Assessing the effects of 10 weeks of fitlight-based plyogility training on basketball players' attention, agility, dribbling, and shooting skills

Evaluación de los efectos de 10 semanas de entrenamiento de plyogilidad basado en FITLIGHT en la atención, la agilidad, el regate y las habilidades de tiro de los jugadores de baloncesto

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Abstract

Introduction: Plyometric and agility (plyogility) training; particularly with cognitive components including light, as in FITLIGHT systems offer immense advantages to enhancing physical performance and cognitive functning.
Objective: The purpose of the study is to assess the impact of a plyogility program utilizing the FITLIGHT technique on basketball players' auditory and visual attention, reactive agility, dribbling, and shooting skills.
Methodology: A population of 40 participants aged 18 20 in Al-Ahsa of Saudi Arabia were randomly selected and assigned to two groups: experimental (EG) and control (CG), totalling 20 participants in each group. The two groups were involved in a ten-week program that entailed four weekly training sessions. The FITLIGHT-assisted plyoagility training treatment was administered to the experimental group.
Results: The experimental group improved much on all the measured variables compared with the control group. The effect sizes ranged between 0.97 and 0.98, and the percentages of improvement rates in the experimental group covered a scale between 12.13% to 74.40%. The control group, by contrast, had even lower improvement rates (3.80% to 39.02%) and medium and large effects (0.77 to 0.94).
Discussion: The data obtained reveals indicated significant improvements in all measured skills for the experimental group (EG), including auditory/visual attention (RRH, RLH), reactive agility (Illinois Test), dribbling (T-Test D), and shooting (T-Test S), with greater gains compared to the control group (CG).
Conclusion: This study underscores the effectiveness of training programs that incorporate FITLIGHT technology in enhancing basketball players' auditory and visual attention, reactive agility, dribbling, and shooting skills.

Keywords

Reaction time; plyometric; reactive agility; dribbling; shooting; fitlight.

Resumen

Introducción: El entrenamiento pliométrico y de agilidad (pliogility), en particular con componentes cognitivos que incluyen la luz, como los sistemas FITLIGHT, ofrece importantes ventajas para mejorar el rendimiento físico y el funcionamiento cognitivo.
Objetivo: El propósito del estudio es evaluar el impacto de un programa de plyogility que utiliza la técnica FITLIGHT en la atención auditiva y visual, la agilidad reactiva, el regate y las habilidades de tiro de jugadores de baloncesto.
Metodología: Se seleccionó aleatoriamente a una población de 40 participantes de entre 18 y 20 años de Al-Ahsa, Arabia Saudita, y se les asignó a dos grupos: experimental (GE) y control (GC), con un total de 20 participantes en cada grupo. Ambos grupos participaron en un programa de diez semanas que incluyó cuatro sesiones semanales de entrenamiento. El tratamiento de entrenamiento de plyoagility asistido por FITLIGHT se administró al grupo experimental.
Resultados: El grupo experimental mejoró significativamente en todas las variables medidas en comparación con el grupo control. Los tamaños del efecto oscilaron entre 0,97 y 0,98, y los porcentajes de mejora en el grupo experimental abarcaron una escala del 12,13 % al 74,40 %. El grupo control, en cambio, presentó tasas de mejora aún menores (del 3,80% al 39,02 %) y efectos de intensidad media y alta (de 0,77 a 0,94).
Discusión: Los datos obtenidos revelan mejoras significativas en todas las habilidades medidas en el grupo experimental (GE), incluyendo la atención auditiva/visual (RRH, RLH), la agilidad reactiva (Test de Illinois), el regate (T-Test D) y el tiro (T-Test S), con mayores mejoras en comparación con el grupo control (GC).
Conclusión: Este estudio subraya la eficacia de los programas de entrenamiento que incorporan la tecnología FITLIGHT para mejorar la atención auditiva y visual, la agilidad reactiva, el regate y el tiro en jugadores de baloncesto.

Palabras clave

Tiempo de reacción; pliométrico; agilidad reactiva; regate; tiro; fitlight.

Introduction

Basketball is one of the most popular and common team sports played both by players and watched by audiences because it is a dynamic and competitive game (Hassan et al., 2022; Venc Turk et al., 2021; O Grady et al., 2020; Refoyo et al., 2009; Lyons et al., 2006). Sport requires a lot of agility and flexibility as players are always required to go between offense and defense. Agility, the capability to maintain the starting body movement, switch directions, speed up, or slow down drastically (Stojanovic et al., 2018) is also essential in basketball. As mentioned by the researchers, agility and reaction time are paramount when it comes to performing skills like dribbling, passing, and changing directions faster (Hassan et al., 2022; Refoyo et al., 2009; Lyons et al., 2006) . Other studies have also emphasised the technology in the form of the FITLIGHT system to improve visual reaction time and technical prowess (Hassan et al., 2022) , whereas others look at the role of workload management and fatigue on the measures of performance in competitive environments (O Grady. et al., 2020; Stojanovic. et al., 2018).

Basketball is a game that technically requires you to be fit yet the game also requires a lot of physical exercise since this directly affects the technical performance of the game and vice versa. General athleticism (GA) includes both coordination and reaction time as its main elements, and they are also important in forming basketball-specific aptitudes (Singh & Saini, 2017). Specifically, new studies have suggested additional research on the influence of training technologies, including FITLIGHT, on the enhancement of the upper limb's coordination and reactive movement schemes among basketball athletes (Steff, Badau, & Badau, 2024). Furthermore, the optimization of physical, technical, and tactical preparation determines the success of the player in training and in the game, and it must develop in complex formation with the evolution of the game and the modern system of coaching (García, Fernández, & Martín, 2022; Curutzianu et al., 2022).

