

Effects of an integrated strength training program on vertical and horizontal explosive performance in youth basketball: A longitudinal study

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Abstract:

Performance in youth basketball is strongly influenced by the development of both vertical and horizontal explosive abilities, the progression of which during the preparatory period represents a crucial element for effective training load planning. Despite the widespread use of strength training in youth basketball, limited longitudinal research is available on its integrated effects on different expressions of explosive performance, particularly when vertical and horizontal components are analyzed simultaneously. However, limited evidence is available regarding the effectiveness of integrated strength training programs in simultaneously improving different manifestations of explosive performance in athletes undergoing maturation. Therefore, this study aims to evaluate the neuromuscular adaptations induced by a progressive strength training protocol in Under-19 basketball athletes. The experimental design is longitudinal, with four assessment points (Pre, Mid, Post, and Follow-up) carried out on fourteen athletes using Squat Jump (SJ), Countermovement Jump (CMJ), and Standing Long Jump (SLJ). The intervention was conducted over an extended training period and integrated into the competitive season, allowing the evaluation of time-dependent neuromuscular adaptations under real training conditions. Statistical analyses were conducted through repeated-measures ANOVA, preceded by verification of data normality (Shapiro–Wilk test). Results show progressive increases across all three tests: SJ from 35.71 ± 1.99 cm to 41.16 ± 2.27 cm, CMJ from 38.14 ± 2.57 cm to 43.57 ± 2.65 cm, and SLJ from 211.71 ± 10.53 cm to 233.29 ± 10.33 cm. ANOVA revealed a highly significant main effect of time for all variables ($F = 2759.0$; $p < .001$), confirming the impact of the program. These improvements suggest that the applied training stimulus was sufficient to induce meaningful adaptations in force production and power expression across multiple movement planes. The findings suggest that a methodologically structured strength program, integrated within the weekly microcycle, is effective in promoting simultaneous improvements in the different expressions of explosiveness relevant to youth basketball performance.

Key Words: athlete development, neuromuscular adaptations, load planning, jump performance

Introduction

In youth basketball, explosive strength plays a decisive role in performance, as athletes are repeatedly required to produce high levels of force in limited time during actions such as jumping, sprinting, rapid accelerations, and changes of direction (Raiola, 2015). Both vertical and horizontal expressions of explosive performance contribute to competitive effectiveness, influencing technical-tactical actions including rebounding, shooting, defensive transitions, and fast breaks (Di Domenico et al., 2022). Consequently, the development of explosive capabilities during youth stages represents a key objective within long-term athletic development models (Raiola et al., 2022; D'Elia et al., 2022). Physical preparation in modern basketball represents a decisive component both in youth developmental pathways and in high-level competitive contexts (D'Elia et al., 2021a; Gonzalo-Skok et al., 2025). During the developmental age, its role is to progressively structure the athlete, promoting the development of a physical profile suitable for the specific demands of the discipline and functional to subsequent technical evolution (Arede et al., 2019; Ceruso et al., 2025; Esposito et al., 2019).

In the senior category, by contrast, it is oriented toward maintaining and optimizing performance, particularly in the decisive phases of the competitive season (Altavilla et al., 2023, 2024). Previous research has demonstrated that resistance and strength-based training can effectively enhance neuromuscular performance in youth athletes when appropriately designed and supervised (Raiola, 2012). Improvements in jump performance, sprint ability, and power output have been widely reported, supporting the inclusion of structured strength training within youth sport programs (Sannicandro et al., 2023). However, much of the existing literature has focused on isolated performance outcomes or short-term interventions, often examining either vertical or horizontal explosive performance separately (D'Elia et al., 2020ab).

