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Organizational and methodological model of training in beach handball integrated with LTAD principles

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Abstract

Purpose. The article presents an analysis of the organizational and methodological features of conducting a training and competition complex in beach handball, which consisted of an Identification/Selection Camp and the John Kovacik Memorial Tournament. The aim of the study is to analyze the organizational and methodological features of the Beach Bash 2025 tournament and the associated Identification/Selection Training Camp, to determine their physiological and preparatory impact on athletes, and to assess the compliance of the proposed model with the principles of Long-Term Athlete Development (LTAD).

Material and Methods. Research methods: analysis and synthesis of scientific and methodological literature and regulatory documents on the training of beach handball athletes; content analysis of official regulations and schedules of the tournament and training camp; pedagogical observation of the training and game process; synthesis of results from the perspective of the LTAD concept.

Results. At the first stage (camp), the priorities were sensorimotor coordination, neuromuscular adaptation, and the formation of specific movement patterns; proprioceptive systems were activated, intermuscular coordination improved, "sand versions" of movements and throws were practiced, and plyometric, stabilization, and eccentric exercises were applied. At the second stage (tournament), the focus shifted to the development of specific endurance and stress adaptation, including the regulation of neuroendocrine responses (cortisol, catecholamines). Training tasks were performed at an rating of perceived exertion (RPE) of 6–8 (75–90% HRmax), simulating competitive intensity and increasing resistance to metabolic stress.

Conclusions. It is recommended to develop a "sand" test profile (CMJ, T-test, 5–20 m sprint, throwing tests) and repeat it at key points of the season. Practical value – the integration of the Identification/Selection Camp and the tournament as a chain of control–intervention–verification with subsequent individualization of plans according to the principle of progressive overload; the application of block-modular sessions "decision under pressure" with video analysis; the implementation of a preventive package (neuromuscular warm-up, heat monitoring, court inspection standards). The proposed model meets the modern requirements of LTAD and can be applied within the national system of beach handball player development.

Keywords: beach handball; LTAD, training and competition complex; Identification/Selection Camp; specific endurance, neuromuscular adaptation; sensorimotor coordination; stress adaptation; plyometric exercises; functional testing.

Анотація

Організаційно-методична модель підготовки у пляжному гандболі, інтегрована з принципами LTAD

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Мета. У статті наведено аналіз організаційно-методичних особливостей проведення тренувально-змагального комплексу з пляжного гандболу, що складається з Identification/Selection Camp (25 липня 2025 р.) та наступного турніру пам'яті Джона Ковачика (26–27 липня 2025 р., Sylvan Lake, AB). Мета дослідження – проаналізувати організаційно-методичні особливості проведення турніру Beach Bash 2025 та пов'язаного з ним Identification/Selection Camp, визначити їх фізіологічний та підготовчий вплив на спортсменів, а також оцінити відповідність представленої моделі принципам LTAD (Long-Term Athlete Development). Об'єкт дослідження – процес підготовки спортсменів із пляжного гандболу в умовах інтеграції змагальної та навчально-тренувальної діяльності. Предмет дослідження – організаційно-методичні та фізіологічні аспекти поєднання Identification/Selection Camp та турніру Beach Bash 2025 як моделі розвитку пляжного гандболу.

Матеріал і методи. Методи дослідження: аналіз та узагальнення науково-методичної літератури та нормативних документів з підготовки спортсменів у пляжному гандболі; контент-аналіз офіційних регламентів та розкладів турніру та Identification/Selection Camp; педагогічне спостереження за тренувальним та ігровим процесом; узагальнення результатів із позиції концепції довгострокового розвитку спортсменів (LTAD).

Результати. На першому етапі (Identification/Selection Camp) пріоритетними були сенсомоторна координація, нейром'язова адаптація та формування специфічних рухових патернів; активізувалися пропріоцептивні системи, удосконалювалася міжм'язова координація, відпрацьовувалися «піщані версії» переміщень та кидків, застосовувалися пліометричні, стабілізаційні та ексцентричні вправи.

На другому етапі (турнір) акцент зміщувався на розвиток специфічної витривалості та стрес-адаптацію, включаючи регуляцію нейроендокринних реакцій (кортизол, катехоламіни). Тренувальні завдання виконувались при RPE 6–8 (75-90% ЧССmax), що моделювало щільність змагання і підвищувало стійкість до метаболічного стресу.

