known sports can develop and achieve significant success on the international stage, highlighting the importance of intercultural and sporting exchange in the globalized world. Thus, to achieve optimal results, teams need to implement training programs that stimulate the development of both physical and mental qualities of the athletes, preparing them for the high demands of competitive activity. The results of the study are of interest not only to specialists in the field of sports science, but also to coaches, sports psychologists and managers involved in the development of handball and other sports in conditions of limited popularity and resources.

## **СИНЕРГІЯ ФІЗІОЛОГІЇ, ПСИХОЛОГІЇ І ТАКТИКИ: КЛЮЧ ДО УСПІХУ В ГАНДБОЛІ**

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**Ключові слова:** *фізична готовність, адаптація, психофізіологічний стрес, когнітивні функції, гормональний баланс, тактична гнучкість, стратегії відновлення, моторне навчання.*

У статті висвітлюється унікальний досвід розвитку гандболу в Австралії. Дослідження фокусується на участі команди Sydney Uni Handball Club у турі Europe Tour 2024, що є важливим кроком на шляху до міжнародного визнання. Мета дослідження – оцінити взаємозв'язок між фізіологічною підготовкою, психологічною стійкістю, тактичною гнучкістю та їх внеском у спортивну продуктивність команди. Об'єкт дослідження – процес підготовки у гандболі на професійному рівні. Предмет дослідження – фізіологічні аспекти підготовки в контексті специфіки тренувального процесу в гандболі. Методи дослідження: теоретичний аналіз і узагальнення науково-методичних джерел за темою дослідження, педагогічні спостереження. Результати дослідження. Автори аналізують ключові аспекти, що впливають на результати виступів команди, включно з проблематикою адаптації до нових умов, тактичною

гнучкістю, управлінням втомою та відновленням, а також ефективністю завершальних атак. Особлива увага приділяється впливу джетлага на фізичну та когнітивну функціональність спортсменів, наголошується на необхідності розробки стратегій адаптації до перельотів і зміни часових поясів. Запропоновані заходи спрямовані на мінімізацію негативного впливу джетлага та підвищення конкурентоспроможності спортсменів на міжнародних змаганнях. Акцентується увага на тому, наскільки важливо для спортсменів і тренерських штабів не тільки розробляти різноманітні тактичні плани, а й швидко переоцінювати ігрову ситуацію та адаптуватися до стратегій противника в реальному часі, що вимагає від гравців не лише високого рівня фізичної підготовленості, а й розвинених когнітивних здібностей, таких як увага, концентрація в умовах стресу, тиску та невизначеності. Висновки. Успіх у міжнародних змаганнях вимагає не лише високого рівня техніко-тактичної та фізичної підготовки, а й розробки ефективних стратегій відновлення, адаптації до різних умов змагань та управління психофізіологічним стресом. Дослідження робить внесок у розуміння того, як маловідомі види спорту можуть розвиватися та досягати значних успіхів на міжнародній арені, наголошуючи на важливості міжкультурного та спортивного обміну в глобалізованому світі. Таким чином, для досягнення оптимальних результатів командам потрібно впроваджувати тренувальні програми, які стимулюють розвиток як фізичних, так і ментальних здібностей гандболістів, готуючи їх до високих вимог змагальної діяльності. Результати роботи становлять інтерес не лише для фахівців у галузі спортивної науки, але й для тренерів, спортивних психологів та управлінців, які займаються розвитком гандболу й інших видів спорту в умовах обмеженої популярності та ресурсів.

**Introductoin.** The relevance of the study is determined by the growing interest in optimizing training processes and increasing the effectiveness of performances in team sports such as handball. Nowadays in highly competitive sports world, the importance of comprehensive training of athletes, including physiological, psychological and tactical components, cannot be overestimated. The research of the relationship between these aspects of training and athletic performance provides valuable information for coaches, sport psychologists, and physical training specialists who are seeking to maximize the potential of their teams.

However, despite significant advances in the field of sports science, a number of unresolved questions remain regarding the most effective training methods, especially in the context of the integration of physiological, psychological and tactical approaches. In particular, there are few studies devoted to the specifics of handball, where the high dynamics of the game and physical contact place special demands on the training of athletes [2]. In addition, the changing rules of the game and the development of new tactical schemes require constant scientific support and adaptation of training methods. Thus, the relevance of this study is due to the need to develop a comprehensive and scientifically based training system for handball players, capable of improving both the individual performance of players and the performance of the team as a whole.

The results of the study can help to increase understanding of the mechanisms for achieving high sports results and the development of new approaches to the training process in handball, which makes it very relevant for modern sports science and practice.

**The purpose of the study** is to assess the relationship between physiological training, psychological stability, tactical flexibility and their contribution to the sports performance of the team.

**The object of study** is the process of training in handball at the professional level.

**The subject of the study** is the physiological aspects of training in the context of the specifics of the training process in handball.