Given the performance model of basketball and the high specificity of injury risk, the strength and conditioning coach is required to dose training loads with methodological rigor, providing targeted stimuli to the necessary conditional capacities without generating excessive stress that could increase the incidence of injuries (Gonzalo-Skok et al., 2025). This sport is characterized by intermittent demands involving aerobic, anaerobic alactic, and anaerobic lactic contributions, and is distinguished by very high-intensity actions such as sprints, jumps, stops, changes of direction, and contact situations, all sustained by high heart-rate values and substantial neuromuscular demands (Altavilla et al., 2020; Santos & Janeira, 2012). From a functional and metabolic perspective, this requires the combined development of high aerobic power, necessary to sustain repeated intense actions, and high strength capacities in their different expressions (Aliberti et al., 2021; D'Elia et al., 2021b). Specifically, a basketball player must be able to express isometric strength, meaning the capacity to develop muscular tension without changes in muscle length and without displacement of the load, which is essential to ensure joint stability and postural control in the frequent situations of opposition and positional maintenance (Esposito et al., 2024ab). Speed strength, understood as the ability to overcome a resistance or to move one's body at the highest possible velocity, expressed through an initial strength component, produced in the very first milliseconds of the action, and an explosive strength component, responsible for the rapid continuation of the movement (D'Elia et al., 2021a; Di Domenico et al., 2023). Reactive strength, defined as the neuromuscular system's capacity to generate a high force impulse in a very short time within a stretch-shortening cycle, exploiting the elastic energy stored during the eccentric phase and released in the concentric phase, typical of explosive actions preceded by a rapid braking phase (Esposito et al., 2025a). Equally indispensable is the ability to transition rapidly and efficiently among these different modes of force expression, in relation to the continuous situational changes inherent to the game (Altavilla et al., 2020).

The planning of muscular and metabolic work must be incorporated into an organic and coherent program, developed in synergy with the technical and medical staff, and structured according to principles of progressivity and specificity (Sannicandro et al., 2025; D'Elia et al., 2022, 2024). An initial extensive phase, aimed at gradually increasing training volume and strengthening muscular and tendinous structures in a general manner, is followed by an intensive phase designed to raise training intensity and elicit maximal levels of strength and power (Esposito et al., 2025b). At the same time, the management of the weekly microcycle, which seeks to achieve the best possible condition in relation to forthcoming competitive demands, and the seasonal macrocycle, oriented toward reaching peak form in the decisive stage of the season, represents an essential component of performance planning (Altavilla et al., 2022). In youth settings, this process requires a multi-year perspective and must consider the stages of biological, hormonal, and neuromotor development, selecting interventions that suit the athlete's actual potential and individual maturation timelines (Arede et al., 2019; Gonzalo-Skok et al., 2025). A substantial portion of the training workload is therefore devoted to the integrated development of strength qualities, with particular attention to speed strength and reactive strength, which are crucial for both technical execution and sport-specific performance (Aliberti et al., 2025; Raiola et al., 2025a). In this regard, the rational alternation of maximal strength stimuli with exercises characterized by high execution speed and plyometric components emerges as a potentially effective methodology for promoting favorable neuromuscular and hormonal adaptations (Raiola et al., 2025b). This is achieved through the activation and selective hypertrophy of type II muscle fibers, which are directly involved in the expressions of strength required in basketball (D'Elia et al., 2021b). Nevertheless, a significant challenge persists in practical application: identifying training protocols that can simultaneously improve maximal strength, explosive strength, and reactive strength through a coherent organization of overloads (Di Domenico et al., 2024; Giardullo et al., 2024). This is especially evident in youth development programs, where training must be harmoniously integrated with ongoing physical and technical growth (D'Isanto et al., 2022a, 2023).

Despite the growing body of evidence supporting strength training in youth populations, several limitations persist within current research. In particular, there is a lack of longitudinal studies conducted under real training conditions that simultaneously investigate vertical and horizontal explosive adaptations within the same cohort of youth basketball players. Furthermore, limited attention has been devoted to understanding how integrated strength training programs implemented during the competitive season may influence neuromuscular development without compromising sport-specific practice. These gaps highlight the need for research that adopts a comprehensive and ecologically valid approach to youth performance enhancement.

To address these limitations, the present study adopts a longitudinal design to examine the effects of an integrated strength training program on both vertical and horizontal explosive performance in youth basketball players. By embedding the intervention within the regular training schedule, this approach allows for the evaluation of neuromuscular adaptations under applied conditions relevant to coaches and practitioners. The findings of this study are expected to provide practical insights into the design of age-appropriate, evidence-based strength training interventions, contributing to performance development, injury risk reduction, and the optimization of long-term athletic preparation in youth basketball.

In light of these considerations, the present study aims to examine the effects of an integrated, progressive, and systematically monitored training protocol on the development of isometric strength, explosive strength, and reactive strength in young basketball athletes. The central assumption is that a training approach grounded in the

physiological principles of neuromuscular adaptation and in the appropriate modulation of training stimuli can promote a coordinated, functional, and sport-specific enhancement of the strength capacities most closely linked to basketball performance.

