Distribution of physical loads for young basketball players in training cycles

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Abstract

This article describes the methodology for step-by-step planning of training loads at the microcycle and mesocycle levels for basketball players aged 10-11 years and their monitoring based on the ACWR (Acute:Chronic Workload Ratio) system. During the study, weekly and chronic loads were determined based on the athletes' subjective rating of perceived exertion (RPE) and the duration of training, and training cycles were structured accordingly. The results of the study showed that it is possible to optimize the physical and technical preparation of athletes by adjusting the load level at different stages of the mesocycle (pull-in, base, developmental, control). Additionally, monitoring the load balance of training days and the weekly load based on the ACWR indicator helped reduce the risk of excessive fatigue and injuries in athletes.

Keywords: training load, RPE, ACWR, microcycle, mesocycle, young athletes, load monitoring, planning technology

Introduction

Worldwide, significant attention is being given to the development of children's and youth sports. In this process, determining the optimal balance of training loads to ensure the physical and technical development of young athletes is becoming a crucial scientific and practical issue. Specifically, in basketball, which demands high-intensity activities during training and games such as sprinting, sharp turns, ball handling, and jumping, excessive loads can lead to fatigue, injuries, and mental stress in young athletes. Conversely, insufficient loads can result in inadequate development of their physical and technical preparedness. Moreover, early specialization coupled with improper load distribution can negatively impact the overall physical development of athletes. Therefore, distributing training loads for young basketball players in optimal proportions is of paramount practical importance.

Currently, scientific research continues worldwide on assessing the preparedness level of young athletes based on individual approaches and balancing training loads. Additionally, sports science is focusing on developing innovative methods for monitoring training loads. Furthermore, determining the optimal ratio of training loads at the initial preparation stage of basketball players is considered one of the global scientific imperatives for sports science. The correct proportions of training loads are crucial for achieving high results in sports. The necessity of this scientific research is increased by the fact that a scientifically-based approach has not yet been fully developed to determine the dynamics of external and internal indicators of training loads in the physical preparation process of young basketball players, assess their impact on physical condition and performance, and improve the effectiveness of the training process.

Methods

This study aims to develop a methodology for planning and monitoring the training loads of 10-11 year old basketball players based on training cycles (microcycle, mesocycle, and macrocycle), and was conducted using observational, experimental, and statistical analysis methods.

Research participants. The study involved a total of 60 basketball players aged 10-11 years from sports schools (3 groups of 20 players each). Participants were selected from Children and Youth Sports Schools in various regions of Uzbekistan.

The research was organized within the framework of a one-year preparatory macrocycle. The macrocycle consists of 4 mesocycles:

Pulling mesocycle (weeks 1-4; 17-20)

Base mesocycle (weeks 5-8; 21-24)

Developmental mesocycle (weeks 9-12; 25-28)

Control-preparatory mesocycle (weeks 13 -16; 29-32)

In each mesocycle, 4-week training mi-

crocycles were planned. Training sessions were held 3 times a week (Monday, Wednesday, Friday). In each training session, the level of subjective load (RPE - Rating of Perceived Exertion) and training duration (minutes) were recorded.

Assessment of training load. The quantitative expression of the training load was determined using the following formula:

Training load (points) = RPE × training duration (min)

Based on these indicators, the weekly load of each athlete and the accumulated 4-week load were calculated. The ACWR (Acute:Chronic Workload Ratio) was determined based on their ratio.

Monitoring methods. RPE (Borg scale 0-10): 30 minutes after each training session, athletes assessed their level of subjective load.

Training duration: Total time spent in the training session (minutes).

ACWR: Calculated for each week using the formula ACWR = Weekly load / Chronic load (4-week average).

Statistical analysis. The research results were analyzed using Excel software. Statistical indicators, including mean values (M) and standard deviation (σ), were calculated. Changes in load dynamics were visualized through graphs and tables. ACWR values were assessed according to safe (1.0-1.3), dangerous (1.4-1.5), and critical (>1.5 or <0.8) zones.