Plyogility training and FITLIGHT technology

Plyometric and Agility training, sometimes called plyogility training uses a combination of conventional plyometric training and reactive agility drills to not only improve physical aspects of performance but also cognitive. The approach has seen successful deployment in a range of populations, including athletes and older adults with the inclusion of visual information, including FITLIGHT 2 technology, to enhance the speed of reaction time, decision-making, and motor sequence (Hassan, Alhumaid, & Hamad, 2022). But in youth sports, especially soccer and basketball, plyogility training has proved to lead to huge gains in agility, speed and the ability to produce power in a short amount of time-- even two weeks (Padrnon-Cabo et al., 2021; Luqman, Abbas, & Manzoor, 2024). Further, it has been suggested that the concomitant use of cognitive challenges increases the degree of improvement in sport-related performance, particularly during dynamic games (Stefanica et al., 2024). Incorporation of light-based stimuli in agility drills adds significant cognitive load when learning to perform a task, thereby becoming an effective instrument of delivering sport-specific abilities that may demand quick reaction to unforeseeable scenarios on court or field. Research led to the conclusion that such motor-cognitive agility training has a considerable impact on the visual reaction, decision-making, and even multitasking skills of athletes (Friebe et al., 2024; Hassan, Alhumaid, & Hamad, 2022). In older adults, training that also follows the principles of agility-like exercise but adapts to a multimodal program, multimodal agility-like exercise training (MAT), was also shown to be effective in training functional mobility, balance, and cognitive engagement, and provides a method of time-efficiently training multiple domains together (Morat et al., 2021).

Plyogility training which uses plyometric combination with drills of agility is very important especially in sports that involve quick change of direction e.g basketball, high speed movements and quick decision making under dynamic circumstances. The exercises pay much attention to explosive strength, speed, reactive coordination, as a result of which it was possible to achieve good results in physical performance in muscle power and movement velocity, as well as agility (Prianto et al., 2024). The success of plyometric training is largely dependent on the stretch-shortening cycle (SSC) of muscle contractions, which elevates the neuromuscular efficiency and improves the capacity to produce forces quickly, which is an essential element of high-intensity actions during the play in competitions (Prianto et al., 2024; Sole et al., 2021). Another study carried out by Cao et al. (2024) as a systematic review also showed that the use of plyometric interventions can indeed lead to significant improvement in terms of physical conditioning among female basketball players as well as the skill-related aspects of the game. It has always been demonstrated in literature that plyometrics training increases speed and agility in several sports, including tennis, football or basketball (Hendrawan, Nasurlloh, & Shuba, 2024; Rehman et al., 2024). Furthermore, in combination with unstable surfaces or reactive components, such drills add additional concerns to motor control and postural stability, enhancing the overall performance on the court (Sedaghati, 2018). Research also shows that modifications in movement patterns that can result in objective improvements in lower-body power and linear speed by six weeks of regular training can include jump squats and skater hops (Sole et al., 2021). This is why plyometric-based agility training becomes a useful part of basketball players conditioning programs to improve not only physical qualities but also technical implementation of the performance in game actions.

As meta-analysis performed by Zhou et al., (2024) shows, plyometric training has a prominent positive impact on linear sprint velocity and change-of-direction velocity which are two crucial elements of athletic performance in sports like basketball. Besides, plyometric program-based exercising has been proven to enhance agility in youth basketball players, including its applicability in early specialization and performance enhancement. Comparisons between pre and post plyometric training as done in a literature review by Hendrawn et al., 2024, indicated that athletes were reported to exhibit significant changes in agility especially when they have improved in directional movement rate and in locomotor effectiveness (Hendrawan et al., 2024). Also, the study by Mujahid et al (2024) emphasized that plyometric training results in substantial increases in explosive strength, sprint speed and agility, especially in long jumpers. The results are consistent with Huang et al., (2023) who also determined that there were positive effects in elite athletes in different sports and noted that plyometric training can benefit events involving the production of force as quickly as possible and in high-intensity movements.

The use of FITLIGHT technology in enhancing cognitive function and reaction time in athletes

The integration of plyometric and agility training (plyogility) with light-based reaction systems, particularly the FITLIGHT® system, has shown significant potential for enhancing both motor performance and cognitive function in basketball players (Silvestri et al., 2023; Lucia et al., 2022). These technologies introduce a cognitive challenge into traditional physical drills, thereby promoting neuro-motor adaptation, increasing visual reaction speed, and making training more engaging and interactive. Silvestri et al. (2023) observed that sensory-based training devices—such as FITLIGHT—can interact with users during physical activity, providing real-time feedback, and transforming conventional exercises into dynamic, task-specific activities that improve attentional focus and decision-making under movement (Silvestri et al., 2023). This interaction enhances the enjoyment and motivation of athletes, which is crucial for long-term adherence to training programs.

Lucia et al., (2022) emphasized the development of cognitive-motor training protocols designed to stimulate key cognitive functions such as attention, working memory, inhibition, and mental flexibility (Lucia et al., 2022). Their findings suggest that these interventions lead to greater improvements in both athletic performance and cognitive efficiency compared to traditional motor-only training paradigms. Moreover, they proposed that such enhancements may be associated with increased proactive brain processing within the prefrontal cortex, which plays a central role in executive function and rapid decision-making during sport-specific scenarios. In a follow-up study, Badau et al. (2022) demonstrated that a 12-week FITLIGHT-based intervention, conducted three times per week for 30 minutes each session, significantly reduced reaction time among athletes engaged in handball, volleyball, and basketball (Badau et al., 2022). This supports the notion that light-reactive technology can effectively target the motor-cognitive interface and improve response speed during competitive play.