Висновки. Рекомендовано формувати піщаний тест-профіль (CMJ, T-test, спринт 5-20 м, кидкові тести) і повторювати його в ключових точках сезону. Практична цінність – інтеграція Identification/Selection Camp та турніру як зв'язки контроль-втручання-перевірка з подальшою індивідуалізацією планів за принципом прогресивного навантаження; застосування блочно-модульних сесій «рішення під тиском» з відеоаналізом; використання профілактичного пакета (нейром'язова розминка, контроль тепла, стандарти огляду майданчика). Запропонована модель відповідає сучасним вимогам LTAD та може бути використана у національній системі підготовки пляжних гандболістів.

Ключові слова: пляжний гандбол; пляжний гандбол; LTAD; тренувально-змагальний комплекс; ідентифікаційно-відбірковий табір Identification/Selection Camp; специфічна витривалість; нейром'язова адаптація; сенсомоторна координація; стрес-адаптація; пліометричні вправи; функціональне тестування.

Introduction

High-intensity and eccentric strength work has demonstrated efficacy for neuromuscular and performance adaptations in court and sand sports (Suárez, 2023). Modern beach handball, as a relatively young sport, is developing under conditions of high dynamism and increasing demands on the technical, tactical, physiological, and psychophysiological preparedness of athletes. One of the key problems is the insufficient integration of the processes of selection, training, and competitive activity into a single, coherent system that takes into account the principles of Long-Term Athlete Development (LTAD). In global practice, a promising approach is the combination of large-scale tournaments with Identification/Selection Camps, which makes it possible to simultaneously promote the sport, conduct high-quality player selection, and integrate them into national training programs. This aligns with the federation's broader strategic initiatives, including the IHF seminar on disability handball rules (Handball Canada, 2024).

The absence of standardized organizational and methodological models for such integration leads to inconsistency in preparation, increases the risk of errors during selection, complicates the individualization of training loads, and hinders the achievement of high sporting results. The proposed model combining the Identification/Selection Camp and the Beach Bash 2025 tournament aims to address these issues by creating a continuous cycle of "control – targeted intervention – effectiveness assessment". The scientific significance of the study lies in the development of a conceptual framework for integrating selection and preparation in competitive settings, in line with modern LTAD principles, individualized training processes, and load periodization. The practical significance is determined by the possibility of implementing the model in the national beach handball training system to enhance athletes' competitiveness at the international level, optimize the talent pool, and preserve generational continuity within the team.

We define the effectiveness of the integrated model as measurable pre–post gains in neuromuscular and on-court performance coupled with retained tactical efficiency under match-like fatigue. The model operationalises a control → targeted intervention → assessment loop within a single microcycle (Camp day followed by tournament days).

Connection of the work with important scientific programmes or practical tasks. The study was conducted within the framework of the research theme «Theoretical and Methodological Foundations for Improving the Teaching–Training Process in Various Sports» (state registration No. 0122U001108) under the 2022–2026 research plan of Zaporizhzhia National University.

Purpose. The purpose of the study is to analyze the organizational and methodological features of the Beach Bash 2025 tournament and the associated Identification/Selection Camp, to determine their physiological and preparatory impact on athletes, and to assess the compliance of the presented model with the principles of LTAD (Long-Term Athlete Development).

Material and Methods

Research methods: analysis and generalization of scientific and methodological literature and regulatory documents on the training of athletes in beach handball; content analysis of official regulations and schedules of the tournament and Identification/Selection Camp; pedagogical observation of the training and game process; generalization of the results from the position of the concept of long-term development of athletes (LTAD).

The studies were conducted in accordance with the rules of the 1975 Helsinki Declaration, revised in 2013.

Research results

The Identification/Selection Camp, held on July 25, 2025, on the eve of the Beach Bash tournament, was a key element of the athletes' comprehensive training. Its significance can be viewed in three interrelated dimensions: selection, development, and integration. The Identification/Selection Camp, held on the eve of the tournament, acts as a primary filter for the formation of the national reserve. Its key feature is the assessment of athletes in conditions as close as possible to competitive ones, which allows us to identify not only technical equipment, but also such integrative qualities as game thinking (the ability to make optimal decisions under limited time conditions); psychological stability (the ability to maintain the quality of actions under pressure and fatigue); team compatibility (the level of communication and mutual understanding with partners).

