World Bulletin Publishing Online Publishing Hub	World Bulletin of Physical Education and Sports Science (WBPESS)
ISSN (E) : 3072-1768	Volume 2, Issue 1, January 2026
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https://worldbulletin.org/index.php/2	

DETERMINATION OF OPTIMAL TRAINING LOAD PARAMETERS OF FOOTBALL SESSIONS IN THE PHYSICAL TRAINING SYSTEM OF CADETS

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Abstract

The physical training system of cadets in military and law enforcement educational institutions must ensure a high level of physical fitness, functional readiness, and adaptive capacity. Traditional training methods, while effective, often lack variability and motivation. Football-based training has gained attention as a multifunctional physical activity; however, scientifically substantiated training load parameters adapted to cadets remain insufficiently studied.

Keywords: Cadets; Physical training system; Football-based training; Training load optimization; Functional readiness; Heart rate monitoring; Physical fitness.

Introduction

The effectiveness of professional activity in military and law enforcement structures largely depends on the level of physical preparedness, functional stability, and adaptive capabilities of cadets. Modern operational conditions impose increased physical and psycho-emotional demands, requiring cadets to demonstrate high endurance, speed, coordination, stress resistance, and the ability to act effectively in dynamic and unpredictable situations. Therefore, the

World Bulletin of Physical Education and Sports Science (WBPESS)
ISSN (E) : 3072-1768
Volume 2, Issue 1, January 2026

https://worldbulletin.org/index.php/2

improvement of physical training systems in military educational institutions remains a relevant scientific and practical problem.

Traditional physical training programs for cadets are primarily based on standardized exercises aimed at developing general physical qualities such as strength, endurance, and speed. While these methods remain essential, recent studies emphasize the need to diversify training tools and introduce more dynamic, multifunctional forms of physical activity that simultaneously develop physical, functional, and psychological components of readiness. In this regard, sports games, particularly football, are increasingly considered as an effective means of physical training.

Football is characterized by a complex structure of motor activity that combines cyclic and acyclic movements, intermittent high-intensity efforts, rapid changes of direction, decision-making under time pressure, and continuous interaction with teammates. Such characteristics make football a valuable training tool for developing aerobic and anaerobic endurance, speed, agility, coordination, and tactical thinking. Moreover, football training promotes emotional engagement and motivation, which are important factors in maintaining training effectiveness among cadets.[1,2]

Despite the growing interest in the use of football within educational and military training systems, the scientific literature reveals a lack of consensus regarding the optimal regulation of training loads during football sessions for cadets. In many cases, football is used as a supplementary or recreational activity without precise control of intensity, duration, and volume of physical load. Unregulated or excessive training loads may lead to functional overload, fatigue accumulation, or increased injury risk, whereas insufficient loads may reduce the training effect and limit functional adaptation.

The concept of training load optimization is a key principle in sports science and physical training theory. Optimal training load parameters ensure effective adaptation of the cardiovascular, respiratory, and neuromuscular systems while preventing overtraining and negative functional shifts. In the context of cadet training, load optimization is particularly important due to the combination of physical training with intensive academic, tactical, and psychological demands.

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Heart rate monitoring, work-to-rest ratios, duration of active play, and intensity zones are widely recognized as reliable indicators for regulating training loads. However, most existing studies focus on professional athletes or civilian students, while the specific characteristics of cadets—such as regimented daily routines, limited recovery time, and professional specificity—are often overlooked. This creates a scientific gap in understanding how football training loads should be adapted to the physical training system of cadets.

Furthermore, cadet physical training systems aim not only at improving general fitness but also at enhancing functional readiness and long-term adaptive capacity. Football training, when scientifically regulated, may serve as an effective means to achieve these objectives by providing controlled intermittent loads that stimulate cardiovascular adaptation and neuromuscular coordination. Nevertheless, the absence of clearly defined optimal load parameters limits the systematic integration of football into official training curricula.

Given these considerations, there is a pressing need for experimental studies that scientifically substantiate the optimal training load parameters of football sessions for cadets. Such studies should be based on objective physiological indicators and comparative analysis with traditional physical training methods. Establishing evidence-based load parameters would contribute to improving training efficiency and ensuring the safe and effective use of football in cadet physical training programs.

Therefore, the purpose of this study is to determine the optimal training load parameters of football sessions within the physical training system of cadets, based on functional and physical performance indicators. The findings of this research are expected to provide practical recommendations for physical training instructors and contribute to the modernization of physical training systems in military and law enforcement educational institutions.[3,4]

Methods

Study Design. This study employed a pedagogical experimental design with a pre-test and post-test control group approach. The experiment was conducted over a period of 12 weeks to evaluate the effectiveness of regulated football

World Bulletin Publishing
Online Publishing Hub

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training loads within the physical training system of cadets. The research design allowed for a comparative analysis between traditional physical training methods and football-based training with controlled load parameters.