Hassan et al., (2023) further confirmed that the FITLIGHT training system enhances visual reaction time and contributes to improved attention and hand-speed coordination in wheelchair basketball players (Hassan et al., 2023). The FITLIGHT device itself features an internal sensor that activates or deactivates based on proximity or touch, allowing users to customize stimulation patterns, light duration, and sequence depending on individual or team-based training goals (FITLIGHT Corp, 2024). Moreover, the FITLIGHT units are highly versatile and can be mounted on various surfaces, including walls, floors, and equipment—making them ideal for implementing sport-specific drills across different environments

(Perroni et al., 2018). Steff et al., (2024) investigated the effects of an 8-week FITLIGHT-based program on balance and reactive stability in male basketball players aged 13–14 years. They reported trends toward improved Y-Balance Test scores and faster reactive balance responses, indicating enhanced neuromuscular control and spatial awareness (Steff et al., 2024). Additionally, Hassan et al., (2023) found that incorporating FITLIGHT into small-sided games significantly improved harmonic abilities and fundamental basketball skills, such as passing accuracy and coordination under pressure (Hassan et al., 2023). These results highlight the value of integrating technology-enhanced, cognitively demanding drills into regular basketball practice to maximize both physical readiness and decision-making capacity under dynamic conditions.

The literature review (Hassan et al., 2022; Jerzy et al., 2015; Steff & Badau, 2024; Luqman et al., 2024; Silvestri et al., 2023) has defined the lack of scientific studies about plyometric-agility training (plyogility) when using light-reactive technology in association with basketball. Although the body of evidence is gradually building in favor of the practical application of cognitive-motor interventions to enhance reaction time, coordination, and sport-specific skills, there exists only limited research that has considered how the approach can be implemented to become part of regimented basketball conditioning training. According to several studies, conventional physical training in isolation is unlikely to be an adequate course to acquire the integrated motor-cognitive skills necessary for high-level performance in basketball [Lucia et al., 2022; Hassan et al., 2023]. Restrictions in visual concentration, mobility, dribbling precision, and shooting effectiveness were exhibited in youths and amateur athletes who failed to participate in dynamic parts that comprise reactive stimuli like that of FITLIGHT ® technology [Badau et al., 2022; Steff et al., 2024]. As an example, a study conducted by Hassan et al. (2022) revealed that FITLIGHT-based agility tasks positively impacted visual reaction time and dribbling speed, as well as the performance of basketball players. Likewise, Silvestri et al. (2023) showed that the FITLIGHT training platform improves attention focus, decision-making under movement, and motor coordination in younger athletes. Such results indicate that visual feedback coupled with task-based movements might result in more improvements compared to a standard training paradigm.

Nevertheless, the study of the effects of FITLIGHT-aided plyogility training on basketball performance is limited to few in-depth studies that specifically investigate the intervention on the basketball sporting area [Friebe et al., 2024; Campanella et al., 2024]. The present study bridges this research gap by adding a new FITLIGHT-based plyogility training program that will have an impact both on physical properties and sport-related cognitive-motor skills among male basketball players. It appears that this is one of the few papers that examines the effect of reactive agility drills based on FITLIGHT technology inside of structured plyometric-agility drills, specifically their effect. The involvement of multimodal stimuli (the integration of explosive movements along with quick decision-making skills) is a new trend in the specifics of basketball conditioning and corresponds to modern trends in high-intense functional training and neuro-motor adaptation. We Hypothesis as follows: H1): It was hypothesized that there are considerable differences in the pre- and post-measurement data comparing the EG and the CG in auditory and visual attention, agility, dribbling, and shooting performance of basketball players in favour of the post-treatment data. H2): The post-measurement analysis of the experimental group and the control group showed a difference between the two sides in terms of auditory and visual attentiveness, speed, dribbling, and shooting performance. H3): On the basis of the results, the subject group was more effective than the control group on measures of auditory and visual attention to stimuli and on measures of agility, dribbling, and shooting.

Method

Participants

The calculation of the sample size of the present study was based on the formula developed by Stephen K. Thompson regarding finite populations [Thompson, 2012], which was developed in consideration of the limited size of a population and makes adjustments in line with the desired representation. The target population was chosen among the male basketball players living in Al-Ahsa, Saudi Arabia, from an initial sampling list of 45 potential participants (n = 45). Using a 95 percent level of confidence (Z = 1.96), a margin of error (d = 0.05), and an estimated proportion of 0.5 (p = 0.5), the required sample size was determined. After five subjects were excluded because of the injury or failure to adhere to the training recommendations, the final sample size comprised 40 subjects who were randomly assigned to two groups of an equal size: experimental (EG, n = 20) and control (CG, n = 20) [see Table 1]. The inclusion criteria maintained that the participants should be: a) Male. b) possess a minimum of four years of structured basketball. c) be free to train four times a week. d) do not have chronic diseases or any drug use in which they take medication that can affect physiological responses. The decision to exclude colleagues who failed to undergo pre-measurements was made, and the impossibility of doing all training sessions because of the injury was also the exclusion criterion. For the experimental group, the mean age was 18.63 ± 0.81 years, height 175.00 ± 1.75 cm, weight 75.56 ± 1.55 kg, and the duration of training experience was 5.44 ± 0.51 years. The control group had a mean age of 18.56 ± 0.73 years, height 175.69 ± 1.49 cm, weight 75.50 ± 1.826 kg, and a duration of training experience was 5.38 ± 0.50 years. These data indicate basic homogeneity between the two groups, ensuring the possibility of comparing variables before the intervention.

