DESIGN AND VALIDATION OF AN AGE-SPECIFIC SELECTION AND TRAINING MODEL FOR MIDDLE SCHOOL BASKETBALL PLAYERS

Janina-Maria GHERDAN[1]*, Alin LARION[2]

[1] PhD Student, Doctoral School of Sport Science and Physical Education, Institute of Doctoral Studies, Ovidius University of Constanța; Assistant Lecturer, Department of Physical Education and Kinetotherapy, Faculty of Geography, Tourism and Sport, University of Oradea, Romania

[2] Professor, PhD Supervisor, Institute of Doctoral Studies, Physical Education and Sport Faculty, Ovidius University of Constanța, Romania

** Corresponding author: gherdanjanina@gmail.com*

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Abstract

The present study aimed to design, implement, and validate an operational model for the selection and preparation of middle school basketball players (ages 12–15), adapted to the age-specific, motor, and psychological characteristics of this developmental stage. The study involved 14 male students from grades V–VIII, who participated in a structured, four-month training program that integrated physical, technical, and tactical development. Anthropometric and motor performance indicators were measured at the beginning and end of the intervention. The statistical analysis, conducted using descriptive indicators, coefficients of variation, and the *t*-test, revealed significant improvements in agility, explosive strength, and shooting accuracy. The results validate the efficiency of the proposed model and its transferability to other school environments. This approach promotes a holistic and inclusive vision of basketball training, aligned with the principles of physical education, youth development, and performance optimization.

Keywords: basketball training, youth athletes, motor development, technical skills, physical education, performance optimization.

Introduction

Youth basketball development plays a crucial role in shaping future athletic potential, as this stage coincides with periods of heightened neuromuscular adaptability and the consolidation of fundamental motor and technical skills (Bompa & Buzzichelli, 2019; Guimarães et al., 2021). Between the ages of 12 and 15, young athletes experience significant biological, psychological, and social changes related to puberty, which directly influence motor performance, learning capacity, and responsiveness to training stimuli (Malina et al., 2004).

In Romania, school-based basketball programs continue to represent an important pathway for the identification and development of young players, particularly through national competitions such as the National School Sports Olympiad (ONSS). Despite their relevance, these programs often face challenges related to limited infrastructure, uneven coaching resources, and the absence of standardized, evidence-based training models. Consequently, the developmental progress of middle school basketball players may vary considerably across different educational environments.

Current research emphasizes that effective youth basketball development requires the integration of physical, technical, and cognitive components within structured and age-appropriate training frameworks (Vaeyens et al., 2009). Beyond performance enhancement, such integrated approaches also support motivation, self-confidence, and social interaction—factors that are essential for maintaining long-term participation in sport during adolescence (Blakemore, 2012; Shao et al., 2022).

Therefore, the purpose of this study was to design, implement, and validate an age-specific operational model for the selection and training of middle school basketball players (ages 12–15), adapted to their motor, biological, and psychological characteristics. In addition, the study aimed to evaluate the effectiveness of this model in improving selected anthropometric, motor, and technical performance indicators within a school-based training context.

Methods

Participants

The study sample consisted of 14 male middle school basketball players aged between 12 and 15 years, all enrolled in a school-based sports program. Participants were selected based on their involvement in the local and regional stages of the National School Sports Olympiad (ONSS).

Inclusion criteria comprised: (a) active participation in at least one official basketball competition during the academic year; (b) a minimum of two years of organized basketball training; and (c) medical clearance for physical activity. Players who sustained injuries or were absent for more than 15% of the training sessions were excluded from the study. All participants and their legal guardians provided written informed consent prior to participation.

Instruments and Measures

Anthropometric and motor performance indicators relevant to youth basketball training were assessed using standardized measurement protocols. Anthropometric variables included body height, arm span, and body weight. Motor performance was evaluated through the 20 m sprint test, the 10 × 5 m shuttle run test, and the standing long jump test. Technical performance was assessed using two basketball-specific shooting tests: a free-throw shooting test and a universal shooting test involving shots from multiple court positions. All tests were selected and implemented in accordance with the methodological guidelines of the Romanian Basketball Federation (FRB, 2022) and previously validated research protocols (Sekulic et al., 2018; Covic et al., 2023). The assessed variables and measurement methods are summarized in Table 1.