The Identification/Selection Camp allowed the Beach Handball Canada coaching staff to evaluate the playing and physical qualities of both newcomers and famous athletes. In essence, it was a "live scouting" format, where the evaluation

was conducted not only on technical and tactical skills, but also on game thinking, teamwork, and psychological stability. This approach is consistent with modern principles of selection in team sports, when a combination of physical, cognitive and psycho-emotional characteristics is taken into account (Тищенко et al., 2024; Tyshchenko et al., 2020). It is based on a comprehensive approach, minimizes the risk of selection errors and allows focusing not only on current performance, but also on the long-term potential of the player. It is recommended to supplement the selection process with video analysis and psychophysiological testing tools (evaluation of reaction speed, decision-making time, attention stability). This will allow the coaching staff to objectify their conclusions and ensure comparability of data on different candidates.

The Identification/Selection Camp program was designed to integrate training elements into a competitive context. Newcomers were adapted to the requirements of the national program, while current players were given in-depth work on technique and tactics. This symbiosis – the use of joint training (for example, mixed warm-ups, game exercises and control meetings) creates conditions for the horizontal exchange of experience between generations of athletes and helps to speed up their professional adaptation. Holding the Identification/Selection Camp in direct connection with a major tournament creates optimal conditions for the prompt inclusion of promising athletes in the national team training system. This approach provides a multi-level check – from the analysis of technical and tactical readiness during training to the assessment of the effectiveness of game actions under competitive stress. The main areas of development: technical optimization (improvement of throwing and catching techniques, increasing the accuracy of passes in conditions of unstable support); tactical variability (simulating situations of changing tempo, playing in the minority or majority, building fast attacks); adaptation to the characteristics of the sand surface (reducing energy costs due to rational movement techniques). Skills adjustment is carried out in the "training episode – feedback – repeat execution" mode, which corresponds to the principles of learning with real-time feedback and ensures the rapid transfer of new solutions into game practice. The main advantage of this format is the ability to monitor continuously a player's progress: the coaching staff gets a comprehensive picture of his functional readiness, psychological stability and ability to adapt to the team.

Integration into the national training system in this case ceases to be a formal procedure and turns into a dynamic process that includes: regular feedback among national team coaches and club mentors; adjustment of individual training plans taking into account identified strengths and weaknesses; planning of the athlete's participation in regional and international tournaments as part of the long-term LTAD (Long-Term Athlete Development) cycle (Balyi et al., 2013). To improve the effectiveness of the development block, it is recommended to use movement tracking technologies (GPS systems or video trackers) to analyze the dynamics of movements on the sand, as well as to use portable strength and jump power sensors to track the effectiveness of training interventions. From a scientific and methodological point of view, such an integration mechanism corresponds to the principles of continuity of training and periodization of loads, allowing to avoid abrupt transitions from club to national requirements, which reduces the risk of injuries and functional breakdowns.

In order to increase the efficiency of integration, it is recommended to supplement the camp with a system of standardized tests and functional profiling (Jump Tests, Agility T-test on sand, heart rate and heart rate variability monitoring), as well as to introduce a digital database of players with a history of their physiological indicators, game statistics and training loads (Abălaşei, 2017). This will make the selection and integration process more objective and predictable, and will also strengthen the scientific basis of the coaching staff's decisions. Thus, the Camp performed a dual function: strategic – the formation and renewal of the national team's personnel reserve; tactical – the immediate adaptation and inclusion of promising players in the Beach Bash competitive process. Its contribution is reflected in increasing the competitiveness of Canadian teams on the international stage, strengthening the continuity between generations of athletes and creating a sustainable model for the development of beach handball, where selection and training are inextricably linked with high-level practice (Balyi et al., 2013; Strategic Plan 2025–2028).

