Methodology for the optimal distribution of training loads during the 12-week pre-competition preparation period of young mini-football players

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Abstract
This study aims to develop a methodology for the rational distribution of training loads in the pre-competition microcycles of young mini-football players. The study involved 20 male mini-football players aged 18–20, who were divided into experimental and control groups. The 12-week program includes training sessions three times a week, lasting 90–100 minutes each, and integrates physical, technical-tactical, game, and recovery-oriented exercises. The training volume, intensity, density, work-to-rest ratio, and recovery intervals are regulated based on a step-by-step wave-like model. Internal and external loads are monitored using session-RPE, heart rate, fatigue, muscle soreness, sleep quality, and readiness indicators. The methodology is designed to reduce excessive fatigue during pre-competition preparation while improving repeated sprint ability, speed-strength indicators, agility, technical precision, and the effectiveness of competitive movements.
Keywords. mini-football, young athletes, pre-competition preparation, training microcycle, training load, load distribution, session-RPE, technical-tactical preparation.

Introduction

Mini-football is a high-intensity, intermittent team sport characterized by repeated accelerations and decelerations, changes of direction, short maximal sprints, and frequent transitions between attacking and defensive actions. The official match format consists of two 20-minute halves, with unlimited substitutions allowing athletes to maintain a relatively high work rate throughout the game. Therefore, a successful outcome requires the comprehensive development of repeated sprint ability, leg muscle power, agility, interval endurance, coordination, and the ability to perform technical and tactical actions under conditions of time constraints and increasing fatigue (Castagna et al., 2009; Naser et al., 2017).

The pre-competition period is of particular importance, as at this stage, the training process must simultaneously improve sport-specific preparation and reduce the accumulation of excessive fatigue before a competition. It is insufficient to manage the training load at this stage solely by the overall duration of the training. The load should be viewed as a multidimensional construct encompassing volume, intensity, density, exercise specialization, number of repetitions, work-to-rest ratio, and the sequence of training effects within weekly microcycles. An improper combination of these components can disrupt the recovery process, reduce the quality of technical movements, and limit the athlete's ability to repeatedly perform high-intensity movements. Milanez et al. (2014) demonstrated a nonlinear relationship between training load and psychophysiological stress in mini-football players, noting that both insufficient and excessive loads can trigger adverse responses.

For effective load management, it is also necessary to account for the difference between the load planned by the coach and the load actually experienced by the athlete. Rabelo et al. (2016) observed a professional mini-football team over a 45-week season and found consistent discrepancies between the intensity planned by the coaches and the perceived exertion level of the athletes. These results justify the need to regularly monitor internal load rather than relying solely on a pre-established training plan. The subjective exertion level of a training session—the session-RPE method, an indicator calculated by multiplying the training duration by the athlete's RPE score—is a practical tool for quantifying daily and weekly internal training loads, especially in the absence of advanced monitoring equipment (Rabelo et al., 2016).

The organization of training exercises within the microcycle is also of great importance. Small-sided games with modified conditions allow for the recreation of the essential physiological, technical, and tactical requirements of mini-football; here, coaches can manage the number of players, field size, task duration, rules, and recovery intervals. Amani-Shalamzari et al. (2019) found that training based on small-sided games induces physiological adaptations comparable to general physical

fitness training and has an additional positive impact on the technical performance of young mini-football players. However, game-based exercises should not completely replace all standardized physical work. Their effectiveness depends on the purposeful combination of special game tasks with repeated sprinting, speed-strength, coordination, and recovery-oriented exercises.

Methodological research on mini-football and football emphasizes the need to distribute training loads in accordance with the specific requirements of the preparatory stage, the athlete's functional state, and their playing position. Sydebu (2020) proposed an integrated approach combining physical, functional, technical-tactical, psychophysiological, and competitive components, as well as differentiated load management for players in various positions. Grigoriev (2014) demonstrated the importance of the sequential arrangement of targeted training blocks for 17–20-year-old football players, while Skorovich (2012) recommended integrating coordination exercises with technical training and performing coordination tasks requiring high precision before significant fatigue occurs.

Despite existing scientific evidence regarding the load requirements of mini-football, internal load monitoring, small-sided games, and periodized training, there remains a need for a practical methodology to determine how to rationally distribute physical, technical-tactical, game, and recovery loads in the pre-competition microcycles of young adult mini-football players. In this regard, the aim of the study was to develop and evaluate a methodology for the rational distribution of training loads in pre-competition microcycles, with special attention to the management of repeated sprint ability, speed-strength training, agility, technical precision, tactical efficiency, and the recovery process.