During the intervention period, the participants engaged in ploygility training sessions at the Al-Adalah Basketball Club in Al-Ahsa, KSA. Tests took place from May 4 to 6, 2024, which allowed for the assessment of all the participants. The EG participated in a 10-week training program that was based on ploygility exercises (described in Appendix A). The CG engaged solely in general training with no ploy agility exercises for the same amount of time as the EG. The training program was implemented from May 11, 2024, to July 25, 2024. The latter was conducted from July 27 to 29, 2024, by using the same approach and conditions as the former. All the participants were notified about the existence of risks and provided their written consent to participate in the experiment. This work was acknowledged by the Ethics Committee of King Faisal University (protocol Ref. No. KFU-REC-2024-MAR-ETHICS2051).

Procedure

The stature (height) of participants was measured on day one at the beginning of the testing using an anthropometric instrument: Martin Anthropological Scale which was proven to be a valid and reliable tool to measure anthropometric parameters (Comi, Roi, & Cicchella, 2015). When standing up the participants were asked to keep their feet together, their arms crossed on their chest, to keep their entire body against the device in touch with each other as well, which meant the heels, the buttocks, and the upper back with the vertical surface of the device. During measurement proper posture was maintained by keeping the head straight and the eyes closed, and the participants were requested to take deep breaths. The height was measured in 0.1 cm increments, and the head of the participant was in contact with the measuring rod. The InBody 720 bioelectrical impedance analyzer (InBody Co., Seoul, South Korea) evaluated the participants body mass and showed significant validity in determining other constituents of body composition like fat mass (FM), fat-free mass (FFM) and body mass index (BMI) (Stefanica et al., 2024; Prianto et al., 2024).

On the second day, test subjects, their reaction time to visual and audio stimuli was tested with the Lafayette Instrument Visual Reaction Time Apparatus Response Panel 63014 (Hassan, Alhumaid, & Hamad, 2023). This is a rather widespread machine, which is employed to measure compound response time, both to the visual and the audible activity. The condition of the test was standardized and was done to test the focus of attention and the speed of decision making. The third day was dedicated to motor testing applied in the sphere of sports with the help of the FITLIGHT system that provides participants with programmable LED lights that are commanded by touch or closeness (Steff, Badau, & Badau, 2024). The subjects were administered two forms of agility tests, namely Modified Reactive Agility T-Test (with dribbling), and Shooting-based agility test. During these tests, the subjects were asked to respond to randomly engaged FITLIGHTs by running and turning on their feet and assessing aspects of physical agility and cognitive processing while moving. Three trials were taken in every trial, and the time to record the best performance of the individual was taken to the nearest 0.1 seconds (Hassan et al., 2022). To have consistency and reliability over time, all the measures were taken under the laboratory environment controlled by the certified evaluators to maintain accuracy and consistency.

Instrument

Tests

Visual and auditory attention test

The Attention Focusing Device (Audio-Visual) Response Panel Model 63014 of the Lafayette Instrument Company (3700 Sagamore Pkwy N, Lafayette, IN 47904, USA) was used to test the visual and auditory attentions in this study (Figure 1). This instrument can be applied to assess the compound reaction time to visual as well as auditory stimuli and has been extensively applied in the field of sport science research due to the assessment of attentional focus in a dynamic environment (Hassan et al., 2023). They had to react as soon as possible to random visual or auditory signals by pushing the relevant button on the panel. The average combination of reaction time was drawn from numerous attempts and was noted in milliseconds (Appendix A). Lafayette Instrument 63014 has proven validity and reliability since its performance was seen to be like other instruments used in comparable studies. An example is the Visual Reaction Time Apparatus Response Panel 63013, a device representing Lafayette Instrument, which has been used in the past in order to measure the visual attention and the speed of reaction in wheelchair basketball players. These comparative analyses endorse the precision and reliability of the results, which are measured using the 63014 model (Hassan et al., 2023). Based on the normal velocity principle, all testing procedures were administered in standardized environmental conditions to obtain a degree of consistency and reduce extraneous effects on the performance of attention and reaction time tasks.

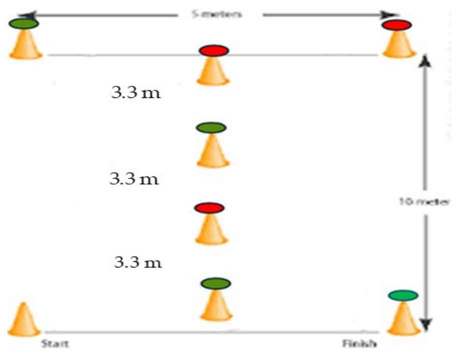
Figure 1. Illustration of participant interface for Auditory and Visual Attention Apparatus 63014 response panel.

Fuente: Hassan et al., 2023

Illinois Modified Agility Test using FITLIGHT

Modified Illinois Agility Test as carried out with the FITLIGHT system has been used to determine reactive agility, change-of-direction speed and motion-based decision-making in male basketball players. This test will encompass a rectangular course in which all the members will have to respond to the randomly lit up FITLIGHT units at a designated spacing on the path. The participants were initialized on a standpoint in the commencement of the course, the brief was to run ahead to the first light, which was switched on manually or automatically. On arriving at the first light, they manipulated them by touching or waving their hand in the direction of the light emitting, hence triggering the use of one of four lights among a randomly chosen target field of lights. The participant was then sent, that is, to sprint to the switched-on light, which he/she activated, and then to the last part and to reach the end at the terminal unit of the light (Steff et al., 2024). In this form of the test, the level of physical agility is not the only indicator measured, but also the level of cognitive processing, since the athletes had to perceive, interpret and react to visual stimuli with high efficiency of locomotor performance. The completion time used to record the total time in which the course had been taken was recorded to the nearest 0.1 seconds, and the participants were given two trials in which the fastest time among the two would be analyzed in the data set (see figure 2). The reliability and validity of this kind of agility test have been confirmed in the past, especially in boys team sport players (Ilham et al., 2025; Hachana et al., 2013), as such, it is an appropriate instrument in assessing the changes in the sport-specific motor-cognitive abilities as a result of specific training regimes, conduct in the form of plyogility exercises with reactive stimuli included.