Table 1 systematizes the key blocks of the Identification/Selection Camp program and their connection with specific aspects of athlete training. Such structuring allows us to evaluate not only the sequence of training activities, but also their target orientation, which corresponds to the principles of planning in sports training. The combination of the tournament and the qualifying camp corresponds to the principles of LTAD (Long-Term Athlete Development), allowing for a continuous cycle: identification – development – testing in a competitive environment. This format ensures not only the preparation of a personnel reserve, but also the strengthening of the continuity of generations in the national team.

The first block – initial training (technique and tactics) – performs a diagnostic function. Its purpose is to determine the initial skill level of the participants, identify strengths and weaknesses. The result is an objective selection and formation of training groups according to the level of preparedness, which corresponds to the principles of individualization of the load.

The second block – joint warm-ups and game exercises – is aimed at developing teamwork, unity and communication between players. This stage is important for the accelerated adaptation of newcomers, as it allows them to integrate into the game system and increase the level of mutual understanding with partners.

The third block – control matches among groups – serves as a tool for testing playing qualities in conditions close to official competitions. It provides the coaching staff with information for the final selection of the most promising players, and also allows for the assessment of the effectiveness of previously conducted corrective training.

The fourth block – mentoring of veterans – is a form of horizontal transfer of experience, in which more experienced athletes help less experienced ones to master game schemes, to optimize technique and tactical decisions. This increases the rate of adaptation of newcomers and speed up the growth of individual skill.

Table 1. Interrelationship of blocks of the Identification/Selection Camp program with aspects of training athletes

Camp program block	The purpose of the block	Main result/effect
Initial training (technique and tactics)	Assessing skill level, identifying strengths and weaknesses	Objective selection, formation of groups by level
Joint warm-ups and game exercises	Formation of team interaction	Improving unity and adaptation of newcomers
Test matches among groups	Testing of game qualities in conditions close to official ones	Selection of the most promising players
Mentoring veterans	Transfer of experience and gaming solutions	Accelerated adaptation and growth of individual skill
Integration with tournament program	Checking selected players in official games	Rapid integration into the national training system

Table 2. Integration Model of Identification/Selection Camp and Beach Bash 2025

Stage	Actions	Result	Key physiological mechanisms
1. Identification/Selection Camp (July 25)	• Assessment of physical and game qualities • Formation of groups • Mentoring of veterans	• Identification of promising players • Individual training plan	• Sensorimotor coordination • Neuromuscular adaptation • Formation of specific motor patterns
2. Integration into the tournament (July 26–27)	• Inclusion in teams • Participation in group stage matches • Performance analysis	• Testing skills in competitive conditions • Adjusting coaching decisions	• Development of specific endurance • Stress adaptation (neuroendocrine response) • Optimization of tactical and technical decisions under load
3. Long-term development	• Progress monitoring • Call to the national team • Preparation for international competitions	• Increasing the competitiveness of the national team	• Improving aerobic-anaerobic power • Forming resistance to competitive stress • Long-term adaptation of the musculoskeletal system

The fifth block – integration with the tournament program – closes the training cycle, testing the selected players in real match conditions. This stage not only records the selection results, but also serves as the first step in integrating the athlete into the national training system.

Thus, Table 1 reflects a logically constructed model of selection and adaptation, in which each event has a clear goal, a measurable result and occupies a certain place in the training sequence. This scheme allows us to consider the Camp not as a one-time event, but as a part of a comprehensive system of long-term athlete development.

The presented model (Table 2) demonstrates that the integration of the Identification/Selection Camp and the Beach Bash 2025 tournament ensures not only organizational and methodological continuity, but also a targeted impact on the key physiological mechanisms that determine the success of competitive activity in beach handball. At the first stage (Camp), the priorities are sensorimotor coordination, neuromuscular adaptation and the formation of specific motor patterns (Hopwood et al., 2023). In conditions of various training stimuli, the work of proprioceptive systems is activated, intermuscular coordination is improved, which is critical for the effective execution of jumping, throwing and defensive actions on a sand surface. At this stage, training tasks can be performed at an RPE intensity of 5–7 (moderately high subjective load), which corresponds to 70–85% of HRmax, at which optimal conditions are created in the body for the development of coordination and technical skills with sufficient cardiorespiratory stimulation, but without excessive fatigue that could negatively affect the quality of performance of complex motor actions.