Results and discussion

Proper distribution of total loads in microcycles is crucial for the overall organization of periodization. Since microcycles have a short duration, their combination can form larger cycles - mesocycles. Microcycles are adapted to each specific period of the season. Research shows that designing microcycles is a complex process, which depends on the coach's personal philosophy, the competition calendar, and the characteristics of the players. Athletes can respond differently to training loads at both individual and group (intra- and inter-individual) levels. Some players adapt positively to loads, while others cannot adapt sufficiently due to low sensitivity. Additionally, some athletes who receive the same load experience excessive fatigue as a result of overtraining. Factors influencing such differences include chronological age (passport age), biological age (level of physiological development), sex, training history, genetics, injury history, ability to adapt to loads, recovery capacity, and psychological state.

Successful distribution of training loads is associated with sensitive management of the content, order, and volume of training. Exercises with different objectives can have varying durations. Training sessions can be conducted with fixed or variable time durations. The total amount of time depends on factors such as the training objective, the type of approach, and the stage of the season.

The results of observations conducted over 3 seasons in Children's and Youth Sports Schools showed that the training load performed one day before a game is more significant than the training load performed two days before the game. It has also been established that prolonged training sessions in a microcycle negatively affect game results. If the team's level of physical preparedness is high, pre-game training should mainly focus on tactical exercises, as excessive physical load can negatively impact the athletes' motor system.

The training model we are presenting is designed for basketball players aged 10-11, which provides for a gradual increase in the level of load and training intensity based on mesocycles.

During the pulling mesocycles, the load is maintained at a moderate level (RPE 5-6), strengthening the overall physical capacity of the athletes. In this period, the ACWR is kept within the range of 1.0-1.2, creating optimal conditions for adaptation. In the basic mesocycles, the load intensity is increased (RPE 6-7), training volumes are expanded, and the ACWR is stabilized between 1.1-1.3. This lays the foundation for enhancing athletes' special physical and technical preparedness. In developmental mesocycles, the load reaches its maximum level (RPE 7-8), and the ACWR is deliberately raised to 1.4-1.5. This ensures athletes adapt to maximum intensity and reach their peak performance. In control-preparatory mesocycles, the load is reduced (RPE 3-5), the ACWR is lowered to 1.0-1.2, which serves to stabilize recovery and functional capabilities.

Daily training loads were determined based on the product of RPE and duration, with the weekly load balance organized as Monday (highest load), Wednesday (medium load), and Friday (lower load).

Standardizing and monitoring training loads in young athletes plays a crucial role in developing their physical and athletic potential. In the presented model, load increases and de-

Table 1. Training load volume in the macrocycle for 10-11 year old basketball players at the initial preparation stage

Mesocycle type	Weeks	Load level	Monday (RPE / minutes)	Wednesday (RPE / minutes)	Friday (RPE / minutes)	ACWR strategy
Pulling meso-cycle	1-4, 17-20	Medium load	5-6 / 70	4-5 / 60	4-5 / 60	1.0-1.2
Base mesocycle	5-8, 21-24	High load	6-7 / 80	5-6 / 70	5-6 / 70	1.1-1.3
Developmental mesocycle	9-12, 25-28	Very high load	7-8 / 90	6-7 / 80	6 / 75	1.4-1.5
Control-preparatory mesocycle	13-16, 29-32	Reduced load (tests)	4-5 / 60	3-4 / 50	3-4 / 50	1.0-1.2

creases between mesocycles are carefully controlled, and adaptation and recovery processes are coordinated.

A gradual increase in load during the pulling and base stages helps make the body resistant to sports loads. At the developmental stage, athletes utilize their maximum functional capabilities by reaching peak loads and maintaining the ACWR level within the range of 1.4 -1.5. Reducing the load during the control-preparatory stage and lowering the ACWR to the range of 1.0-1.2 serves to fully restore the body and prepare for competitions.

Load management based on RPE and training duration prevents excessive fatigue in athletes and negative consequences (injuries, functional disorders) caused by overload.

This system provides accurate monitoring and systematic management of training loads, supporting the long-term development of athletes and consistent improvement in sports performance.

The table above is designed to optimize the physical and technical-tactical development processes of 10-11-year-old basketball players at the initial training stage. The table systematically outlines the intensity levels of training loads, load characteristics on training days (RPE scores and training duration), as well as the ratio of total load accumulated during the week - ACWR (Acute: Chronic Workload Ratio).

The table includes the following main components:

Based on the structure of the preparatory period, mesocycles are divided as follows:

Pulling mesocycle (weeks 1-4, 17-20): characterized by a moderate load level for establishing basic general physical fitness.

Basic mesocycle (weeks 5-8, 21-24): a high-load phase aimed at deepening specific physical and technical training.