Figure 2. . Illustration of illinoise test with fitlight for the reactive agility test

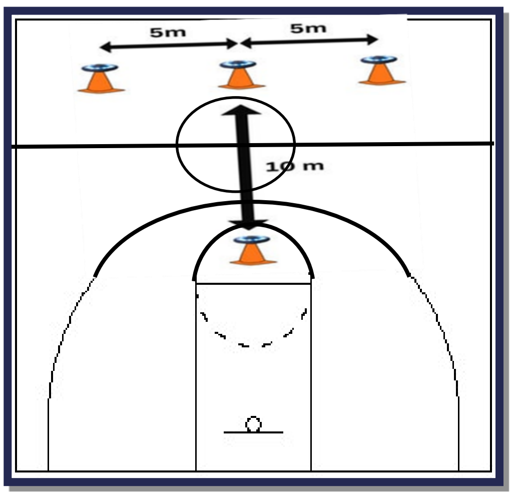


Fuente: Steff et al., 2024

AT with Dribbling and Shooting

The functional task involved Reactive Agility Test (RAT) and dribbling and shooting using the FITLIGHT system, namely, the units were placed on the cones in a modified T-shape, as in Figure 3. This test was made to assess reactive agility, decision-making during motion, and basketball specific performance of acquired skills. The participants had to react to the activation of randomly selected FITLIGHT turning on and moving as soon as they saw the light on the suitable direction and including dribbling and making the opposite directional changes when they controlled the basketball-dribbling with one or both hands and then shooting the basketball into the basket at the end of the trial. It used three lights, two at the end points of the horizontal portion of shape T, and the other one in the middle. A random number of the two end lights would turn on when the central light was triggered, and the participant would have to respond quickly and make a turn according to the indicator light (Hassan et al., 2022; Steff, et al., 2024). Three trials were given to each of the subjects and the fastest time (in seconds) which is the time which the subject took since the start of the firing till the task was completed successfully was analyzed. Later, in the dribbling portion, there was a demand to make a response that was required by light, moving either to the side or ahead of the body in controlling the ball. The last stage of the test involved performing a free basketball shot in the last maneuver of the sequence of agility-dribbling. Marking guidelines were as: 2 points: Whenever the ball went straight into the basket. 1 point: When the ball hit the backboard and touched the rim or went in the basket. Non points: When the ball struck neither the backboard nor the basket. There were three tries per participant and the average was proved statistically. The current testing protocol has previously been validated in some studies testing reactive agility in basketball players (Hadžovi et al., 2023), and its application is further supported by evidence that it has proven to be an effective way of measuring a specific change in sport performance after applying cognitive-motor training interventions (Steff et al., 2024).

Figure 3. Illustration of Reactive Agility T-Test (RAT) with Dribbling and Shooting



Fuente: Hassan et al., 2022; Steff, et al., 2024

Experimental Procedures

The experimental training program aimed to improve visual and auditory attention span, reactive agility, dribbling ability, and shooting of basketball players using a 10-week plyometric training program with the help of the FITLIGHT ® system. Both the EG and CG were taking part in the 4 training sessions per week (Sat-Mon-Wed-Thu), each training lasting 90 -120 minutes, giving a total of 32 training sessions to the study. In the case of the experimental group, each of the sessions was organized according to three basic components:

1. FITLIGHT Plyogility Training (30-45 min) During the session, both plyometric and agility patterns were incorporated; the subjects reacted to randomly activated visual responses of FITLIGHT® devices either on cones or walls. The purpose of the exercises was to enhance the neuromuscular coordination, response time, and cognitive-motor combination under dynamic performance patterns like sprinting, cutting, and jumping. The reps (8 to 10 repetitions) and the sets (35 of them) were completed with 40 to 90 s rest between the sets to minimize fatigue-associated degradation of movement quality but still maintain high-intensity effort [see Appendix B].

2. Basketball Skill Development Stage (25-35 min): In this segment, we combine the FITLIGHT technology with the motor tasks that are related to a specific sport activity, mainly dribbling and shooting in reactive conditions. Those who practice tasks involving fast reaction to the signals of lights when completing technical activities, which helps to improve the speed of decisions and the performance of skills in stressful situations, and attention concentration.

3. Tactical and Application, and Game Simulation (20- 25 minutes): The last of these elements was small-sided games and situation play, which would be the chance to apply previously developed physical and cognitive skill sets, a factor that would enable athletes to perform learned skills in competitive settings. It was supposed to retune the distance between practice in a vacuum, the isolated growth of the mastery of skills and proficiency, and the reality of playing the game, combining physical fitness, technical expertise, and an understanding of how the game is played.

Warm-up and Recovery protocols: Each session was preceded by a standardized warm-up of 10 min, followed by 5 min recovery after the actual training to facilitate physiological reset and to prevent injuries. These steps guaranteed the optimum preparation and risk-free elaboration of the intervention [see Tables 2 and 3 on a week-by-week timetable and session structure]. Notably, the program of the control group excluded any exercises and drills based on Plyogility or involving FITLIGHT in the experiment and made it possible to draw a clear parallel between the specifics of regular basketball training and the innovative intervention used in the experimental group.

Table 1. Distribution of 10-week Plyogility workout program for basketball players.