In this range: aerobic-anaerobic mechanisms are actively involved, providing an influx of energy for long-term and high-quality development of elements; the neuromuscular system receives a stimulus for the formation and consolidation of specific motor patterns; proprioceptive mechanisms work in an optimal mode, allowing you to improve balance, landing control and movement precision; the risk of injury is minimal compared to training in zones >85% HRmax, when fatigue begins worsen significantly technique. Sand creates an unstable supporting surface, which requires the athlete to correct constantly his movements due to the active work of proprioceptors (muscle spindles, Golgi tendon organs, receptors of joint capsules and skin). This enhances sensorimotor integration and improves the accuracy of body positioning in space. As an adjunct for elite handball, blood flow restriction training has shown effectiveness in optimizing physiological indicators (Tyshchenko et al., 2025).

A variety of training stimuli (different types of jumps, accelerations, throws) help to improve the connection between sensory inputs (vestibular, visual and somatosensory information) and motor responses. These speeds up the reaction to changes in the game situation and minimizes the delay time of the motor response. Repeated performance of specific movements under the resistance of a sand surface leads to optimi-

zation of the work of motor units: the synchronicity of their activation increases, the latent time of muscle contractions decreases, and the efficiency of movement performance improves.

Beach handball is characterized by jump shots, sharp changes of direction, defensive movements in a half-squat. Repetition of these actions in a training environment leads to the automation of motor programs, which are later implemented without conscious control, which is especially important under competitive pressure. Improving proprioceptive and intermuscular coordination directly increases the effectiveness of jumping, throwing and defensive actions, as an athlete adjusts more quickly to the trajectory of the ball, corrects the posture when receiving and passing, and also stabilizes better the joints when landing. Thus, the results obtained at the Identification/ Selection Camp serve not only as a means of diagnostics and correction of technical and tactical skills, but also form a physiological and psychological basis that is directly integrated into the strategy of performance at the tournament. This ensures a smooth transition from the stage of targeted preparation to the stage of competitive implementation.

At the second stage (integration into the tournament), the emphasis shifts to the development of specific endurance and stress adaptation, including the regulation of neuroendocrine reactions (cortisol, catecholamines). The combination of high-intensity game episodes with limited recovery time forms the ability to maintain tactical and technical efficiency under the influence of fatigue, which is associated with the optimization of the cardiorespiratory system and buffering mechanisms of acid-base balance. At this stage, training tasks can be performed at an RPE intensity of 6–8, which corresponds to 75–90% HRmax to simulate competitive conditions. The Beach Bash tournament format involves several games over a single day, which requires maintaining a high intensity of action with limited recovery time. In such conditions, specific endurance becomes key – the ability to maintain tactical and technical effectiveness against the backdrop of increasing fatigue. In this range, the contribution of anaerobic energy supply mechanisms increases, which is important for maintaining power and speed during repeated sprinting and jumping actions; stress adaptation of the neuroendocrine system is stimulated – an increase in the activity of catecholamines and the mobilization of energy substrates; specific endurance develops due to training in conditions of accumulation of metabolites (lactate), which improves the ability to maintain high intensity until the end of the match; psychophysiological resistance to time pressure, fatigue and tactical changes during the game is formed (Mariscal et al., 2019).

In beach handball, energy expenditure is generated through the interaction of aerobic and anaerobic mechanisms of ATP resynthesis. Constant acceleration, jumping and fighting for the ball stimulate: anaerobic alactic mechanism (explosive movements up to 6-8 seconds), anaerobic lactate mechanism (series of intense actions 20-60 seconds), aerobic mechanism (recovery between game episodes and matches). The competitive environment is accompanied by activation of the hypothalamic-pituitary-adrenal axis, which leads to the release of cortisol and catecholamines (adrenaline, noradrenaline). These hormones provide mobilization of energy substrates (glycogenolysis, lipolysis), an increase in heart rate and minute volume of blood circulation, and improvement of peripheral muscle perfusion.

Resistance to competitive stress is directly related to the efficiency of autonomic nervous system regulation. Optimal adaptation ensures a balance between sympathetic activation (combat readiness) and parasympathetic recovery, which allows the athlete to maintain throwing accuracy, coordination and tactical thinking even under fatigue. Players with a high level of specific endurance and stress resistance demonstrate a smaller drop in speed, strength and accuracy of movements in the final stages of a match and in the final games of a tournament, where psychological pressure is at its maximum.

