sciendo International Conference KNOWLEDGE-BASED ORGANIZATION
Vol. XXXI No 2 2025

PHYSICAL TRAINING METHODS IN COMBINED SPORTS. AN ANALYSIS APPLIED TO MILITARY PENTATHLON

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Abstract: *The training methods in combined sports, such as military pentathlon, require a complex, interdisciplinary and personalized approach, aiming at the development of motor skills. Training in the military pentathlon integrates specific training for shooting, obstacle running, obstacle swimming, precision and distance grenade throwing and cross-country running. The five events require distinct skills such as reaction speed, endurance, strength, strength, accuracy and coordination and combinations of these. Modern training methods include integrated training, which combines event-specific physical exercises with techniques to recover and optimize performance. Functional training and variable-intensity training also help to develop athletes' adaptability under competitive conditions. Mental preparation also plays a key role, including strategies to manage stress, increase concentration and improve response to prolonged exertion. Recent studies show that rigorous training planning, based on the principles of periodization and individualization, leads to increased performance, injury prevention and peak performance for pentathlon athletes.*

Keywords*:* **combined sport, military pentathlon, training methods, analysis, versatility**

1. Introduction

Combined sports are athletic disciplines that encompass multiple distinct events, simultaneously testing athletes speed, strength, endurance, agility, coordination, and tactical abilities. These sports are particularly valuable for developing the physical and mental attributes that define a well-rounded athlete. Historically, they have played a significant role in both competitive sports and military training. The origins of combined sports can be traced back to Antiquity. The ancient pentathlon was introduced in 708 BC at the 18th edition of the Olympic Games and became the second discipline added to the competition program after running events. Interestingly, three of its components - discus throwing, javelin throwing, and the long jump performed with hand-held weights - later became individual athletic events in their own right. Along with running and hand-to-hand combat, these formed the structure of the ancient pentathlon [3, 16]. During the Middle Ages, knightly competitions such as jousting continued the tradition of combining various physical challenges, though these lacked the complexity of the ancient versions [10]. In the modern era, Baron Pierre de Coubertin strongly advocated for the inclusion of the pentathlon in the inaugural Modern Olympic Games in Athens in 1896. Although it was not included at that time, the modern pentathlon was officially introduced at the 1912 Stockholm Olympic Games [7]. The pursuit of defining the versatile athlete has long

DOI: 10.2478/kbo-2025-0058

captured human interest. Following the Second World War, the first military pentathlon competition was held in 1947 in Freiburg, located in the French-occupied zone of Germany, and featured soldiers from Belgium, the Netherlands, and France. By 1950, the military pentathlon had been formally adopted by the International Military Sports Council (CISM), and Romania has been participating in these competitions since 1998 [1]. Analyzing training methods in this context aims to enhance athletic performance in combined sports such as the military pentathlon. These competitions are vital to soldier preparation, as they simulate the physical and psychological demands encountered on the battlefield. The military pentathlon consists of five events: *Firearms shooting* (accuracy and speed): Requires precision and emotional control under sustained mental pressure. *Utility swimming* (50 meters with obstacles): Tests technique, speed, coordination, and aquatic endurance. *Obstacle course* (500 meters): Demands agility, speed, and strength under fatigue. *Grenade throwing* (accuracy and distance): Involves coordination, technique, power, and control. *Military cross-country* (8 km for men, 4 km for women): Focuses on endurance and strategic pacing. The shared objective among participating nations is to foster camaraderie through sport within the international military community while simultaneously preparing soldiers for real-world combat scenarios. By combining strength, speed, precision, and endurance, the military pentathlon not only pushes the physical limits of military athletes but also cultivates critical values such as discipline, self-control, and teamwork [1, 3].

2. Training Methodology in Combined Events

The training methodology for combined athletic events requires a comprehensive and structured approach. The primary objective of applying scientifically grounded methods is to ensure athletes reach peak performance at the time of competition. The methodology is guided by several fundamental principles:

Training periodization: Dividing the training process into distinct phases to optimize performance and minimize the risk of injury.

Training integration: Combining endurance, strength, speed, and coordination exercises to support the athlete's overall development.

Mental preparation: Implementing techniques to enhance concentration, manage stress, and facilitate rapid decision-making under pressure.