Material & methods

Study Participants

The study sample consisted of fourteen male athletes in the Under 19 category, selected through a convenience sampling criterion based on their availability to take part in a continuous monitoring program throughout the entire preparatory period. Inclusion criteria comprised participation in the same competitive category and within the same club environment, regular attendance at training sessions with a minimum frequency of five sessions per week, absence of muscular, tendinous, or joint injuries in the six months preceding the start of the study, absence of chronic diseases or clinical conditions incompatible with high intensity sports activity, and provision of informed consent for participation in the experimental protocol. Athletes were excluded if they had a recent history of injury, were undergoing rehabilitative or pharmacological treatments that could interfere with neuromuscular response or were unable to ensure sufficient continuity in attending the sessions required by the protocol. All participants trained in a homogeneous environment under the supervision of the same coaching staff and the same strength and conditioning coach, a condition that enabled stricter control of external variables related to workload and training methodologies. The selected group exhibited relatively homogeneous anthropometric characteristics. The average age was 17.8 years (SD 0.4), average height 188.3 cm (SD 7.4), average body mass 81.2 kg (SD 8.5), and average BMI 22.8 kg/m² (SD 1.6). The choice of a uniform sample in terms of age range, technical level, and training status allowed for a reduction in the influence of confounding variables and enabled a more precise isolation of the effects of the training protocol on the variables under investigation.

Study Design

The study employed longitudinal design and was conducted over the preparatory period between 18 August and 8 November. Four assessment points were scheduled, each corresponding to specific phases of the training program (Pre, Mid, Post, and Follow-up), with the aim of monitoring the progression of athletes' vertical and horizontal explosive abilities in relation to the applied training loads. During each assessment, three standardized tests widely used in basketball performance analysis were administered: the Squat Jump (SJ), designed to evaluate explosive strength under static starting conditions; the Countermovement Jump (CMJ), used to assess the ability to exploit the stretch-shortening cycle; and the Standing Long Jump (SLJ), aimed at measuring the explosive-reactive component expressed in the horizontal direction. All tests were performed using identical procedures across the four sessions in order to ensure a high level of reliability in the collected data. Each athlete completed three attempts for each test, separated by standardized recovery periods, and only the best performance recorded in each test was included in the statistical analyses.

Training Protocol

The protocol was incorporated into the team's typical weekly organization. Strength training sessions were scheduled twice per week, with a minimum interval of forty-eight hours between sessions and placed on days without high-intensity technical or tactical commitments. This approach ensured the preservation of movement quality and allowed for adequate recovery between training stimuli, maintaining a coherent balance among strength work, technical requirements, and the physical demands characteristic of the preparatory period. The training protocol was structured into two closely integrated phases, each designed to progressively increase neuromuscular demands. The first phase, lasting approximately eight weeks (18 August to 10 October), aimed to gradually increase training volume, consolidate execution technique in fundamental exercises, and enhance inter- and intramuscular coordination. The main exercises included squats, bench press, bent-over row, and shoulder press, performed at an intensity of about 70 to 80 percent of estimated maximal strength, organized into four sets of eight repetitions with two minutes of recovery between sets. The second phase, characterized by a more intensive approach (10 October to 8 November), implemented a load structure based on alternating short high-intensity sets (three repetitions at 90 to 95 percent of maximal strength) with submaximal sets performed with explosive concentric intent (six repetitions at 80 percent of one-repetition maximum with maximal velocity intent). Recovery time between sets was two minutes and thirty seconds, selected to ensure adequate restoration of neuromuscular capacities while preserving execution quality and maintaining coherence with the principles of contrast training. This structure was designed to promote the integrated development of maximal strength, explosive strength, and reactive strength, thereby improving the ability to generate high levels of force in reduced time intervals and to exploit the stretch-shortening cycle more efficiently, in accordance with the functional demands of basketball.

Table 1. Training protocol.

Phase 1 – Extensive preparation (August 18 – October 10)				
Exercise	Set	Repetitions	Rest	Load
Squat	4	8	2'	70–80% 1RM
Flat bench	4	8	2'	70–80% 1RM

Barbell row	4	8	2'	70–80% 1RM
Shoulder press	4	8	2'	70–80% 1RM
Phase 2 – Intensive preparation (October 10 – November 8)				
Exercise	Set	Repetitions	Rest	Load
Squats – high intensity	3	3	2'30"	90–95% 1RM
Squats – explosive intent	3	6	2'30"	80% 1RM
Flat bench press – high intensity	3	3	2'30"	90–95% 1RM
Flat bench press – explosive intent	3	6	2'30"	80% 1RM
Barbell row – high intensity	3	3	2'30"	90–95% 1RM
Barbell row – explosive intent	3	6	2'30"	80% 1RM
Shoulder press – high intensity	3	3	2'30"	90–95% 1RM
Shoulder press – explosive intent	3	6	2'30"	80% 1RM