Developmental mesocycle (weeks 9-12, 25-28): focused on developing peak athletic form through maximum intensity training.

Control-preparatory mesocycle (weeks 13 -16, 29-32): designed to monitor athletes' condition and stabilize functional capabilities, with a reduced load level.

Training day loads (RPE / duration):

The load for training days was determined based on the following principle:

Monday: Highest weekly load (main training day).

Wednesday: Medium-intensity training.

Friday: Relatively low-intensity training sessions aimed at reinforcing and refining skills.

Each day, the RPE (Rating of Perceived Exertion) and training duration (in minutes) were specified, adapted to the athletes' age and level of preparedness.

The ACWR strategy was implemented as follows:

The ratio of weekly training loads to the accumulated 4-week average loads was calculated, and the following strategic management was carried out:

Progressive mesocycle: ACWR in the range of 1.0-1.2, for sustainable development without the risk of overload.

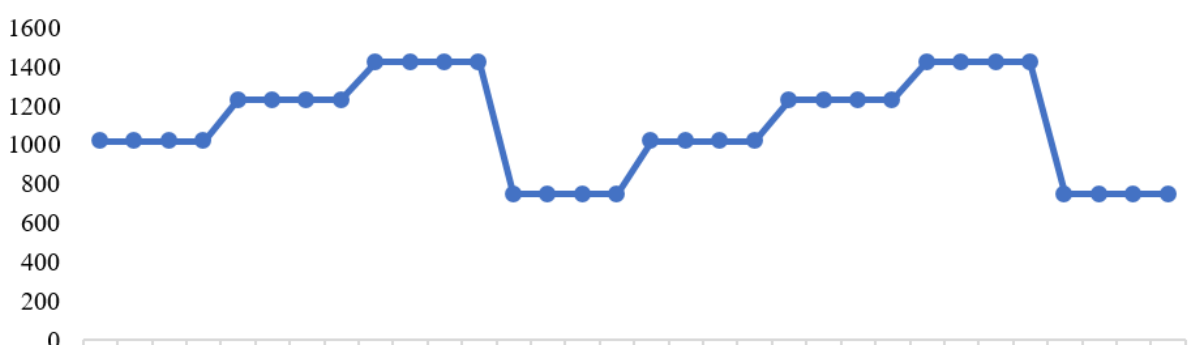
Base mesocycle: ACWR in the range of 1.1-1.3, higher load for deepening specialized

Table 2. Weekly distribution of loads in the training macrocycle of basketball players aged 10-11 at the preliminary training stage

Week	Mesocycle	Monday (RPE / min)	Wednesday (RPE / min)	Friday (RPE / min)	Weekly load (points)	Chronic load (4 weeks)	ACWR
1.	*Introductory*	6 / 70	5 / 60	5 / 60	1020	-	-
2.	*Introductory*	6 / 70	5 / 60	5 / 60	1020	-	-
3.	*Introductory*	6 / 70	5 / 60	5 / 60	1020	-	-
4.	*Introductory*	6 / 70	5 / 60	5 / 60	1020	-	-
5.	*Basic*	7 / 80	6 / 70	6 / 70	1230	1125.0	1.09
6.	*Basic*	7 / 80	6 / 70	6 / 70	1230	1125.0	1.09
7.	*Basic*	7 / 80	6 / 70	6 / 70	1230	1125.0	1.09
8.	*Basic*	7 / 80	6 / 70	6 / 70	1230	1125.0	1.09
9.	*Developmental*	8 / 90	7 / 80	6 / 75	1425	1327.5	1.07
10.	*Developmental*	8 / 90	7 / 80	6 / 75	1425	1327.5	1.07
11.	*Developmental*	8 / 90	7 / 80	6 / 75	1425	1327.5	1.07
12.	*Developmental*	8 / 90	7 / 80	6 / 75	1425	1327.5	1.07
13.	*Control*	5 / 60	4 / 50	4 / 50	750	958.0	0.78
14.	*Control*	5 / 60	4 / 50	4 / 50	750	958.0	0.78
15.	*Control*	5 / 60	4 / 50	4 / 50	750	958.0	0.78
16.	*Control*	5 / 60	4 / 50	4 / 50	750	958.0	0.78
17.	*Introductory*	6 / 70	5 / 60	5 / 60	1020	1020.0	1.06
18.	*Introductory*	6 / 70	5 / 60	5 / 60	1020	1020.0	1.06
19.	*Introductory*	6 / 70	5 / 60	5 / 60	1020	1020.0	1.06
20.	*Pulling*	6 / 70	5 / 60	5 / 60	1020	1020.0	1.06
21.	*Base*	7 / 80	6 / 70	6 / 70	1230	1230.0	1.08
22.	*Base*	7 / 80	6 / 70	6 / 70	1230	1230.0	1.08
23.	*Base*	7 / 80	6 / 70	6 / 70	1230	1230.0	1.08
24.	*Base*	7 / 80	6 / 70	6 / 70	1230	1230.0	1.08
25.	*Developmental*	8 / 90	7 / 80	6 / 75	1425	1425.0	1.07
26.	*Developmental*	8 / 90	7 / 80	6 / 75	1425	1425.0	1.07
27.	*Developmental*	8 / 90	7 / 80	6 / 75	1425	1425.0	1.07
28.	*Developmental*	8 / 90	7 / 80	6 / 75	1425	1425.0	1.07
29.	*Control*	5 / 60	4 / 50	4 / 50	750	750.0	0.79
30.	*Control*	5 / 60	4 / 50	4 / 50	750	750.0	0.79
31.	*Control*	5 / 60	4 / 50	4 / 50	750	750.0	0.79
32.	*Control*	5 / 60	4 / 50	4 / 50	750	750.0	0.79