Recovery and nutrition: Promoting effective recovery through rest, appropriate nutrition, and mobility-focused exercises. Modern approaches emphasize integrated training that merges event-specific physical exercises with recovery strategies and performance optimization techniques. Functional training and variable-intensity workouts further enhance athletes' adaptability to competition-like conditions. Mental preparation remains a key element, incorporating strategies to manage stress, sharpen focus, and improve performance during extended exertion. By starting with a well-defined selection process and systematically addressing technical, tactical, mental, psychological, recovery, and nutritional aspects of training, coaches and athletes can progressively monitor improvements, achieve set goals, and foster long-term motivation and engagement in both training and competition [2, 6, 8].

2.1. Integrated Training. The General and Specific Physical Preparation of the Military Pentathlete

Physical training in the military pentathlon is structured into two main components: General Physical Preparation (GPP) and Specific Physical Preparation (SPP). Both are essential for optimizing performance across the event's five disciplines. A critical aspect of effective physical preparation lies in maintaining high performance in the athlete's preferred disciplines (DP), while

progressively improving performance in the remaining ones (SP), without compromising existing strengths. Each pentathlete tends to excel in one or more disciplines, where the required physical and mental effort is lower compared to those where their capabilities are less developed. Consequently, the physical and psychological strain is greater in the latter. Performance in military pentathlon competitions is evaluated both individually and as part of a team, adding an extra layer of complexity for coaches who must manage and prepare a high-performing group of athletes [14, 15].

A. General Physical Preparation (GPP) for the Military Pentathlete

The goal of GPP is to develop essential motor skills and to build a solid foundation for discipline-specific training. This includes:

Long-distance running (8-16 km) over varied terrain to improve aerobic capacity. Distances are adjusted for athletes for whom endurance is a specific (SP) challenge. Circuit training (CT) to enhance muscular strength, cardiovascular endurance, and explosive power. Weight training (e.g., squats, deadlifts, pull-ups) to strengthen both upper and lower body muscle groups. Explosive strength exercises (such as jumps, sprints, and plyometric) to improve reaction speed. Flexibility and balance training to reduce injury risk, especially during military-style obstacle navigation. Coordination and agility drills to improve adaptability across different terrains [1, 2, 5].

Examples of Training Circuits (CT) for Military Pentathletes:

1. *Classic Circuit* (General Fitness GF). Duration: 40-60 minutes.

Components: Standard push-ups, crunches, pull-ups, barbell rows, jump rope exercises, and stretching. Note: It is essential to alternate between major muscle groups using diverse exercises targeting the entire body.

2. *Strength Circuit* (PF). Duration:30-40 minutes. This circuit includes traditional strength-building exercises such as dumbbell squats, chest presses, and deadlifts. The training is typically performed in a gym setting using heavier weights and fewer repetitions, aiming to increase muscle mass and overall muscular strength.

3. *Resistance Circuit* (RF). Duration: Up to 60 minutes. Designed to enhance muscular and cardiovascular endurance, this circuit involves exercises performed at moderate intensity with high repetitions and low resistance. Equipment may include light dumbbells, weighted bags, treadmills or ergometers, rowing machines, kettlebells, and functional bodyweight movements such as burpees.

4. *High-Intensity Interval Training Circuit* (HIIT). Duration: 30-40 minutes.

This circuit focuses on high-effort exercises interspersed with short rest periods to burn calories and improve overall physical fitness. It may include sprint intervals over varied distances, running technique drills, jumping, climbing exercises, and stair climbing. The training can be conducted both indoors and outdoors.

5. *Explosion and Speed Circuit* (ES). Duration: 30-40 minutes. Focused on developing explosive power and speed, essential for grenade throwing, swimming hurdles, and obstacle course running. This circuit emphasizes plyometric exercises, sprinting, jumping, and various throwing drills. Equipment such as gym benches, ply boxes, medicine balls, and other gym apparatus may be integrated into the session.

6. *Functional Circuit* (FC). Duration: Up to 30 minutes. This circuit incorporates exercises that replicate natural body movements and combine strength, mobility, and coordination. Many of these exercises are common in sports therapy and injury prevention. Examples include throwing weights at a target, rope pulling, unilateral deadlifts, box jumps, medicine ball push-

ups, sandbag carries, and maze walking.