Methods

A 12-week pedagogical experiment based on repeated measurements was conducted to evaluate the methodology for the rational distribution of training loads in pre-competition microcycles. The experiment consisted of a total of 36 sessions performed three times a week, with at least a 24–48 hour break between consecutive sessions. Each session lasted 90–100 minutes, resulting in a planned weekly training volume of 270–300 minutes. Assessments were conducted at baseline during week 1, at an intermediate control point during week 8, and at the end of the experiment during week 12. The program was organized based on a progressive wave-like model. During the developmental microcycles, training volume and intensity were consistently increased, whereas during weeks 4, 7, and 12, they were reduced to ensure recovery and adaptation. The program integrated physical, technical-tactical, game, and recovery-oriented training tools. Its structure was based on the demands of high-intensity intermittent loads in mini-football, the need for comprehensive preparation, and the principles of differentiated load management according to the athletes' functional state and playing position.

Participants. The study involved 20 male mini-football players aged 18–20. All participants had 3–5 years of experience in regular mini-football training and held either the first or second sports category. The athletes represented the main outfield positions—defender, all-rounder, and forward. At the beginning of the experiment, participants were required to have medical clearance to participate in training and competitions, and to have no acute injuries or illnesses. Before the start of the study, the athletes were informed about its purpose, procedures, potential risks, and expected benefits. Written informed consent was obtained from all participants. Participation was voluntary, and the athletes had the right to withdraw at any stage of the study without any adverse consequences. Personal data was coded to ensure confidentiality.

The pedagogical experiment was divided into five consecutive stages: diagnostic-adaptive, general preparation, special preparation, pre-competition integration, and load reduction (tapering). This step-by-step structure allowed for a gradual transition from general physical conditioning and motor qualities to the high-intensity work characteristic of mini-football and competition-oriented technical-tactical tasks.

Training loads were distributed across three independent classifications:

– physical and technical-tactical preparation: 30% and 70% respectively;

– general and special training tools: 40% and 60% respectively;

– game-based and non-game training tools: 40% and 60%, respectively.

These ratios were calculated separately, as these classifications are not mutually exclu-

Table 1. Structure of the 12-week training experiment

Stage	Weeks	Primary goal	Priority training tools	Load description
Analytical-adaptation	1	Initial assessment and adaptation to planned loads	Testing, movement preparation, and low-to-medium intensity technical exercises	Low to medium
General preparation	2–4	Development of general strength, mobility, coordination, and aerobic recovery capacity	Bodyweight strength exercises, running exercises, coordination tasks, and dosed technical work	Progressive in weeks 2–3; reduced in week 4
Special preparation	5–7	Development of repeated sprint ability, speed-strength, agility, and special endurance	Short sprints, change of direction, interval exercises with the ball, and 1x1–3x3 games	High in weeks 5–6; reduced in week 7
Pre-competition adaptation	8–11	Integration of physical and technical-tactical training in game conditions	2x2–4x4 games, pressing, transitions, positional tasks, and game modeling	Medium to high, undulating
Load reduction	12	Reducing accumulated fatigue while maintaining speed and technical quality	Short, quality-oriented exercises, set pieces, final testing, and reduced-volume game tasks	Volume is reduced; specialization is maintained

sive. For example, a repeated sprint exercise with a ball can be classified simultaneously as a special, non-game, and integrated physical-technical exercise.

Exercise intensity was monitored using the rating of perceived exertion (RPE) scale and, where possible, heart rate indicators. Due to the absence of individual laboratory threshold values, heart rate zones were interpreted as practical work zones rather than physiological boundaries.

Heart rate was not used as the sole indicator of load, as the heart rate response during short sprint actions may be delayed relative to the actual mechanical and metabolic demands. Therefore, intensity was interpreted in conjunction with exercise duration, number of repetitions, number of sprints, technical activity, and RPE indicators.

During the pedagogical experiment, internal and external training loads were regularly monitored. Session-RPE was chosen as the primary internal load indicator, as this method can be equally applied in both technologically well-equipped and resource-limited training environments. Approximately 20–30 minutes after each session, athletes rated the overall difficulty level of the training using a 0–10 RPE scale.