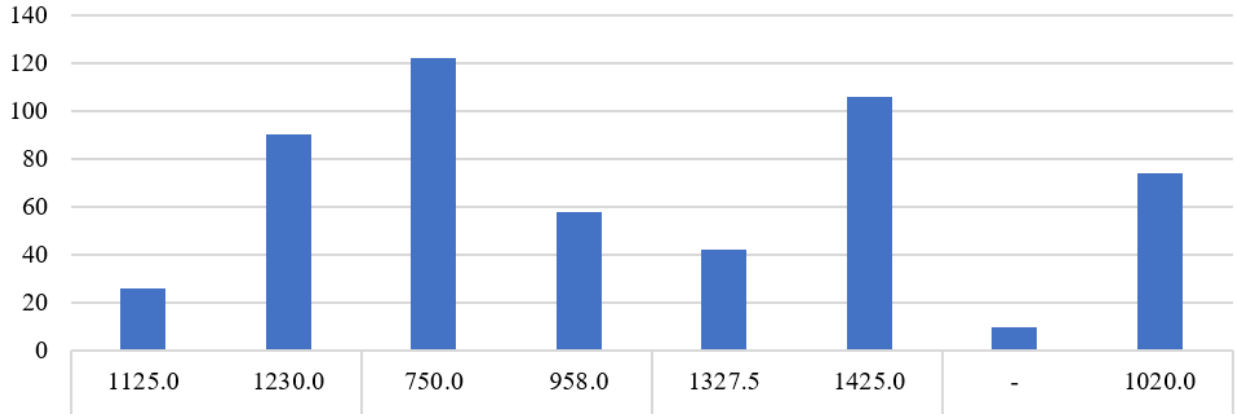
training. Developmental mesocycle: ACWR is increased up to the range of 1.4-1.5, for maximum adaptation and reaching peak athletic form. Control-preparatory mesocycle: ACWR is reduced to the range of 1.0-1.2, to ensure recovery and optimization of the athletic condition. Load management was implemented **as follows:**

Figure 1. Short-term (last 7 days) load volume in the microcycle



Note: 1 - 4 Traction, 5 - 7 Basic, 8 - 11 Developmental, 12 - 15 Control, 16 - 20 Traction, 21 - 23 Basic, 24 - 27 Developmental, 28 - 32 Control

Figure 2. **Long-term (4-week average) load volume in the mesocycle**



Note: *1125.0-1230.0-Basic, 750.0-958.0-Control, 1327.5-1425.0-Developmental –102.0-Traction*

Individual training sessions and weekly training volumes were monitored using a combination of subjective load levels and duration. This allowed for reducing the risk of fatigue and injuries in athletes while more effectively guiding their physical development.

This table and the training model based on it serve to ensure the consistent development of physical and technical-tactical training of young basketball players, preventing negative consequences arising from excessive or insufficient training load. At the same time, the ACWR monitoring system allows for systematic load management and optimization of the adaptive development process.