Field Tests

Explosive strength of the lower limbs under static starting conditions was assessed using the Squat Jump (SJ). The test was performed starting from a squat position with a knee angle of approximately 90 degrees, torso upright, and hands placed on the hips to eliminate the contribution of the upper limbs. At the signal, the athlete executed a maximal vertical push without any preliminary countermovement, aiming to reach the highest possible jump. Jump height, expressed in centimeters, was measured using certified equipment. Vertical explosive strength was assessed through the Countermovement Jump (CMJ). The jump was performed from an upright standing position, with the hands kept firmly on the hips to eliminate upper-limb contribution and reduce confounding variables. Jump height was measured using certified equipment. Horizontal explosive-reactive strength was measured using the Standing Long Jump (SLJ). The jump was performed from an upright standing position, with the feet parallel behind the starting line and a free countermovement. The distance was measured from the take-off point to the most posterior point of contact at landing. Each test was performed three consecutive times, with standardized recovery intervals between attempts to minimize fatigue effects and ensure high data reliability. For statistical analysis, only the best performance recorded for each test and each athlete was considered.

Statistical Analysis

The collected data were organized and reported as mean $\pm$ standard deviation (SD) in order to provide a concise representation of central tendency and the dispersion of performance for each variable and at each assessment point. Prior to inferential analyses, the distribution of the data was verified using the Shapiro–Wilk test, employed to assess the normality of the dependent variables. Subsequently, to examine potential differences across the four assessment points over time, a repeated-measures ANOVA was conducted, which is appropriate for comparing repeated measurements on the same subjects. The level of statistical significance was set at $p < 0.05$. All statistical analyses were performed using JASP software.

Results

Table 2 presents the mean values, standard deviations, and coefficients of variation for the Squat Jump (SJ), Countermovement Jump (CMJ), and Standing Long Jump (SLJ) across the four assessment phases (Pre, Mid, Post, and Follow-up). The data show a progressive and systematic improvement in all variables, indicating a positive response to the training protocol administered during the preparatory period.

Table 2. Descriptive statistics

Time	Test	N	Mean	SD	SE	Coefficient of variation
Pre	SJ	14	35.71	1.986	0.531	0.056
	CMJ	14	38.14	2.568	0.686	0.067
	SLJ	14	211.71	10.528	2.814	0.050
Mid	SJ	14	37.25	1.961	0.524	0.053
	CMJ	14	40.21	2.547	0.681	0.063
	SLJ	14	220.14	10.114	2.703	0.046
Post	SJ	14	39.62	2.290	0.612	0.058
	CMJ	14	42.07	2.674	0.715	0.064
	SLJ	14	227.21	10.009	2.675	0.044
Follow up	SJ	14	41.16	2.266	0.606	0.055
	CMJ	14	43.57	2.652	0.709	0.061
	SLJ	14	233.29	10.329	2.760	0.044

Regarding the Squat Jump (SJ), a gradual increase in jump height was observed, rising from a mean value of 35.71 ± 1.99 cm in the Pre phase to 41.16 ± 2.27 cm in the Follow-up phase. This increase suggests a significant improvement in the ability to express explosive strength under static conditions, likely associated with enhanced neuromuscular activation and greater efficiency of the concentric phase of the movement. The coefficient of variation remained low across all phases, indicating a relatively homogeneous response within the group.

The Countermovement Jump (CMJ) also showed a favorable trend, with jump height increasing from 38.14 ± 2.57 cm (Pre) to 43.57 ± 2.65 cm (Follow-up). This improvement reflects an enhanced ability to exploit the stretch-shortening cycle (SSC), likely resulting from adaptations in muscle-tendon stiffness and greater synchronization of high-threshold motor units. Similarly, the Standing Long Jump (SLJ) demonstrated a significant increase in distance, rising from 211.71 ± 10.53 cm in the Pre phase to 233.29 ± 10.33 cm in the Follow-up phase. This result suggests an improvement in horizontal explosive-reactive power, along with greater efficiency in force transmission along the kinetic chain and improved intermuscular coordination.