Stage		General preparation				Special preparation			Pre-competition preparation		
Week		1	2	3	4	5	6	7	8	9	10
Load	Max					■		■	■		
	High	■	■		■						■
	Mid			■			■			■	
Week Time		420 min	420 min	360 min	420 min	480 min	360 min	480 min	480 min	360 min	420 min
Total Program Time		4200 min									

Table 1. Continue

Week	Session	Intensity %	FitLight	Organizing the Session					Session Time
				Warm-UP	Main Phase			Recovery	
					Plyogility	Skills	Tec& Tac		
	1	70%		10 min	30 min	30 min	20 min	5 min	95 min
1	2	75%		10 min	35 min	30 min	20 min	5 min	100 min
	3	75%		10 min	35 min	30 min	20 min	5 min	100 min

	4	65%		10 min	30 min	30 min	20 min	5 min	95 min
2	5	75%		10 min	30 min	35 min	25 min	5 min	105 min
	6	75%		10 min	30 min	35 min	25 min	5 min	105 min
	7	80%		10 min	35 min	35 min	25 min	5 min	110 min
	8	70%		10 min	30 min	30 min	20 min	5 min	95 min
3	9	75%		10 min	35 min	30 min	25 min	5 min	105 min
	10	75%		10 min	40 min	35 min	20 min	5 min	110 min
	11	80%		10 min	45 min	30 min	25 min	5 min	115 min
	12	70%		10 min	35 min	30 min	20 min	5 min	105 min
4	13	75%		10 min	45 min	35 min	20 min	5 min	115 min
	14	80%		10 min	40 min	35 min	20 min	5 min	110 min
	15	85%		10 min	35 min	35 min	20 min	5 min	105 min
	16	65%		10 min	30 min	30 min	20 min	5 min	95 min
5	17	75%		10 min	40 min	35 min	25 min	5 min	115 min
	18	85%		10 min	45 min	35 min	25 min	5 min	120 min
	19	85%		10 min	40 min	30 min	25 min	5 min	100 min
	20	70%		10 min	35 min	35 min	25 min	5 min	110 min
6	21	80%		10 min	30 min	30 min	20 min	5 min	95 min
	22	80%		10 min	35 min	30 min	20 min	5 min	100 min
	23	75%		10 min	30 min	30 min	25 min	5 min	100 min
	24	70%		10 min	35 min	35 min	25 min	5 min	110 min
7	25	75%		10 min	40 min	35 min	25 min	5 min	115 min
	26	75%		10 min	35 min	30 min	25 min	5 min	105 min
	27	80%		10 min	30 min	30 min	25 min	5 min	100 min
	28	70%		10 min	30 min	35 min	25 min	5 min	105 min
8	29	75%		10 min	40 min	35 min	25 min	5 min	105 min
	30	75%		10 min	45 min	30 min	25 min	5 min	105 min
	31	80%		10 min	30 min	30 min	25 min	5 min	100 min
	32	65%		10 min	40 min	35 min	20 min	5 min	110 min
9	33	80%		10 min	30 min	35 min	25 min	5 min	105 min
	34	85%		10 min	35 min	35 min	25 min	5 min	110 min
	35	75%		10 min	30 min	30 min	25 min	5 min	100 min
	36	70%		10 min	30 min	30 min	25 min	5 min	100 min
10	37	75%		10 min	30 min	35 min	25 min	5 min	105 min
	38	75%		10 min	35 min	35 min	25 min	5 min	110 min
	39	80%		10 min	30 min	30 min	25 min	5 min	100 min
	40	65%		10 min	30 min	30 min	20 min	5 min	95 min

Table 2. Demonstrates a plyogility training session for basketball players using FitLight.

Plyogility session									
	Illustration and formation of pregnancy cycle								
Training distance	10/15/20/25 meters								
The number of times the speed of direction change	Once								
direction change angle	30 degrees								
The number of straight lines for running	1/2(lines) Multiple								
Variations	 without ball / a ball								
The goal of the training		Physical	skill	visual	auditory	mixed	complex	total	notes
		*	*	*		*	*		
Pregnancy cycle formation	performance time	Repetition	Rest every now and then	number of groups	time for each group	Rest between groups	Total training time	Rest before starting a new training	notes
	4 min(max)	4 r	15 sec	4r	45 sec	1 min	4.7 min	1min	
Cognitive map of the performance sequence			 1	 1	 2				
The number of colors used		2/3	*		*				
FitLight time and shape		Average	*						
		fast		*	*				
		Full	*						
		partial			*				

Data analysis

The data collected in the present study were analyzed using the statistical software IBM-SPSS 26 (Chicago, IL, USA) to calculate the mean, the standard deviation, the coefficient of variation, the confidence interval with lower and upper limits (95% CI), the threshold values, and the effect size (partial eta square). In the following analysis, the effect size was interpreted using eta squared; the associated ηp^2 values represent small (0.01), moderate (0.06), and large (0.14) effects. A repeated measures analysis of variance (ANOVA) was used to compare the mean differences between the randomly selected EG and CG. This was complemented by a t-test to determine the differences between the means of the two groups. In this study, the reference that was chosen for the level of statistical significance was $p \leq 0.05$.

Results

Displays the descriptive statistics of the experimental group (EG) and the control group (CG) participants in terms of age, height, weight and years of experience in table 3.

Table 3. Descriptive statistics for age, height, weight and training variables.