In the absence of heart rate or positional tracking devices, a low-tech monitoring system was used. It included training duration, RPE, assessments of overall functional state, manual counting of repetitions and sprints, coach observations, and smartphone video recordings. The pre-developed program defined the same monitoring hierarchy, which made it possible to ap-

Table 2. Standard training structure

Training component	Duration	Main content	Planned intensity
Organizational introduction	3–5 minutes	Attendance, pre-training general wellness screening, and explanation of training goals	Very low
General and specific warm-up	15–18 minutes	Mobility, dynamic activation, movement preparation, and ball warm-up exercises	Low to medium
Speed or coordination block	10–15 minutes	Short accelerations, agility tasks, reactive exercises, and exercises focused on movement accuracy	Medium to maximum
Main physical block	15–22 minutes	Sprint, repeated sprint, speed-strength, or interval conditioning exercises	Medium to high
Technical-tactical block	25–30 minutes	Passing and receiving, dribbling, finishing, pressing, and transition phase tasks	Medium to high
Integrated game block	15–25 minutes	Small-sided games, positional exercises, and game modeling tasks	Medium to very high
Cool-down	5–8 minutes	Low-intensity movements, mobility exercises, stretching, and breathing exercises	Very low
Post-training monitoring	2–3 minutes	Recording attendance and external load; subsequent assessment of session-RPE	—

Table 3. Practical work intensity zones

Intensity zone	HRmax, %	RPE 0–10	Practical application
Recovery	50–60%	1–2	Cool-down, mobility exercises, breathing exercises, and active recovery
Low	60–70%	3–4	Technical recovery sessions and low-intensity aerobic work
Moderate	70–80%	5–6	General conditioning and standardized technical-tactical exercises
High	80–90%	7–8	Specific endurance exercises, repeated high-intensity tasks, and small-sided games
Maximal/submaximal	90–100%	9–10	Short maximal sprints, testing procedures, and certain competition-specific tasks

ply the methodology in practice even without advanced monitoring equipment.

Before each session, sleep quality, fatigue, muscle soreness, and training readiness were assessed. At the end of each session, the planned and actual loads performed were compared. The training volume or intensity was reduced when the athlete experienced incomplete recovery, a higher-than-expected RPE response, a deterioration in technical quality, or signs of unusual discomfort.

The following practical correction criteria were applied:

– if two or more indicators of the athlete's general condition deteriorated by at least 2 points compared to their usual level, the volume of the next training session was reduced;

– if the repetition RPE was 2 or more points higher than the planned value, the next high-intensity block was shortened or the recovery intervals were extended;

– if technical precision significantly decreased during standardized exercises, the exercise complexity or work duration was reduced;

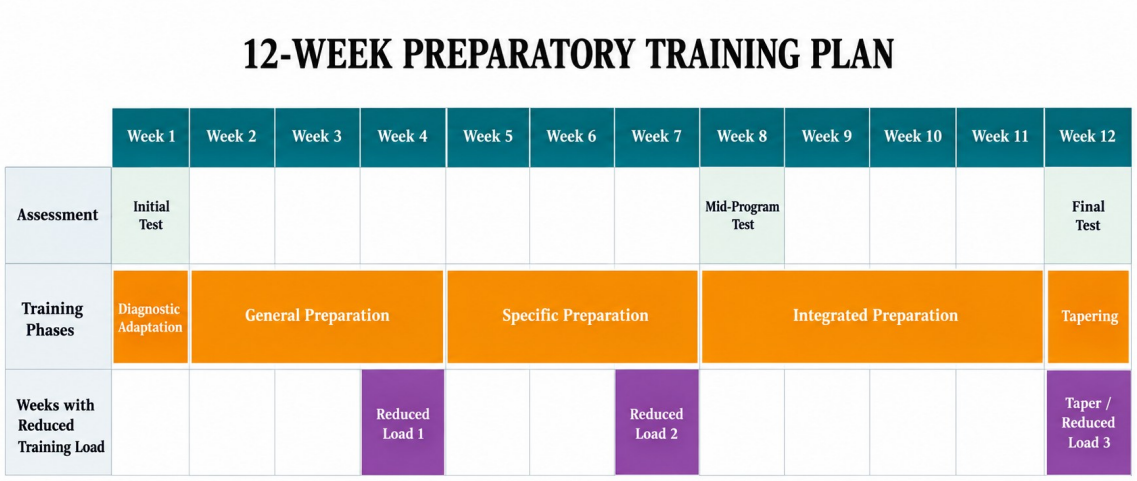
– if the RPE was below the planned value in two consecutive sessions and technical quality remained stable, only one load parameter was increased by approximately 5–10%;

– in case of pain, dizziness, impaired coordination, symptoms of acute illness, or unusual weakness, high-intensity training was suspended, and the athlete was referred for a medical examination.