Participants. The study involved 60 male cadets aged 18 to 22 years enrolled in a military educational institution. All participants were medically examined and declared fit for physical training activities. Cadets had a comparable level of baseline physical preparedness and no prior specialization in football training. Participants were randomly assigned into two groups:

Experimental Group (EG): 30 cadets who participated in football-based training sessions with regulated load parameters.

Control Group (CG): 30 cadets who followed the standard physical training curriculum approved by the institution.
All participants provided informed consent, and the study was conducted in accordance with ethical principles of educational and sports research.

Training Intervention. The experimental intervention consisted of integrating football sessions into the physical training program of the experimental group. Football training sessions were conducted twice per week, each lasting 60 minutes, and replaced part of the traditional physical training content.
Each football session included:

Warm-up (10 minutes): dynamic stretching and mobility exercises,
Main part (40 minutes): small-sided football games and technical-tactical exercises,
Cool-down (10 minutes): low-intensity running and stretching exercises.

Training Load Regulation. Training loads during football sessions were regulated using objective physiological and methodological parameters. The primary indicators for load control included:

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Volume 2, Issue 1, January 2026

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Heart rate (HR) monitoring using wearable devices,
Intensity zones defined as 60–85% of maximum heart rate (HRmax),
Duration of active play within the main part of the session,
Work-to-rest ratio set at 2:1.
Based on preliminary testing, the optimal training load parameters targeted an average heart rate range of **140–165 beats per minute**, ensuring moderate-to-high intensity suitable for functional adaptation without excessive fatigue.

Results

The analysis of the experimental data demonstrated significant differences in physical and functional fitness indicators between the experimental and control groups after the 12-week intervention.

Baseline Comparability. At the beginning of the experiment, no statistically significant differences were observed between the experimental group (EG) and the control group (CG) in any of the measured indicators ($p > 0.05$), confirming the initial homogeneity of the groups.[5]

Changes in Physical Fitness Indicators. After the experimental period, the experimental group showed statistically significant improvements in all tested physical fitness parameters compared to the control group.

Changes in Physical Fitness Indicators of Cadets (Mean ± SD)Table 1.

Indicator	Group	Pre-test	Post-test	Change (%)
1000 m run (min)	EG	4.12 ± 0.18	3.59 ± 0.16	↑ 12.8%
	CG	4.10 ± 0.17	3.98 ± 0.18	↑ 2.9%
100 m sprint (s)	EG	13.4 ± 0.5	12.1 ± 0.4	↑ 9.7%
	CG	13.3 ± 0.6	13.0 ± 0.5	↑ 2.3%
Shuttle run 4×9 m (s)	EG	10.6 ± 0.4	9.6 ± 0.3	↑ 9.4%
	CG	10.5 ± 0.4	10.2 ± 0.4	↑ 2.8%

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The improvements observed in the experimental group were statistically significant compared to both baseline values and the control group results ($p < 0.05$).

Functional Readiness Indicators. Significant positive changes were also recorded in functional readiness indicators among cadets in the experimental group.

Functional Readiness Indicators Before and After the Experiment Table 2.

Indicator	Group	Pre-test	Post-test	Change (%)
Resting HR (bpm)	EG	72.4 ± 3.1	66.8 ± 2.9	↓ 7.7%
	CG	71.9 ± 3.0	70.2 ± 3.2	↓ 2.4%
HR recovery (1 min) (bpm)	EG	34.6 ± 4.2	24.8 ± 3.9	↓ 28.3%
	CG	33.9 ± 4.0	31.7 ± 4.1	↓ 6.5%
Ruffier Index	EG	10.2 ± 1.1	7.6 ± 0.9	↓ 25.5%
	CG	10.1 ± 1.0	9.5 ± 1.1	↓ 5.9%

The reduction in resting heart rate, faster heart rate recovery, and improved Ruffier index values in the experimental group indicate enhanced cardiovascular efficiency and functional adaptation.

Optimal Training Load Parameters.

Analysis of heart rate monitoring data during football sessions revealed that the most effective training adaptations were achieved when the following load parameters were maintained:

Average heart rate: **140–165 bpm**,
Intensity zone: **65–85% of HRmax**,
Active play duration: **30–35 minutes per session**,
Work-to-rest ratio: **2:1**.

Cadets training within these parameters demonstrated stable performance improvements without signs of excessive fatigue or functional overload.