7. *Recovery and mobility circuit(RM)* lasting a maximum of 30 minutes including stretching exercises, yoga or core training. Through this circuit, the pentathlete learns the use of recovery exercises after a strenuous effort, improves muscle mobility and reduces the risk of injury. The circuit includes foam rolling, plank or active stretching exercises. [15]

B. Specific Physical Preparation (PFS) of the military pentathlete

PFS is focused on developing the special skills required for each event of the military pentathlon:

a. *The specific physical preparation required for the military pentathlon specific firearms shooting test*.

Training of between 50 and 60-minute duration will be performed comprising:

- Concentration and breath control exercises for hand relaxation.

-Breathing and arm coordination exercises

-Light weight training to strengthen stabilizing arm muscles.

-Pulling simulations after more intense mental or physical exercises.

b. *Specific physical training for utility swimming (50 m with hurdles).*

Workouts will last 60 to 90 minutes and will include: medium and short distance swimming to improve crawl swimming technique; starts from the starting block with or without approaching the first obstacle; diving, grabbing and pushing techniques in obstacles; training for start and finish reactions; exercises for the optimal approach and rapid overcoming of obstacles in the water; exercises for compensating swimming speed by making optimal use of foot strokes

c. *Specific physical preparation for the 500 meters with 20 obstacles on the CISM obstacle course.*

Training sessions will last 40 to 60 minutes and will include: sprinting combined with jumping over hurdles drills; medium distance running with repeated rhythm breaks; traction and strength exercises for climbing vertical obstacles; simulations of speed over obstacles; exercises jumping off obstacles.

d. *Specific physical training for throwing grenades in distance and precision*.

Training will last 30-40 minutes and will include: exercises to increase throwing strength and accuracy; eye-hand-target coordination drills to improve accuracy; repetitive throws from different positions (with moose, static); medicine ball pushing exercises from different positions; exercises on the simulator to improve distance throwing technique.

e. *Specific physical preparation for running in varied terrain (8 km men / 4 km women)*.

Workouts will last 40 to 100 minutes: combined endurance running (running on uneven terrain, on an incline or with changes of direction); interval training to increase speed and anaerobic endurance; race simulations; running on sand or soft ground. [1, 4, 14]

2.2. Technical and Tactical Training (ATT) for the Combined Military Pentathlon Event

Technical training is a fundamental component of preparation, focused on refining the execution of each element within every event. Its primary goal is to optimize movement efficiency and energy expenditure during competition while minimizing errors. Tactical training complements this by enabling athletes to manage their physical resources effectively and make rapid, strategic decisions to enhance performance in real-time scenarios.

Both technical and tactical training are tailored to the individual needs of each athlete and are critical for achieving success in high-level international competitions. [11, 13, 14].

ATT training in the five disciplines

a) *Shooting*

Stable shooting position - minimizing vibrations and maximizing accuracy. Breath control - synchronizing shooting with breathing rhythm. Rapid shooting exercises - increasing shooting frequency to reduce competition times. Shooting under stress

through simulated shooting exercises after intense physical effort. Tactical time management exercises for shooting with precision and speed

b) *Obstacle course*

Effective overcoming of obstacles by training jumping, climbing and crawling techniques. Speed running with tempo changes to adapt to the way of approaching different forms of obstacles. Strength training in speed and resistance regime to strengthen the muscles of the lower limbs and to make explosive movements more efficient.

c) *Obstacle swimming*

Minimizing water resistance by improving the technique for fast and efficient swimming. Optimizing physical resistance in swimming to overcome obstacles through exercises with weight or additional clothing.

Improving the start and finish diving technique. Improving the technique of passing obstacles through exercises in water but also on land

d) *Grenade throwing*

Improving the accuracy of aiming by training the throwing movement from different directions and distances. Strength and coordination training - strengthening the muscles of the arms and shoulders.

e) *Cross*

Improving the technique of energy delivery in endurance running through cross-country running training on rough terrain. Combination of long-distance running and sprint intervals through exercises to adapt to different sections of the route. [2, 14]

2.3. Mental and Psychological Training

Mental and psychological training is essential in combined athletics competitions, where concentration, mental toughness and the ability to make quick decisions can make the difference between success and failure. Through adequate mental training, athletes can control stress, maintain motivation and optimize performance in all events of the competition. Well-structured psychological training helps athletes control their emotions, maintain concentration and optimize performance in all events [12, 14].