The repeated-measures ANOVA (Table 3) revealed a statistically significant main effect of time ($p < .001$) for all three tests, confirming that the observed changes were not due to chance but reflect actual adaptations induced by the training protocol. Although the tests measure different capacities and use the same unit of measurement (cm), the interpretation focused exclusively on the temporal evolution of each variable rather than on direct comparison of absolute values across tests.

Table 3. Repeated-measures ANOVA.

Cases	df	Mean Square	F	p
Time	3 ^a	921.470 ^a	2759.0 ^a	< .001 ^a
Test	2 ^a	627765.226 ^a	5415.2 ^a	< .001 ^a
Time * Test	6 ^a	223.496 ^a	665.8 ^a	< .001 ^a

The graphical representation visually confirms this upward trend: the SJ shows a steady and progressive increase across all phases, the CMJ exhibits a marked improvement particularly between the Pre and Mid phases followed by consolidation, while the SLJ displays a continuous increase, reflecting a progressive optimization of horizontal explosive-reactive strength.

Fig 1. SJ test

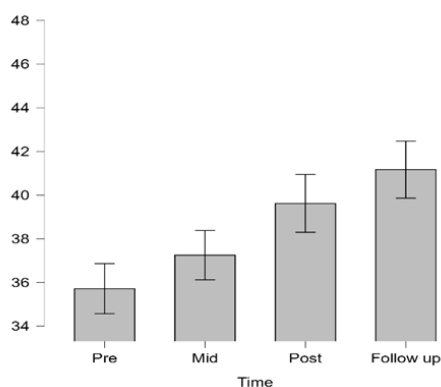


Fig.2. CMJ test

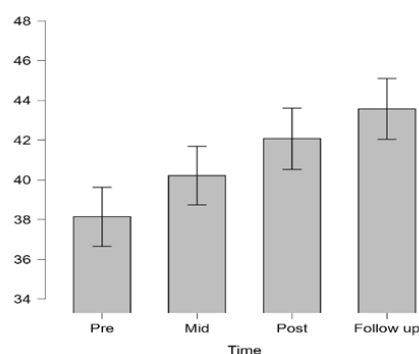
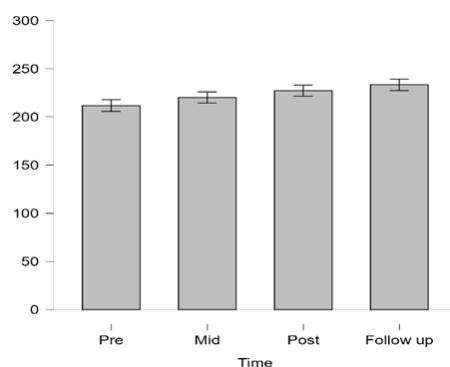


Fig.3. SLJ Test



Dicussion

The adopted training protocol produced significant improvements in the main expressions of strength analyzed, confirming the effectiveness of the program in promoting meaningful adaptations throughout the preparatory period. The presence of a significant main effect of time indicates that the athletes responded positively to the prescribed workload, while the differences between the various tests suggest specific adaptation trajectories for each assessed capacity.

The increase observed in the Squat Jump (SJ) highlights an improvement in the ability to rapidly recruit a high number of motor units even in the absence of a countermovement, emphasizing a positive adaptation of the neural component of strength. This result is particularly relevant in basketball, where numerous game actions, such as standing jumps, rebounds, and changes of pace, require the expression of explosive strength from static or semi-static conditions. The improvement in the Countermovement Jump (CMJ) reflects an increase in the efficiency of the stretch-shortening cycle, likely associated with both increased muscle-tendon stiffness and enhanced neuromuscular coordination. These adaptations are consistent with the intensive phase of the program, characterized by the integration of high loads and movements executed with explosive intent. The increase in the Standing Long Jump (SLJ) suggests an enhancement in the ability to generate force in the horizontal direction, a quality essential for short sprints, first steps, and changes of direction, all critical components of basketball performance. This improvement reflects greater effectiveness in force transmission along the kinetic chain and in the horizontal component of propulsion. The differences in improvement between the SJ, CMJ, and SLJ confirm that the various expressions of strength, although interrelated, follow specific adaptation patterns. This supports the idea that an effective training program should include diversified and targeted stimuli capable of acting on the different components of neuromuscular performance. It is plausible that the degree of biological maturation and individual characteristics modulated the extent of the adaptations, suggesting further potential for load personalization (D'Isanto et al., 2022b). Despite the promising results, the study has some limitations. The small sample size, the absence of a control group, and the use of only standardized field tests limit the generalizability of the findings and the in-depth analysis of neuromuscular mechanisms. Nevertheless, the systematic repetition of tests provides practically relevant data that are consistent with the applied methodology.