Discussion

The findings of the present study confirm the effectiveness of football-based training as a regulated component of the physical training system of cadets. The statistically significant improvements observed in the experimental group

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indicate that properly controlled football training loads contribute to the development of both physical fitness and functional readiness.

The improvement in endurance indicators, as demonstrated by the reduction in 1000 m run time (12.8%), aligns with previous research highlighting the aerobic benefits of intermittent team sports. According to Bangsbo et al., football training induces substantial cardiovascular adaptations due to repeated high-intensity efforts interspersed with active recovery periods. The current study supports this concept by demonstrating enhanced endurance performance when cadets trained within an average heart rate range of 140–165 bpm.[6,7]

Speed and agility improvements observed in the experimental group (9.7% and 9.4%, respectively) are consistent with findings reported by Hoff and Helgerud, who emphasized the role of small-sided football games in developing neuromuscular coordination and rapid directional changes. Football training inherently involves acceleration, deceleration, and multi-directional movements, which likely contributed to the superior gains in these qualities compared to traditional linear training methods used in the control group.

Functional readiness indicators further support the adaptive value of regulated football training. The significant decrease in resting heart rate and faster heart rate recovery in the experimental group indicate improved cardiovascular efficiency. Similar results were reported by Krustrup et al., who found that structured football training enhances autonomic regulation and cardiac adaptation in non-athlete populations. The substantial improvement in Ruffier index values in the experimental group also reflects positive functional adaptation, which is critical for cadets exposed to high physical and psycho-emotional demands.

An important contribution of this study lies in identifying optimal training load parameters specifically adapted to cadet training conditions. While previous studies have established effective load zones for athletes and recreational participants, limited attention has been given to cadets, whose training context includes regimented schedules and limited recovery opportunities. The present findings suggest that maintaining football training intensity within 65–85% of

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Online Publishing Hub

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HRmax, combined with a work-to-rest ratio of 2:1 and 30–35 minutes of active play, ensures effective adaptation without signs of overtraining.

Compared with traditional physical training programs, football-based training offers greater variability and engagement while maintaining controlled physiological stress. This observation supports pedagogical studies emphasizing that increased motivation and emotional involvement enhance training adherence and outcomes. In military and law enforcement educational settings, such engagement is particularly valuable for sustaining long-term training effectiveness.

Despite the positive results, certain limitations should be acknowledged. The study involved only male cadets and was conducted within a single institution, which may limit the generalizability of the findings. Future research should consider longer intervention periods, inclusion of female cadets, and the use of additional physiological markers such as lactate concentration or heart rate variability to further refine load optimization.

Overall, the results of this study corroborate existing sports science literature while addressing a specific research gap related to cadet physical training systems. The evidence supports the systematic integration of football training with scientifically regulated load parameters as an effective means of enhancing physical and functional readiness in cadets.[8,9,10]

Conclusion

The results of the present study demonstrate that football-based training, when implemented with scientifically regulated load parameters, can be an effective and safe component of the physical training system of cadets. The experimental data confirm that the integration of football sessions into the regular training curriculum leads to significant improvements in both physical fitness and functional readiness compared to traditional physical training methods.

The findings indicate that cadets who participated in football training with controlled intensity and volume showed superior gains in endurance, speed, and agility, as well as marked improvements in cardiovascular efficiency. These positive adaptations were reflected in faster heart rate recovery, reduced resting

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heart rate, and improved Ruffier index values, which are critical indicators of functional readiness for professional service activities.

One of the key outcomes of this study is the identification of optimal training load parameters for football sessions specifically adapted to the conditions of cadet physical training. The most effective training effects were achieved when football sessions were conducted twice per week with an average heart rate range of 140–165 bpm (65–85% of HRmax), active play duration of 30–35 minutes, and a work-to-rest ratio of 2:1. These parameters ensured adequate physiological stimulation while preventing excessive fatigue and functional overload.

The practical significance of the study lies in its potential application to the modernization of physical training programs in military and law enforcement educational institutions. The proposed load parameters can be used by physical training instructors to optimize training intensity, enhance functional adaptation, and improve overall training efficiency. Moreover, football-based training contributes to increased motivation and engagement among cadets, which is an important factor in sustaining long-term physical preparedness.

Despite the positive findings, further research is warranted to expand the scope of investigation. Future studies should explore longer intervention periods, include female cadets, and incorporate advanced physiological monitoring tools to further refine training load regulation. Additionally, comparative studies involving other team sports may provide valuable insights into the relative effectiveness of different game-based training methods.

In conclusion, the present study provides scientific evidence supporting the systematic and controlled use of football training within the physical training system of cadets. The identified optimal load parameters offer a practical and evidence-based framework for enhancing physical and functional readiness, thereby contributing to the development of more effective and sustainable cadet training programs.

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