In combined athletics competitions, athletes are subject to psychological factors such as competitive stress – the pressure to perform at the highest level in each event.

Mental fatigue – maintaining concentration throughout the entire competition. Adaptation to the unpredictable – managing external factors (weather, competition surface, opponents).

In order to successfully face these challenges, the coach must systematically apply mental and psychological training and recovery techniques

a) *Concentration and attention control techniques*. Focus training, exercises to maintain attention under intense effort.

Control of external stimuli, techniques to ignore noises or distractions. Mental routines before each test – establishing actions that help regulate the mental state.

b) *Stress and emotion management*. Controlled breathing techniques and reducing the pulse and stabilizing emotions.

Progressive relaxation, muscle relaxation training to reduce tension. Mindfulness and self-control for awareness and regulation of emotions in real time.

c) *Simulating competition conditions*. Creating competition scenarios in training, practicing rapid transitions and competitive pressure. Shooting under stress-Quick decision-making exercises, testing the ability to react in critical situations.

d) *Visualization and self-motivation techniques*. Visualization of success, mentally replaying each test before the competition. Positive autosuggestion, replacing negative thoughts with motivational statements.

Goal setting, establishing clear and achievable targets for each test.

e) *Recovery techniques*. Debriefing techniques, analyzing performance and identifying strengths and weaknesses. Relaxation and disconnection time,

recreational activities to reduce accumulated stress.
Psychological support – discussions with coaches or sports psychologists to improve mental state. [12]

2.4. Recovery and Nutrition Strategies

A proper recovery and nutrition strategy is essential for athletes in combined sports, helping to achieve and maintain performance, prevent injuries and maximize adaptation to effort. A well-structured hydration, nutrition and recovery plan accelerates the body's regeneration and improves competitive results**.** This plan would include:
a) *Immediate post-competition/training recovery*. Rapid hydration – rebalancing water and electrolyte losses with water, isotonic drinks or water with salt and lemon. Stretching and mobility exercises – preventing muscle stiffness and maintaining flexibility. Contrast baths (cold-warm) – to reduce inflammation and accelerate blood circulation.
b) *Active recovery*. Light recovery training - light running, swimming or cycling to eliminate lactic acid.
Sports massage - relaxing muscles and improving blood circulation. Compression therapy - using compression to reduce inflammation and muscle fatigue.
c) *Mental recovery*. Deep breathing techniques – reducing stress and improving oxygenation. Quality sleep – 7-9 hours of sleep for muscle regeneration and hormonal balance. Active relaxation – meditation, yoga or recreational activities to reduce competitive stress.
A plan regarding Nutrition in combined sports includes the following phases
a) *Pre-competition nutrition*. Complex carbohydrates – rice, pasta, sweet potatoes for sustained energy. Lean proteins – lean meat, fish, eggs to support muscle mass. Optimal hydration – sufficient water and electrolyte consumption to prevent dehydration.
b) *Nutrition during competition*
Isotonic drinks and energy gels – to maintain glycogen and prevent fatigue. Fruit and protein bars – for quick energy and essential amino acids.
c) *Post-competition nutrition.* Glycogen replenishment, fast carbohydrates (bananas, rice, whole meal bread) 30-60 minutes after exercise. Protein for muscle recovery – lean meat, dairy, plant-based proteins. Healthy fats – avocado, nuts, olive oil to reduce inflammation. [9]

3. Comparative Analysis of Physical Training Methods of Athletes from Romania and Germany

Both Germany and Romania train military athletes for the military pentathlon event. Military training represents for the two NATO member states a basic pillar of specialized training of the military. Through the comparative analysis of the physical training methods of pentathletes from the two states, the aim is to optimize athletic performance and create a training standard for participation in international military pentathlon competitions of Romanian athletes. The main aspects pursued in the analysis were:
1. *Selection method within the military pentathlon team*
Germany demonstrates a high level of transparency in its process for recruiting athletes into the military pentathlon team. The selection criteria and procedures are publicly available and easily accessible on the official website of the Bundeswehr (German Ministry of Defence). In contrast, Romania selects military pentathletes exclusively from within its existing pool of approximately 90,000 active military personnel already serving in the Ministry of National Defence. This results in a notable strategic advantage for Germany. With a total population of approximately 83 million and over 400,000 individuals reaching the age of 18 each year, Germany has a significantly broader and more diverse talent pool from which to identify and

recruit promising young athletes into military sports programs.