Future studies could benefit from the inclusion of larger samples and control groups subjected to different training protocols in order to compare the relative effectiveness of various methodologies. The use of advanced assessment tools, such as force platforms or inertial sensors, would allow the analysis of parameters such as rate of force development, tendon stiffness, and force-velocity profiles, offering a more comprehensive understanding of neuromuscular adaptations. Finally, longitudinal evaluations of sport-specific performance and multi-year studies could clarify the transfer of the observed adaptations to the competitive context and the cumulative effect of progressive training stimuli in relation to youth biological development.

Conclusions

The present study investigated the effects of an integrated strength training program on vertical and horizontal explosive performance in youth basketball players over a longitudinal period. The main findings demonstrated that athletes exposed to the structured strength-based intervention achieved greater improvements in both vertical jump performance and horizontal explosive capacity compared to those following regular basketball training alone. These results confirm the effectiveness of integrating strength-oriented stimuli within youth basketball training to enhance multiple expressions of explosive performance. From a scientific perspective, these findings contribute to the existing literature by providing longitudinal evidence of neuromuscular adaptations induced by an integrated strength training approach in youth athletes. Unlike previous studies that focused on isolated performance outcomes or short-term interventions, the present research highlights the potential of a comprehensive training strategy to simultaneously improve vertical and horizontal explosive abilities under ecologically valid training conditions.

The improvements observed across the different test measures suggest that a coherent and structured training program can functionally support the neuromuscular development of athletes, promoting a more complete preparation that is adaptable to the specific demands of the sport. The practical implications of this study are particularly relevant for coaches, strength and conditioning professionals, and youth development programs. The results suggest that incorporating age-appropriate strength exercises into regular training schedules can effectively support performance enhancement without interfering with sport-specific practice. Such an approach may facilitate the development of force production, power expression, and movement efficiency, all of which are essential for long-term athletic development in youth basketball. Although these findings require further investigation to be confirmed in larger and more diverse samples, they indicate a promising methodological approach: dynamic protocols that integrate complementary stimuli and respect the stages of youth development may provide an effective foundation for enhancing performance while reducing the risk of maladaptive training loads. Future research should further investigate the long-term effects of integrated strength training across different age groups, competitive levels, and seasonal phases.

Additionally, examining the relationship between neuromuscular adaptations and game-related performance indicators may provide deeper insights into how improvements in explosive capabilities translate into competitive effectiveness. These directions could support the refinement of evidence-based training models and promote more efficient and sustainable practices in youth basketball development. Overall, the findings of this study support the integration of structured strength training as a key component of youth basketball programs, offering a practical and scientifically grounded strategy to enhance explosive performance and foster long-term athletic progression.

Conflicts of interest

The authors declare no conflicts of interest.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors didn't use of AI in the writing of the article.