**Research methods:** theoretical analysis and generalization of scientific and methodological sources on the topic of the research, pedagogical observations.

**Results of the research.** Handball in Australia may not be the most popular sport, but its unique position and development on this continent is an inspiring example of perseverance and passion for the game. Cricket, football and rugby dominates in this country, handball has found its niche and is slowly gaining popularity among enthusiasts and athletes, who are looking for a new kind of sporting challenge [13]. It inspires because it demonstrates how a relatively small sporting community can make a significant contribution to the development of this kind of sport at an international level. Participation in international competitions such as the “Europe tour 2024” of “Syd-

ney Uni Handball Club” highlights their tenacity and commitment to promote handball in an environment where it does not receive the same level of attention and support as other kinds of sports.

Analyzing the performance of the team (Australia), 4 games were held (Sydney Uni Handball Club – TSV Amicitia Viernheim (Germany) 20–22; Sydney Uni Handball Club – TV Grosswallstadt (Germany) 22–32; Sydney Uni Handball Club – SG Köndringen-Teningen (Germany) 26–36; Sydney Uni Handball Club – Sarrebourg MSH (France) 27–38), there are several key aspects that could have influenced the results and, perhaps, what the team lacked to achieve victories.

1. Insufficient preparation and adaptation to conditions.

Flying across multiple time zones shifts the body's internal clock, disrupting normal sleep-wake cycles, which reduces cognitive function, responsiveness and physical fitness. Jet lag adaptation strategies, including phase shift before travel and correction by using light therapy, can improve the synchronization of internal rhythms and the overall condition of the players.

Pre-travel phase shifting is a strategy for adaptation to a new time zone used to minimize the impact of jet lag. This method involves gradually changing of sleep and wakefulness patterns before travel to synchronize the body's internal circadian rhythm with the future time at the destination.

The human biological clock, which regulates circadian rhythms, is highly dependent on environmental light signals. When traveling across multiple time zones, there is a dissonance between the body's internal clock and external light conditions, which can lead to symptoms of jet lag: sleep disturbances, cognitive decline, decreased overall performance, and even mood changes. Using of light therapy stimulates or suppresses the production of melatonin (a hormone that regulates sleep-wake cycles), which helps to adapt to a new time zone.

The short preparation period and jet lag indicates that the team may not have had enough time to adapt to new conditions and recover after a long flight, which reduced physical readiness and concentration of the players and did not allow the full implementation of super compensation processes, which is important for improving athletic performance. Super compensation, in which, after recovery from physical activity, the level of certain physiological indicators not only returns to the original level, but also exceeds it, makes the athlete stronger, faster and more resilient. Therefore, insufficient time for full preparation reduced the effectiveness of this process.

Jet lag, which occurs as a result of quickly traveling across multiple time zones, disrupts the circadian rhythms of the body, leading to disruptions in

sleep and wakefulness patterns, decreased cognitive function and general fatigue. These symptoms can negatively impact athletic performance, as accuracy, coordination, speed and strength endurance are key components to success in most sports.

Physiologically, jet lag affects the production of a number of hormones, including melatonin, which regulates sleep-wakefulness cycles, and cortisol, a stress hormone that can affect recovery and exercise readiness. Disturbance in hormonal balance and circadian rhythms can reduce training efficiency and recovery, making adaptation to a new time zone critical to maintain high level of performance. Hormonal balance is responsible for regulating growth, recovery, metabolism and adaptation to stress.

Key hormones such as testosterone, cortisol and growth hormone have a direct impact on training ability, adaptation to exercise and recovery. Testosterone promotes anabolic processes, accelerating muscle recovery and growth. Cortisol, on the other hand, is a catabolic hormone that, in high concentrations, can contribute to the breakdown of muscle tissue and poor recovery. Disturbance of balance among these hormones can slow down your workout progress and increase recovery time.

Circadian rhythms, as an internal biological clock, regulate many physiological functions, including sleep, metabolism, hormone production and body temperature [9]. For example, peak physical performance typically occurs late in the day when a body temperature is highest, making this the optimal time for training. Disruption of circadian rhythms, such as due to jet lag, can shift this peak performance, reducing training efficiency and impairing coordination, reaction time and in general fitness.

Deep sleep phases are especially important for recovery, since during them the production of growth hormone, which promotes tissue repair and regeneration, increases. Circadian rhythm disruption can reduce sleep duration and quality, reducing the quantity and quality of these important recovery phases.

Thus, the short training periods and jet lag presents challenging barriers to high athletic performance, requiring from teams to pay special attention to adaptation and recovery strategies in order to minimize their negative impact.

2. Tactical flexibility of opponents.

The example of a defensive change in a game with “TV Grosswallstadt” (Germany) to an aggressive 4–2 formation, that dramatically changed the course of the game, shows that the team may not have had the flexibility or plan B to adapt to the tactical changes of the opponents.