Results and discussion

Physical performance was assessed at weeks 1, 8, and 12. A set of tests was selected to evaluate acceleration, linear speed, the ability to change direction, leg muscle strength, repeated sprinting ability, and interval endurance. All tests were conducted at approximately the same time of day under comparable surface and envi-

Table 4. Algorithm for monitoring and correcting training load



ronmental conditions. Before testing, the athletes performed standardized warm-up exercises. In the short sprint, jump, and agility tests, at least two attempts were permitted, and the best result was accepted for analysis. Sufficient recovery time was ensured between attempts to reduce the interference of fatigue with the results.

All 20 participants completed the 12-week pre-competition training program. No serious adverse events were recorded during the pedagogical experiment. While the attendance rate was 45%, the average number of completed sessions out of the 36 scheduled sessions was 14.

The weekly training load profile aligned with the planned progressive wave-like pattern. During the developmental microcycles, the load consistently increased, while it was reduced in weeks 4, 7, and 12. The highest session-RPE values were recorded during the special training and pre-competitive integration stages, whereas lower values were observed in microcycles with reduced loads. This structure served the methodological goal of combining progressive overload with planned recovery.

The most significant changes were observed in indicator 78, which improved by 12% and 18%, respectively. The final test also revealed statistically significant improvements; however, the observed changes in the variable did not reach the level of statistical significance.

The decrease in sprint time and the reduction in performance decrement during repeated sprints indicate an improvement in the athletes' ability to repeatedly perform high-intensity movements with less loss of efficiency. This result is especially important for mini-football, as players regularly perform repeated accelerations, maximal effort movements, sharp stops, and changes of direction. Mini-football competitive activity is characterized by a work-to-rest ratio of approximately 1:1, frequent alternations in locomotor activity, and a significant proportion of high-intensity running and sprinting.

Passing accuracy increased from the lowest to the highest level, while shooting accuracy improved by 16%. In the final game simulations, the number of successful passing actions increased, and the frequency of turnovers decreased. These results indicate that the rational distribution of physical and technical-tactical loads was not limited solely to improving individual physical fitness indicators. Additionally, the athletes' ability to perform sport-specific movements under conditions of fatigue and time constraints also improved. The integration of physical, functional, technical-tactical, psychophysiological, and game-related components is an important condition for the effective organization of mini-football training. Position-specific differentiation and specialized game exercises can further increase motor activity and competitive efficiency.

The use of exercises in 1x1, 2x2, 3x3, and 4x4 formats may have contributed to the improvement of technical-tactical indicators, as these formats increase the frequency of touches on the ball, decision-making, transition phases, and direct confrontations with the opponent. Previous methodological studies have emphasized that game-based tools can simultaneously develop spatial orientation, operational thinking, psychomotor abilities, and technical-tactical actions.

The main result of the study is that a rationally structured, gradual wave-like distribution of training loads in pre-competition microcycles led to positive changes in the physical and technical-tactical preparation of young mini-football players. The program combined progressive overload, pre-planned weeks of reduced workload, specialized game exercises, and systematic monitoring of internal workloads.

Improvements in acceleration, repeated sprint ability, and change of direction efficiency can be attributed to a gradual increase in the specialization level of the training effects. During the initial weeks, the program focused on movement quality, coordination, and general physical conditioning. In the subsequent stages, the athletes performed repeated sprints, change of direction drills, small-sided games, and transition phase exercises. This sequence ensured the gradual transfer of general physical capabilities into movements specific to mini-football.

The results show that the effectiveness of pre-competition training depends not on the maximum possible training load, but on its rational distribution across microcycles. A progressive developmental load, planned recovery weeks, integrated technical-tactical exercises, and individual monitoring ensure an optimal balance between training effects, recovery, and competitive readiness.

Conclusion

The rational distribution of training loads in pre-competition microcycles creates a systemic basis for improving the physical and tech-

nical-tactical training of young mini-football players. The proposed 12-week methodology combines progressive loads, planned recovery microcycles, repeated sprints and speed-strength exercises, small-sided games, position-specific tasks, and regular monitoring of internal loads. The practical significance of the methodology is manifested in the possibility of controlling the training volume, intensity, density, and recovery parameters in accordance with the current functional state of the athletes, instead of applying the same load at all stages of the preparatory period. Session-RPE, overall condition indicators, assessment of technical performance, and periodic testing allow coaches to compare planned and completed loads, as well as make timely corrections. This methodology is suitable for organizing pre-competition training in young mini-football teams and can help maintain high-intensity work capacity, technical precision, tactical efficiency, and recovery stability. Further research involving large samples, control groups, and objective external load monitoring tools is required to confirm its effectiveness at various competition levels and playing positions.

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