References

- Aliberti, S., Calandro, A., Esposito, G., Altavilla, G., & Raiola, G. (2021). Three workouts compared: interval training, intermittent training and steady state training for the improvement of VO 2 max and BMI. *Sports Science & Health*, 11(2). <https://doi.org/10.7251/ssh2102197a>
- Aliberti, S., D'Elia, F., Giardullo, G., & Raiola, G. (2025). Agonism and performance in adolescent football players in informal physical education settings. *Frontiers in Sports and Active Living*, 7, 1511719. <https://doi.org/10.3389/fspor.2025.1511719>
- Altavilla, G., D'Isanto, T., & D'Elia, F. (2020). The educational value of rules in basketball. *Journal of Human Sport and Exercise*, 15(4), 1195-1203. <https://doi.org/10.14198/jhse.2020.15.proc4.21>
- Altavilla, G., Esposito, G., Ceruso, R., Di Domenico, F., & D'Isanto, T. (2022). Profile and Differences in Anthropometric Data and Jumping Ability Performance between Elite and Amateur U16 Volleyball Players. *Physical Education Theory and Methodology*, 22(2), 237-241. <https://doi.org/10.17309/tmfv.2022.2.13>
- Altavilla, G., D'Isanto, T., Raiola, G., & D'Elia, F. (2023). Different Explosive Strength and Physiological Demands Between Male and Female Basketball Teams. *Physical Education Theory and Methodology*, 23(2), 271-275. <https://doi.org/10.17309/tmfv.2023.2.16>
- Altavilla, G., Aliberti, S., & D'Elia, F. (2024). Assessment of Motor Performance and Self-Perceived Psychophysical Well-Being in Relation to Body Mass Index in Italian Adolescents. *Children*, 11(9), 1119. <https://doi.org/10.3390/children11091119>
- Arede, J., Ferreira, A. P., Gonzalo-Skok, O., & Leite, N. (2019). Maturation development as a key aspect in physiological performance and national-team selection in elite male basketball players. *International Journal of Sports Physiology and Performance*, 14(7), 902-910. <https://doi.org/10.1123/ijsp.2018-0681>
- Ceruso, R., D'elia, F., Sannicandro, I., Manzi, V., & Esposito, G. (2025). Effects of an Ecological-Dynamic Training Protocol Integrating Football eSports on Reactivity in Young Footballers: A comparative study. *International Journal of Kinesiology & Sports Science*, 13(3), 12. <https://doi.org/10.7575/aiac.ijkss.v.13n.3p.12>
- D'Elia, F., Di Domenico, F., D'Isanto, T., Altavilla, G., & Raiola, G. (2020a). From biomechanics to motor learning. *Acta Medica Mediterranea*, 36, 3073-3078.
- D'Elia, F., Rago, V., Ermidis, G., & Raiola, G. (2020b). Relationship between lower limb asymmetries and functional capacities in women in Basketball: A case study. *Sport Science*, 13, 90-95.
- D'Elia, F., D'Andrea, D., Esposito, G., Altavilla, G., & Raiola, G. (2021a). Increase the performance level of young basketball players through the use of high intensity interval training. *International journal of human movement and sports sciences*, 9, 445-450. <https://doi.org/10.13189/saj.2021.090308>
- D'Elia, F., D'Isanto, T., Altavilla, G., & Raiola, G. (2021b). Evolution of explosive strength data in youth volleyball players before and after pandemic. *Teoria Ta Metodika Fizicnogo Vihovanna*, 21, 375-380. <https://doi.org/10.17309/tmfv.2021.4.13>
- D'Elia, F., Altavilla, G., Esposito, G., Aliberti, S., & Raiola, G. (2022). Perceptions and benefits of static and dynamic stretching in dancers: Qualitative and quantitative aspects. *Journal of Physical Education*, 33, e3339. <https://doi.org/10.4025/jphyseduc.v33i1.3339>
- D'Elia, F., Esposito, G., Aliberti, S., Ceruso, R., & D'Isanto, T. (2024). Associations between sport practice, educational and demographic data in sports sciences students in Salerno. *Sport Mont*, 22(1), 9-14. <https://doi.org/10.26773/smj.240202>
- D'Isanto, T., Aliberti, S., Altavilla, G., Esposito, G., & D'Elia, F. (2022a). Heuristic learning as a method for improving students' teamwork skills in physical education. *International Journal of Environmental Research and Public Health*, 19(19), 12596. <https://doi.org/10.3390/ijerph191912596>
- D'Isanto, T., Di Domenico, F., Aliberti, S., D'Elia, F., & Raiola, G. (2022b). Criticisms and perspectives of heuristic learning in physical education. *Pedagogy of Physical Culture and Sports*, 26(2), 93-100. <https://doi.org/10.15561/26649837.2022.0203>