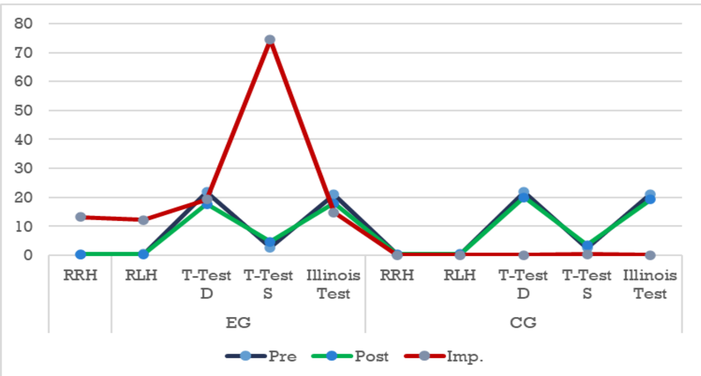
Variables	EG				CG			
	Mean	Std.	Min	Max	Mean	Std.	Min	Max
Age	18.625	0.806	17.000	20.000	18.563	0.727	18.000	20.000
Height	175.000	1.75	172.000	178.000	175.69	1.493	173.000	178.000
Weight	75.563	1.55	72.000	78.000	75.50	1.826	72.000	77.000
Training	5.438	0.512	5.000	6.000	5.375	0.500	5.000	6.000

EG—Experimental Group; CG—Control Group; Min—Minimum; Max—Maximum.

Table 1 shows the pre-test descriptive statistics of age, height, weight, and training experience of the experimental group (EG) and the control group (CG). The participants of both groups (experimental and control groups) belonged to approximately the same age range (1720 years), whereby the experimental group consisted of the subjects whose age on average comprised 18.63 ± 0.81 years, and the control group had 18.56 ± 0.73 years. The mean height values were 175.00 ± 1.75 cm and 175.69 ± 1.493 cm in the EG and the CG, respectively, indicating that all the people were within a small range of height (172-178 cm), which indicates uniformity of body dimensions across groups. The average weight of the experimental group is 75.56 1.55 kg, whereas the average weight of the control group is 75.50 1.826 C 72.000 to 78.00 kg, Minimum 72.00 77.00 C kg, respectively. Such results show that there are no significant differences in the body composition at the baseline in both groups. Regarding the basketball-specific training experience, the experimental group had a mean of 5.44 ± 0.51 years of systematic preparation, and the control one 5.38 ± 0.50 years, with 5 years as a minimum and 6 years as a maximum of playing basketball. Overall, this data indicates that both groups were relatively identical in their baseline measure of age, anthropometrics, and background in basketball training, thus making inter-group comparisons acceptable after the intervention.

The results in Figures 4 and 5 display mean Pre- and Post-intervention data, as well as the rates of improvement. Besides, the tables also reveal the trend of improvement in the post-test and the difference between the experimental group and the control group, and therefore, the impact of the intervention on both groups.

Figure 4. Depict the measure of the study variables with the experimental group and the control group at both the pre and post stages of the study.



From Figure 4, it is apparent that the experimental and control groups have different pre- and post-measures for the studied variables, where the experimental group demonstrated percentage improvement rates of the variables (RRH, RLH, T-Test D, T-Test S, Illinois Test), respectively 13.16% and 12.13%, 19.20%, 74.40%, and 14.83%. In contrast, the control group showed an improvement in the variables (RRH, RLH, T-Test D, T-Test S, Illinois Test), respectively 3.80% and 5.11%, 8.19%, 39.02%, and 8.59%.

Table 4. Descriptive statistics and sample test.

Group	Outcome measures	Pre			Post			t	ES	CI		Imp.	p
		Mean	Std.	CV %	Mean	Std.	CV %			Lower	Upper		
EG	RRH (ms)	0.395	0.006	1.59	0.343	0.005	1.46	28.90	0.98	0.048	0.055	13.16%	<0.01
	RLH (ms)	0.445	0.008	1.78	0.391	0.006	1.46	25.69	0.98	0.049	0.058	12.13%	<0.01
	T-Test D (sec)	21.809	0.094	0.43	17.621	0.613	3.48	25.13	0.98	3.832	4.543	19.20%	<0.01
	T-Test S (score)	2.688	0.793	29.51	4.688	0.704	15.02	21.91	0.97	-2.195	-1.805	74.40%	<0.01
	Illinois Test (sec)	21.046	0.560	2.66	17.924	0.198	1.10	21.24	0.97	2.809	3.435	14.83%	<0.01
CG	RRH (ms)	0.395	0.007	1.77	0.380	0.010	2.63	7.46	0.79	0.011	0.020	3.80%	<0.01
	RLH (ms)	0.450	0.010	2.22	0.427	0.013	3.04	7.15	0.77	0.013	0.023	5.11%	<0.01
	T-Test D (sec)	21.811	0.093	0.43	20.024	0.462	2.31	15.77	0.94	1.544	2.026	8.19%	<0.01
	T-Test S (score)	2.563	0.814	31.76	3.563	0.814	22.85	11.91	0.90	1.490	2.139	39.02%	<0.01
	Illinois Test (sec)	21.110	0.576	2.73	19.296	0.465	2.41	7.46	0.79	0.011	0.020	8.59%	<0.01

Key: EG — Experimental Group; CG — Control Group; RRH—Reaction Right Hand; RLH—Reaction Lift Hand; T-Test D — T-Test with dribbling; T-Test S — T-Test with shooting; CV —Coefficient of Variation; ES— Effect size; Imp. % — improvement percent.

Table 4 shows the comparable means by pre- and post-treatment measurement for all variables – RRH, RLH, T-Test D, T-Test S, and Illinois Test – for both the experimental and control groups. The results of the analysis revealed a positive improvement rate in the experimental group at a scope of 12.13% to 74.40%. The significant effect sizes, excluding heterogeneity (ES= 0.97 – 0.98), $p < 0.001$ showed this group to have highly statistically significant results. In the pre-measurements, the average coefficient of variation for the experimental group ranged from 0.43% to 29.51%; in post-measurements, the range shrunk to 1.10% to 15.02%. In the case of the experimental group, the T-test values varied from 21, 24 to 98, 90. In contrast, the changes observed in the behaviors of a control group were less significant, with only slight increases on all measured parameters. Regarding the control group, the improvement rates varied from 3.80 to 39.02%; ES 0.77 to 0.94; $p < 0.001$. The percentage CV of the control group subjects was between 0.43 % and 31. 76% in pre-test, and a number of variables reduced in the post-test. The T-test values of the control group are found between 7.15 and 15.77.