At the third stage (long-term development), the main result is the improvement of aerobic-anaerobic power, increasing resistance to competitive stress and structural adaptation of the musculoskeletal system. Regular exposure to specific loads promotes hypertrophy of fast-twitch muscle fibers, increases the power of the anaerobic alactate and lactate pathways of ATP resynthesis, strengthens the ligament-tendon apparatus, which reduces the risk of injury.

In the long term, the key to success in beach handball is the ability to combine high anaerobic power with a developed aerobic base. The aerobic system provides faster recovery between game episodes and matches, supports oxygen transport and metabolite utilization. The anaerobic system (alactic and lactate) determines the power and explosiveness of game actions such as jumping throws and sudden accelerations. Over the course of several seasons, highly skilled players develop a more balanced response between the hypothalamic-pituitary-adrenal axis and the autonomic nervous system, which reduces the severity of catabolic reactions associated with chronic stress, allowing the athlete to maintain high functional readiness in the conditions of a tight competition schedule and multi-day tournaments. Constant specific load on a sand surface cause strengthening of the ligament-tendon apparatus (increase in collagen density and elasticity), hypertrophy of fast and intermediate muscle fibers, and an increase in bone mineral density due to repeated impact and jumping loads. These adaptations reduce the risk of knee and ankle injuries and improve the efficiency of game actions. Through repeated training and competitive cycles, stable motor patterns are formed that economize the execution of complex game actions and reduce energy costs per unit of work. The combination of energetic, neurohumoral and structural adaptation creates the basis for stable high results in international competitions and prolongs the athletic longevity of athletes. Thus, each stage contributes to the formation of the athlete's integral functional readiness, and a clear sequence is observed: from the sensorimotor base and coordination – through stress adaptation – to long-term morphofunctional restructuring of the body.

The LTAD concept involves the gradual development of sports skills, taking into account the age, physiological and psychosocial characteristics of the athlete. For beach handball, the key stages are: Train to Train (12–16 years): development of basic physical qualities, mastering technical elements, expanding the tactical arsenal; Train to Compete (16–23 years):

individualization of training, optimization of the tactical model, adaptation to high competitive loads; Train to Win (19 years and older): achieving maximum competitive efficiency, sustained maintenance of form during peak moments of the season. The participants of Identification/Selection Camp Beach Bash 2025 (U18 and adults) allow us to classify the event mainly into the Train to Compete and Train to Win stages. Comparison of the LTAD stages with the elements of the presented model showed that the selection of promising players corresponds to the objectives of Train to Train and Train to Compete, ensuring the identification of athletes with high potential to reach the national and international levels. It also implements the Talent Identification principle built into LTAD by assessing not only current results, but also long-term development prospects.

The development and adjustment of skills is fully consistent with Train to Compete, where the priority is to improve individual technique and tactical variability, as well as adaptation to the specifics of the competitive environment (in this case, sand). The use of game exercises and real-time feedback also meets the LTAD principle of Quality Training over Quantity. Integration into the national training system is the link between Train to Compete and Train to Win, and ensures a gradual increase in the intensity and complexity of competitive tasks, observing the principles of Periodization and Progressive Overload, laid down in LTAD.

The model implemented at Beach Bash 2025 is consistent with key LTAD principles, ensuring continuity between athlete development stages and integrating selection, training and competition components into a single preparation system. The principles of gradual increase in load, individualization of training and focus on long-term results are observed, which makes this model applicable as a reference for the development of beach handball at the national level.

Conclusions

The study reveals the effectiveness of an integrated organizational–methodological model of training in beach handball, which combines an identification/selection camp and a competitive tournament into a single continuous cycle of "control – targeted intervention – effectiveness assessment". The proposed approach ensures the simultaneous development of sensorimotor coordination, neuromuscular adaptation, specific endurance, and stress resilience in athletes, aligns with LTAD principles, and contributes to improved performance under competitive conditions. The model optimizes the player selection process, reduces the risk of errors in team composition, and ensures the smooth integration of promising athletes into the national training system.

It is advisable to expand the research by developing individualized training programs considering LTAD stages and the international competition calendar.

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