The lack of tactical flexibility (a complex phenomenon requiring the integration of cognitive, social and physiological aspects of training) to adapt to changes of opponents in sports games could also significantly

reduce the chances of success [12]. This problem reflects the difficulty of integrating cognitive functions, teamwork, and strategic planning in a dynamic environment.

Cognitive flexibility is the ability to switch quickly between different tasks or concepts and adapt to new, unexpected conditions. In the context of handball, it means the ability of the players and coaches to reassess the situation on the field and change strategy in response to the actions of the opponent. Neuropsychological researches show that cognitive flexibility depends on the effective functioning of the prefrontal cortex, which is responsible for planning, decision-making and social interaction. The lack of cognitive flexibility can lead to slower responses to changes and missed opportunities for effective counteraction.

The scientific approach to training, including the use of simulations and problem-solving exercises in conditions that closely resemble actual game situations, can significantly improve tactical flexibility. This ensures not only the development of individual skills, but also improved communication within the team, which is crucial important for successful adaptation to the strategies of the opponent.

Tactical flexibility in sports as a complex phenomenon requires the integration of cognitive, social and physiological aspects of training, plays a decisive role in the ability of the team to adapt to the dynamic conditions of the competitive process, which makes its development a priority task for coaches and sports psychologists.

3. Physical and mental fatigue (psychophysiological stress).

In the last game of the “Europe tour 2024” with “Sarrebouurg MSH” (France), fatigue, both physical and mental, was evident, highlighting the importance of managing of the resources of the players and their recovery during an intense competitive period [8, 11]. It is common knowledge that playing matches over the short periods of time increases stress on the muscles, leading to fatigue and an increased risk of injury [1]. Physiologically, this is associated with the accumulation of metabolites such as lactic acid and microdamage to muscle fibers. Both of these processes are essential for understanding the mechanisms of fatigue and injury risk during short competition schedules.

Lactic acid is a product of anaerobic glycolysis, a process that provides energy to muscles in conditions of oxygen deficiency during intense physical activity. The accumulation of lactic acid and other metabolites in muscle tissue leads to a decrease in pH (meaning increased acidity), which which can worsen the functional state of muscles, slow energy processes and contribute to the development of fatigue. This, in turn, reduces the ability of muscles to contract and

increases the possibility of injury due to poor motor control.

Intense physical activity, especially with a high level of eccentric (deceleration) contractions, can lead to microtrauma in the structure of muscle fibers [10]. These microdamages activate the inflammatory response of the body, the purpose of which is to repair and restore damaged tissue. Although this process is a natural part of muscle adaptation to increased workload, excessive accumulation of damage without adequate recovery time can increase the risk of serious injury. The inflammatory response can also contribute to muscle swelling and soreness, further reducing muscle function and increasing the probability of injury.

Recovery strategies, including adequate nutrition, hydration, passive recovery (rest), active recovery (light exercise), massage, and physical therapy, are aimed at reducing muscle metabolite levels, stimulating repair processes, and reducing inflammation. Stimulation of reparative processes refers to the activation of the body's natural mechanisms aimed at restoring and healing damaged tissues, and includes a number of biological processes such as the regeneration of muscle fibers, the elimination of damaged cells, the synthesis of new proteins and the restoration of microcirculation in the affected areas [4, 7]. So immediately after tissue damage, the body initiates an inflammatory response that removes dead cells and debris and attracts immune cells to the site of injury to fight infection. New formation of capillaries (angiogenesis) in the area of injury improves the delivery of oxygen and nutrients necessary for tissue repair, which helps to accelerate the healing process. Stimulating the growth of the new muscle fibers and collagen synthesis in connective tissue helps to restore the structural and functional integrity of damaged areas. Tissue remodeling ensures restoration of their strength and elasticity. Maintaining an optimal balance of nutrients and adequate hydration is crucial to support reparative processes. Proteins, vitamins (especially C and E), minerals (such as zinc and magnesium) and amino acids play a key role in tissue repair.

The use of such strategies helps to accelerate recovery, reduce fatigue and reduce the risk of injury, thereby optimizing athletic performance and improving the overall well-being of athletes.

Implications for training and recovery include: analysis of the effects of short-interval games on muscle fatigue and increased risk of injury; development of individualized recovery programs and approaches to manage the physical training of athletes; optimization of training and competition schedules; introducing new methods to reduce fatigue and prevent injuries.

Competitive stress can activate the sympathetic nervous system, increasing levels of cortisol and

adrenaline, part of the autonomic nervous system that prepares the body to respond quickly in situations that require increased activity but leads to exhaustion over long periods of exposure. When the sympathetic nervous system is activated in response to stress, epinephrine and norepinephrine are released from the adrenal glands, which leads to a number of physiological changes: increased heart rate, increased blood pressure, dilation of the bronchi, and increased blood glucose levels. These changes are aimed at providing the body with additional energy and oxygen to improve physical performance.