2. *Training structure*

Germany: It has a very technical and scientific approach, based on performance analysis and optimization of each test through modern physical training methods. Advanced technologies are used, such as biomechanical analysis and performance monitoring with sensors.

Romania: It focuses more on endurance and adaptability. Training is more physically intense, with an emphasis on traditional training and less dependence on technology.

The difference is not significant between the two countries, but the possibility of using advanced technologies in physical training increases the level of performance.

3. *Physical training*

Germany: The training program is well structured, with specific preparation periods for each test. The emphasis is on training efficiency but also on recovery methods and nutrition.

Romania: There is a lot of emphasis on volume and physical endurance. Romanian soldiers are trained to cope with harsh conditions, with fewer resources. In endurance events, the results of Romanian athletes are better compared to technical events.

The difference in physical training is that athletes from Germany have continuity and a clear training structure. From the moment of selection in the pentathlon group, their mission is to perform in the military pentathlon. In Romania, military pentathletes participate in training camps only during time intervals approved by the structures they are part of.

4. *Shooting competition*

Germany: Modern shooting training systems are used. Shooting is performed in mechanized ranges equipped with video equipment. The weapons comply with the standards imposed by the regulations of the military pentathlon competitions. Training that includes virtual shooting simulators brings a plus in the preparation for the competition. The emphasis is on the precision test because, in addition to offering the athlete a good start in the competition, it also brings valid points in the general ranking.

Romania: pentathlon athletes train more in real field conditions. There is no automatic shooting range. The weapons cannot be used at full capacity in the absence of ranges. Lack of a specialized shooting coach in the military pentathlon group is a problem.

Differences: in the shooting competition the balance is clearly tilted in favour of Germany. The results of all military pentathlon competitions confirm the fact that in Germany there is a clear emphasis on details, especially in the technical tests.

5. *Obstacle course*

Germany: Obstacle courses are optimized and standardized; training methods emphasize the development of technique and speed of passing obstacles.

Romania: athletes train on varied, non-standardized surfaces with CISM-type obstacles. These contribute to the development of strength and adaptability in different environments of the military but make it difficult to achieve performance in international competitions

Difference: the results of athletes in Germany are superior to those in Romania where there is only one standard CISM-type track.

6. *Mentality and strategy*

Germany: has an approach based on statistical data and continuous optimization. Military athletes are trained to manage their effort and be as efficient as possible. In addition to the opportunity offered to them to be part of an elite army team, they are offered the opportunity to be part of the active military of their army at the end of their career as pentathletes.

Romania: The mentality at the level of the military pentathlon team is imposed by the leadership of the ministry through the specialists designated to prepare the team.

They focus their training methodology generally on resistance training. The idea is that the military must have the ability to adapt to unforeseen situations. [15]

4. Conclusions and Recommendations

Military pentathlon serves as an effective tool for assessing both the physical and mental capabilities of soldiers. Athletes in this discipline often represent the pinnacle of physical training within the armed forces and act as a symbol of military readiness and excellence. Training approaches in military pentathlon vary across countries, reflecting different philosophies and institutional priorities. Success in this demanding sport depends on the ability to identify, adopt, and refine the most effective training methods. Continuous improvement in these areas directly contributes to achieving high-level performance. In Romania, a comprehensive evaluation of the current athlete selection and training system is necessary to enhance the competitiveness of its military pentathlon program. One of the most pressing requirements is the development of an automatic shooting range, a critical investment to bring Romania in line with international standards and improve performance consistency in the shooting discipline. Furthermore, hosting an international military pentathlon competition in Romania would not only raise the profile of the sport nationally but also provide valuable experience for athletes, coaches, and organizers. Such an event would position Romania as an active and engaged member of the international military sports community.

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