Table 1. Variables and measurement methods

No.	Variable	Measurement Method	Unit	Description
1	**Height**	Anthropometric measurement	cm	Vertical body size, barefoot
2	**Arm span**	Anthropometric measurement	cm	Distance between fingertips
3	**Body weight**	Scale measurement	kg	Body mass
4	**20 m sprint**	Stopwatch test	sec	Running speed from standing start
5	**Shuttle run**	10 × 5 m test	sec	Agility and anaerobic power
6	**Standing long jump**	Metric measurement	cm	Explosive leg strength
7	**Free-throw shooting**	Practical test	no. successful shots	6 attempts
8	**Universal shooting test**	Practical test	no. successful shots	6 attempts from various positions

Procedure

The research followed an applied experimental design with two testing moments: initial testing (TI), conducted at the beginning of the training program, and final testing (TF), performed after a four-month intervention period. The training program was implemented over four months, with three training sessions per week, each lasting approximately 90 minutes. Each session followed a structured format consisting of a warm-up and coordination phase, technical drills focused on shooting, passing, and dribbling, motor development and strength exercises, applied game situations, and a recovery phase. All assessments were conducted in the school gymnasium under standardized conditions using regulation equipment**.**

Data Analysis

Collected data were processed using Microsoft Excel and SPSS Statistics (version 27.0). Descriptive statistics, including means and standard deviations, were calculated for all variables. The coefficient of variation (CV) was used to assess group homogeneity. Differences between initial and final testing were analyzed using the paired samples Student's t-test. Statistical significance was set at $p < 0.05$.

Results

The results obtained after the four-month training program are presented in Tables 2 and 3 and indicate consistent improvements across all assessed anthropometric, motor, and technical variables.

Table 2. Initial (TI) and Final (TF) Measurements

Variable	TI Mean ± SD	TF Mean ± SD	Δ (Difference)	*t*	p
Height (cm)	163.0 ± 5.82	164.4 ± 5.90	+1.43	3.12	<0.05
Arm span (cm)	163.9 ± 6.67	165.0 ± 6.78	+1.07	2.88	<0.05
Body weight (kg)	49.9 ± 9.60	50.7 ± 9.49	+0.85	2.45	<0.05
20 m sprint (sec)	3.86 ± 0.32	3.71 ± 0.28	-0.15	4.99	<0.01
Shuttle run (sec)	10.95 ± 0.80	10.59 ± 0.63	-0.36	6.31	<0.001
Standing long jump (cm)	161.6 ± 21.5	171.1 ± 22.4	+9.43	2.84	<0.05
Free-throw test (no.)	2.71 ± 1.20	3.36 ± 0.74	+0.65	3.72	<0.01
Universal shooting test (no.)	3.50 ± 0.94	4.43 ± 0.76	+0.93	4.92	<0.01

Note. TI = initial testing; TF = final testing.

Anthropometric Indicators

The results show a natural increase in height and arm span, consistent with normal growth trajectories for this age group (Malina et al., 2004). The average body weight also increased slightly (+0.85 kg), reflecting the somatic maturation process. These changes confirm the biological progression expected in early adolescence and did not interfere with motor development outcomes.

The coefficient of variation (CV = 3.6% for height and 4.1% for arm span) indicated homogeneity across the sample, aligning with previous findings on balanced somatic profiles in youth athletes (Covic et al., 2023).

Motor Performance Indicators

The *20 m sprint test* revealed a statistically significant improvement ($t = 4.99$, $p < 0.01$), with average times decreasing from 3.86 s to 3.71 s. This indicates enhanced acceleration and neuromuscular coordination, confirming the positive effects of systematic training (Bompa & Buzzichelli, 2019).

The *shuttle run test* also recorded significant progress ($t = 6.31$, $p < 0.001$), demonstrating improved anaerobic capacity and movement efficiency. The reduction in standard deviation (from 0.80 to 0.63) indicates greater homogeneity, which suggests the effectiveness of group-based drills in promoting consistent physical gains (Vaeyens et al., 2009).

In the *standing long jump*, players improved from 161.6 cm to 171.1 cm ($t = 2.84$, $p < 0.05$), confirming the development of lower-body explosive strength. This outcome aligns with previous research linking plyometric training and improved vertical or horizontal jump performance (Zatsiorsky & Kraemer, 2006).

Table 3. *Descriptive Statistics and Coefficients of Variation (CV)*

Variable	TI CV (%)	TF CV (%)	Interpretation
Height	3.6	3.6	Stable, homogeneous group
Body weight	19.3	19.7	Moderate variability
20 m sprint	8.2	7.5	Improved homogeneity
Shuttle run	7.3	5.9	Increased coordination consistency
Standing long jump	13.3	13.1	Small improvement
Free-throw test	44.4	22.2	Major consistency gain
Universal shooting	26.9	17.1	Significant progress

Technical Performance Indicators

Both shooting tests demonstrated clear improvement.

- **Free-throw shooting** increased by 24%, from a mean of 2.71 to 3.36 successful attempts ($t = 3.72$, $p < 0.01$).
- **Universal shooting performance**, involving shots from various positions, improved by 26.6%, from 3.50 to 4.43 successful attempts ($t = 4.92$, $p < 0.01$).

The reduction in the coefficient of variation (from 44.4% to 22.2% in free-throws and from 26.9% to 17.1% in the universal test) confirms increased

execution stability and coordination accuracy (Verhoeven & Newell, 2016; Sekulic et al., 2018). These findings support the hypothesis that consistent technical training significantly enhances precision and shooting confidence in youth players (Han et al., 2023).