Cortisol, often called the “stress hormone”, is also released in response to stressful situations and plays a key role in regulating metabolism, reducing inflammation and helps to restore energy reserves. In the short term, increasing cortisol levels can improve ability to concentrate, increase alertness and strengthen motivation, all of which are beneficial in a competitive environment.

However, with prolonged exposure to stress and persistently elevated levels of cortisol and adrenaline, unwanted physiological and psychological changes can occur. Chronic stress can lead to exhaustion, poor cognitive function, decreased immune defenses, and an increased risk of depression. At a physiological level, prolonged elevations in cortisol levels can disrupt metabolic processes, promote fat storage, reduce muscle mass, and impair recovery from physical exercises.

Based on this knowledge about the mechanisms of stress, it is necessary to develop stress management techniques for athletes, including psychological preparation, relaxation techniques, meditation and autogenic training. These methods are aimed at reducing stress levels and its negative consequences, allowing for better adaptation to the competitive environment and maintaining optimal levels of performance over the long term.

#### 4. Nutritional support and hydration.

Proper nutrition and hydration are key for maintaining energy balance and physiological efficiency. Adequate intake of carbohydrates, proteins, fats, vitamins and minerals, as well as maintaining fluid and electrolyte balance can improve physical endurance, speed recovery and reduce the risk of dehydration and hyponatremia.

#### 5. Accuracy and efficiency of finishing attacks.

In the game against “Sarrebouurg Moselle Sud Handball” (France), a lack of accuracy in throws was noted, which indicates problems with the efficiency of execution.

Accuracy in throwing and coordination of movements require well-developed motor skills and neuromuscular synchronization. Fatigue impairs these aspects by reducing small muscle control and cognitive function, which is achieved through a combina-

tion of neuromuscular coordination, motor learning and psychological preparation.

Thus, the effectiveness of a throw in handball depends largely on the coordinated work of the muscles of the arm, shoulder girdle and torso. Neuromuscular coordination ensures precise synchronization of contraction of muscle groups at optimal moments, which allows you to generate maximum throwing force and control its trajectory. Improving of the skills of completion of attacks and greater shooting accuracy could increase the chances of scoring goals.

Motor learning plays a key role in mastering and improving throwing technique, making movements more automatic and less dependent on external conditions [5]. The use of a variety of training techniques, including video analysis, simulation exercises and special simulators, promotes the formation of stable neural connections, which makes it easier to perform accurate and powerful throws under pressure.

Thus, a comprehensive approach that includes improved physical skills, mental preparation and tactical planning helps to improve shooting accuracy and completion of attacks efficiency.

#### 6. Ability to adapt to pressure.

Analysis of performances in the “Europe tour 2024” showed that the team started the matches well, but over time lost the initiative. Psychological stability and the ability to concentrate at the moment of throwing are no less important than physical preparation. The stress and pressure of a competitive situation can significantly reduce throwing accuracy [6]. Using mental preparation techniques, including visualizing successful shots and mindfulness training, helps players to maintain focus and confidence during key moments in the game [3]. In this regard, it is necessary to improve mental stability, and the ability to maintain a high level of performance under pressure throughout the match.

The successful performances of the young players at the end of the tour suggest that greater use of the entire squad can be made to keep the game fresh and intense.

Consequently, the synthesis of these components forms a stable basis for achieving high results in handball, emphasizing the importance of a multidisciplinary approach in preparing a sports team.

**Conclusions.** To maximize their chances of winning in future competitions, the team should focus on improving adaptation and recovery, tactical flexibility, fatigue management, attack accuracy, mental toughness and optimizing the staff of the team.

The participation of Australian handball players in the “Europe Tour 2024” is a living proof of their commitment to the development and improvement of the level of the play. This represents a unique opportunity for Australian teams to compete against the best European teams, share experiences and learn from the best;

highlights the importance of international exchange and competition in the development of handball as a sport. Participation in such tournaments helps not only to improve the level of play of the team, but also promotes cultural and sporting exchange among different countries, helps to strengthen ties among handball communities and contributes to the global development and popularization of this exciting sport.

This story of the development of handball in Australia serves as a reminder that passion and dedication can lead to significant achievements even when resources are limited; emphasizes the importance of

sport as a mean for uniting people with different interests and cultural backgrounds in the pursuit of common goals and success.

Australian handball proves that there are no small countries or unpopular disciplines in sport, there are only opportunities to grow, to develop and to demonstrate that passion and hard work can overcome any barriers. Thus, the participation of Australian handball players in the “Europe Tour 2024” is not only the indicator of their desire to achieve high sporting results, but also reflects the global nature and influence of handball as a sporting discipline.

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