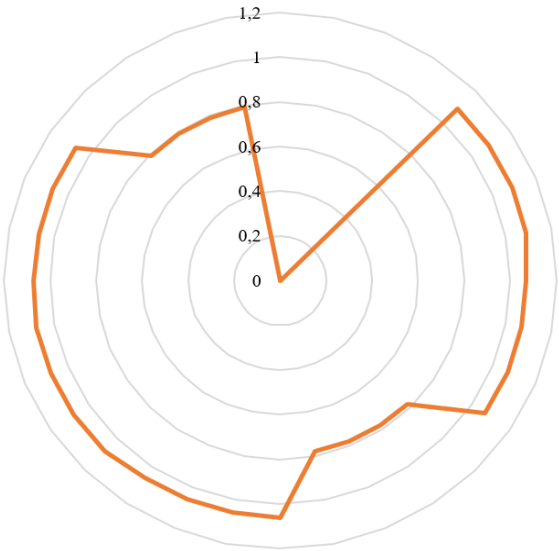
The presented table is compiled based on the training load for basketball players aged 10-11 years and the ACWR (Acute: Chronic Workload Ratio) monitoring system. This table systematically reflects the type of mesocycle for each week, load levels during training days (in the form of RPE and duration), weekly total load and 4-week average load, as well as ACWR indicators.

The structure of the table has the following features:

The levels of training load and intensity were determined for the types of mesocycles (Pulling, Base, Developmental, Control).

RPE and training duration were given for Monday, Wednesday, and Friday, which made it possible to determine the weekly load balance. Weekly total workload is calculated based

Figure 3. **Ratio of short-term (last 7 days) to long-term (4-week average) workload**



on the sum of workload points from training days.

Chronic load was calculated based on the average of 4-week loads and was determined starting from the 5th week. ACWR indicators are presented based on the ratio of weekly load to chronic load.

In the table structure, mesocycles and their load characteristics are mutually coordinated:

In traction mesocycles (weeks 1-4, 17-20), RPE was set at a relatively moderate level (6/70, 5/60) and the weekly load was maintained at around 1020 points. In the base mesocycles (weeks 5-8, 21-24), the RPE and training duration were increased (7/80, 6/70), with the weekly load raised to 1230 points. In the developmental mesocycles (weeks 9-12, 25-28), the load was maximized (8/90, 7/80, 6/75), with the weekly load reaching 1425 points. In the control-preparatory mesocycles (weeks 13-16, 29-32), the training load was significantly reduced (5/60, 4/50), and the weekly load was around 750 points.

Safe and effective management of training load is ensured through ACWR monitoring:

During the pulling and base stages, the ACWR was maintained between 1.06-1.09, indicating stable adaptation. In the developmental stage, the ACWR was kept at 1.07, which is considered an optimal level for achieving maximum load and peak athletic form. In the control-preparatory stage, the ACWR was reduced to 0.78-0.79, creating favorable conditions for recovery and re-preparation.

As evident from the table, the gradual increase and decrease of training load, as well as continuous monitoring of load through ACWR indicators, help reduce the risk of fatigue and injuries in young athletes and optimize the development of their functional capabilities.

Conclusion

The research results demonstrate that it is possible to scientifically manage the physical development of 10-11 year old basketball players by planning training loads at microcycle and mesocycle levels and monitoring based on ACWR (Acute:Chronic Workload Ratio). The load model developed in this study, which distributes training volume and intensity in a systematic sequence of increase and decrease, helped reduce the risk of overload and injuries in athletes while maintaining their adaptation level at an optimal state.

The model developed based on training load levels, RPE indicators, and weekly load balance across mesocycle types (pulling, basic, developmental, control-preparatory) has proven to be a practically effective and safe methodology. Specifically, as a result of training sessions within the RPE range of 5-8 and ACWR range of 1.0-1.5, athletes' physical and technical-tactical preparation consistently improved.

Furthermore, balance between recovery and high-quality training in training cycles was ensured by distributing weekly loads across Monday (main load day), Wednesday (medium load), and Friday (lower load). Continuous monitoring of training load based on ACWR served as an effective tool in preventing excessive fatigue, overload, and functional disturbances in athletes.

Overall, this study demonstrated that for young basketball players, balanced distribution of training loads based on cycles, load monitoring, and tailored approaches founded on athletes' individual responses are crucial factors in enhancing the effectiveness of the sports training process.

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