- D'Isanto, T., D'Elia, F., Aliberti, S., Di Domenico, F., & Esposito, G. (2023). Unified bench press through the elimination of leg-drive to promote sports inclusion. *Physical Education of Students*, 27(6), 319-324. <https://doi.org/10.15561/20755279.2023.0603>
- Di Domenico, F., Altavilla, G., & Raiola, G. (2022). Relationship between rapid strength, reactive and strength and agility in university sports students. *International Journal of Human Movement and Sports Sciences*, 10, 98-103.
- Di Domenico, F., D'Isanto, T., Esposito, G., Aliberti, S., & Raiola, G. (2023). Exploring the influence of Cognitive and Ecological Dynamics approaches on Countermovement jumping enhancement: a comparative training study. *Journal of Functional Morphology and Kinesiology*, 8(3), 133. <https://doi.org/10.3390/jfmk8030133>
- Di Domenico, F., Esposito, G., Aliberti, S., D'Elia, F., & D'Isanto, T. (2024). Determining the relationship between Squat Jump performance and knee Angle in Female University students. *Journal of Functional Morphology and Kinesiology*, 9(1), 26. <https://doi.org/10.3390/jfmk9010026>
- Esposito, G., Ceruso, R., & D'Isanto, T. (2019). Evaluation of some quantitative aspects in the young soccer players training process during puberty. *Journal of Physical Education and Sport*, 19, 1777-1783. <https://doi.org/10.7752/jpes.2019.s5261>
- Esposito, G., Altavilla, G., Giardullo, G., Ceruso, R., & D'Isanto, T. (2024a). The Effects of the Use of Plyometric Exercises with and without the Ball in the Development of Explosive Strength in Volleyball. *Journal of Functional Morphology and Kinesiology*, 9(3), 126. <https://doi.org/10.3390/jfmk9030126>
- Esposito, G., Ceruso, R., Aliberti, S., D'Isanto, T., & D'Elia, F. (2024b). A comparative study of university training of sports and physical activity kinesiologist. *BMC Sports Science, Medicine and Rehabilitation*, 16(1), 231. <https://doi.org/10.1186/s13102-024-01016-y>
- Esposito, G., Aliberti, S., Ceruso, R., Tessitore, A., & Raiola, G. (2025a). Maximum strength development in martial arts and perception and awareness: new approach for training methods. *Frontiers in Sports and Active Living*, 7, 1676250. <https://doi.org/10.3389/fspor.2025.1676250>
- Esposito, G., Ceruso, R., Invernizzi, P. L., Manzi, V., & Raiola, G. (2025b). Effects of Stretching and Resistance Training on Psychophysical Awareness: A Pilot Study. *Applied Sciences*, 15(15), 8259. <https://doi.org/10.3390/app15158259>
- Giardullo, G., Aliberti, S., Sannicandro, I., Fattore, S., & Ceruso, R. (2024). Karate game: using a playful and participatory approach to enhancing children's social and motor perception during the developmental age. *Physical Education Theory and Methodology*, 24(4), 539-544. <https://doi.org/10.17309/tmfv.2024.4.04>
- Gonzalo-Skok, O., Arede, J., & Dos' Santos, T. (2025). Effects of strength training and detraining considering maturity status in youth highly trained basketball players. *Plos one*, 20(2), e0317879. <https://doi.org/10.1371/journal.pone.0317879>
- Raiola, G. (2012). Bodily communication in volleyball between human and experimental sciences. *Mediterranean Journal of Social Sciences*, 3(1), 587-597.
- Raiola, G. (2015). Basketball feint and non-verbal communication: empirical framework. *Journal of Human Sport and Exercise*, 10(1), S360-S368.
- Raiola, G., D'Isanto, T., Di Domenico, F., & D'Elia, F. (2022). Effect of teaching methods on motor efficiency, perceptions and awareness in children. *International journal of environmental research and public health*, 19(16), 10287.
- Raiola, G., Esposito, G., Aliberti, S., D'Elia, F., & D'Isanto, T. (2025a). Physical Exercise and Psychophysical Learnings on Basic Strength Development. *Methods and Protocols*, 8(2), 40. <https://doi.org/10.3390/mps8020040>
- Raiola, G., Esposito, G., Aliberti, S., & D'Elia, F. (2025b). Effects on performance, perception, and awareness of plyometric training in youth volleyball: a novel methodological approach to training. *Applied Sciences*, 15(3), 1581. <https://doi.org/10.3390/app15031581>
- Sannicandro, I., & Cofano, G. (2023). Large-Sided Games and Sport-Specific Training: Parameters of High Intensity in Professional Soccer Players. *Physical Education Theory and Methodology*, 23(1), 124-132. <https://doi.org/10.17309/tmfv.2023.1.18>
- Sannicandro, I., Trotta, N., D'Onofrio, R., & Simonelli, C. (2025). The Acute Fatigue Effects of Small-Sided Games on Lower Limb Strength, Inter-Limb Asymmetry and Landing Technique in Young Under-15 Female Soccer Players. *Physical Education Theory and Methodology*, 25(5), 1110-1118. <https://doi.org/10.17309/tmfv.2025.5.10>
- Santos, E. J., & Janeira, M. A. (2012). The effects of resistance training on explosive strength indicators in adolescent basketball players. *The journal of strength & conditioning research*, 26(10), 2641-2647. <https://doi.org/10.1519/jsc.0b013e31823f8dd4>