Discussion

The findings of this study indicate that the implementation of an age-specific training model can positively influence both physical and technical performance in middle school basketball players. Improvements in sprinting speed and agility suggest enhanced neuromuscular coordination and movement efficiency, which are key performance factors during early adolescence. The observed gains in standing long jump performance reflect improvements in lower-body explosive strength, an important component of basketball-specific movement patterns such as acceleration, jumping, and rapid changes of direction. Furthermore, the reduction in variability across several motor tests suggests that the applied training model contributed not only to individual progress, but also to greater homogeneity at the group level.

Technical performance showed particularly clear improvements. The increase in shooting accuracy, combined with the substantial reduction in coefficients of variation, indicates greater execution stability and improved coordination. These findings suggest that consistent, age-appropriate technical practice supports the consolidation of shooting skills and enhances performance reliability in young players.

Beyond physical and technical outcomes, the applied training model also supported positive group dynamics. The inclusion of players with different ability levels encouraged engagement, cooperation, and sustained participation, highlighting the educational and social value of structured school-based training programs.

Conclusions

The findings of this study support the effectiveness of an age-adapted selection and training model for middle school basketball players. Significant improvements were observed in motor performance and shooting accuracy, while anthropometric changes followed expected growth-related patterns.

These results highlight the potential of structured, school-based training programs to promote balanced physical and technical development, even in educational contexts with limited resources. The proposed model proved to be adaptable and transferable, offering a practical framework that can be implemented in similar school environments.

Ethical Statement

The study complied with the ethical standards of the *Doctoral School of Sport Science and Physical Education, Ovidius University of Constanța*. Participation was voluntary, and informed consent was obtained from all players and their parents before data collection.

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References

Blakemore, S.-J. (2012). Development of the social brain in adolescence. Journal of the Royal Society of Medicine, 105(3), 111–116. https://doi.org/10.1258/jrsm.2011.110221

Bompa, T. O., & Buzzichelli, C. (2019). Periodization: Theory and methodology of training (6th ed.). Human Kinetics. https://doi.org/10.5040/9781718225435

Covic, N., Čaušević, D., Alexe, C., Manchanda, B., Dulceanu, C., Abazović, E., Lupu, G., & Alexe, D. (2023). Relations between specific athleticism and morphology in young basketball players. Frontiers in Sports and Active Living, 5, Article 1276953. https://doi.org/10.3389/fspor.2023.1276953

Federația Română de Baschet. (2022). *Concepția unitară de joc și pregătire pe niveluri formative* [*Unified game and training concept across formative levels*] (Ediția a II-a; coord. A. D. Moanță & D. Berceanu). București: Editura Discobolul. ISBN 978-606-798-166-7

Guimarães, E., Baxter-Jones, A. D. G., Williams, A. M., Tavares, F., Janeira, M. A., & Maia, J. (2021). Tracking technical skill development in young basketball players: The INEX study. International Journal of Environmental Research and Public Health, 18(8), 4094. https://doi.org/10.3390/ijerph18084094

Han, M., Ruano, M., Lorenzo Calvo, A., & Calvo, J. (2023). Basketball talent identification: A systematic review and meta-analysis of the anthropometric, physiological and physical performance factors. Frontiers in Sports and Active Living, 5, Article 1264872. https://doi.org/10.3389/fspor.2023.1264872

Malina, R. M., Bouchard, C., & Bar-Or, O. (2004). Growth, maturation, and physical activity (2nd ed.). Human Kinetics. https://doi.org/10.5040/9781492596837

Sekulic, D., Separovic, V., Sisic, N., & Pojskic, H. (2018). Association between conditioning capacities and shooting performance in professional basketball players: An analysis of stationary and dynamic shooting skills. Journal of Strength and Conditioning Research, 32(7), 1981–1992. https://doi.org/10.1519/JSC.0000000000002100

Shao, Z., Bezmylov, M. M., & Shynkaruk, O. A. (2022). Individual characteristics of physical and mental development and their connection with regular physical exercises when playing basketball. Current Psychology. https://doi.org/10.1007/s12144-022-03692-w

Kinetics.

Vaeyens, R., Güllich, A., Warr, C. R., & Philippaerts, R. M. (2009). Talent identification and promotion programmes of Olympic athletes. Journal of Sports Sciences, 27(13), 1367–1380. https://doi.org/10.1080/02640410903110974

Verhoeven, F. M., & Newell, K. M. (2016). Coordination and control of posture and ball release in basketball free-throw shooting. Human Movement Science, 49, 216–224. https://doi.org/10.1016/j.humov.2016.07.007

Zatsiorsky, V. M., & Kraemer, W. J. (2006). Science and practice of strength training (2nd ed.). Human