Table 5. presents the results of the analysis of variance (ANOVA), including the F-statistic for the main effects of measurement and group, as well as the partial eta squared (η^2) for the interaction between measurement and group. According to Bonferroni's post hoc test, the increases in all variables were significantly greater in the experimental group compared to the control group.

Table 5. Post-hoc analyses incorporated analysis of variance (ANOVA).

Outcome measures	Measurement			Group			Group ×Time Interaction		
	F	P	η2	F	P	η2	F	P	η2
RRH (ms)	602.45	<0.01	0.953	69.43	<0.01	0.698	175.85	<0.01	0.854
RLH (ms)	481.83	<0.01	0.941	39.68	<0.01	0.569	120.25	<0.01	0.800
T-Test D (sec)	879.41	<0.01	0.967	163.47	<0.01	0.845	142.30	<0.01	0.826
T-Test S (score)	1080.00	<0.01	0.973	5.25	<0.01	0.149	120.00	<0.01	0.800
Illinois Test (sec)	543.77	<0.01	0.948	30.43	<0.01	0.504	38.15	<0.01	0.560

Key: RRH—Reaction Right Hand; RLH—Reaction Lift Hand; T-Test D — T-Test with dribbling; T-Test S — T-Test with shooting; F — F-value; P —P-value; η^2 — Eta Squared.

For the repeated measures with the factorial factors of measurement, group, and the interaction between them, the differences in the measurements are at a significant level of $P < 0.001$. For the main measurement, the F-values varied from 481.83/1080.00, $P < 0.000$ as shown in table 5, while the effect size (η^2) for these measurements was 0.941/0.967 hence implying a very large effect. The F-values for the main group varied from 5.25/163.47, ($P < 0.001$) as shown in table 5. The interaction results show that there was a significant difference as proven by the significant F-values of the groups resulting from

38.15 to 175.85. This means that there is inequity with performance not being constant across the different groups. The η^2 values for the interaction ranged from 0.560 to 0.854 and classified the effect size as medium to large. This implies that the measurement-performance relationship depends on group membership, showing that group differences affect how the results should be analyzed.

Figure 5. Illustrates the nature of the post-measurements and the improvement rates between the experimental and the control groups.

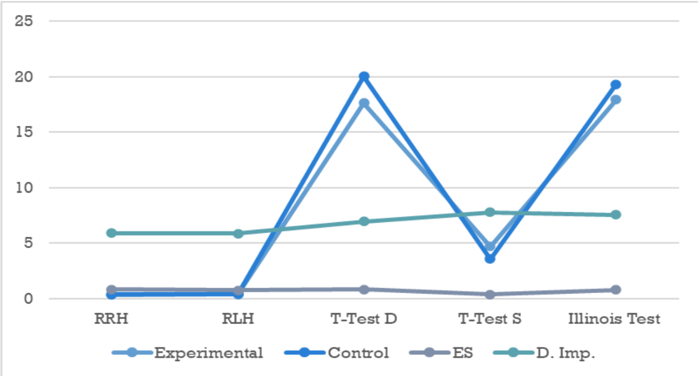


Figure 5 reveals that the experimental group has significantly higher percentage improvement rates as compared to the control group for the variables that are under study, and their differences are 5.9%, 5.87%, 6.97%, 7.76%, & 7.54%, respectively, for RRH, RLH, T-Test D, T-Test S, and Illinois Test.

Table 6. Independent t-test to show the differences between the dimensional measurements of the experimental and control groups.

Outcome measures	EG		CG		t	ES	D. Imp.	P	95% CI	
	Mean	Std.	Mean	Std.					Lower	Upper
RRH (ms)	0.343	0.005	0.380	0.010	13.19	0.85	5.9%	<0.01	-0.042	-0.031
RLH (ms)	0.391	0.006	0.427	0.013	9.74	0.76	5.87%	<0.01	-0.043	-0.028
T-Test D (sec)	17.621	0.613	20.024	0.462	12.52	0.84	6.97%	<0.01	-2.794	-2.011
T-Test S (score)	4.688	0.704	3.563	0.814	4.18	0.37	7.76%	<0.01	0.575	1.675
Illinois Test (sec)	17.924	0.198	19.296	0.465	10.85	0.80	7.54%	<0.01	-1.630	-1.114

Key: EG — Experimental Group; CG — Control Group; RRH—Reaction Right Hand; RLH—Reaction Lift Hand; T-Test D — T-Test with dribbling; T-Test S — T-Test with shooting; ES — Effect Size; D. Imp. — Differences in improved percent, 95% CI —95% Confidence Interval.

Table 6 shows present significant differences between the experimental and control groups regarding dimensional measurements. The outcomes of implementing the experimental suggested improvements were higher numbers on the variables RRH, RLH, T-Test D, T-Test S, and the Illinois Test of 5.9%, 5.87%, 6.97%, 7.76 as well as 7.54% respectively. Furthermore, the mean difference results revealed that the experimental group had a significantly higher score compared with the control group, with the effect range of the experimental group was from 0.37 to 0.85, indicating the experimental group had vastly superior effect.

Discussion

The purpose of the present study was to determine the effectiveness of a plyogility training program incorporating FITLIGHT technological enhancements as a medium on basketball players' auditory and visual attention, reactive agility, and dribbling and shooting performances. The comparison of the test results showed the impact of the program on the skills that were attempted, namely auditory and visual attention as indexed by RRH and the Reaction Lift Hand (RLH), reactive agility, dribbling as assessed by the T-Test D Illinois Test, and shooting as assessed by the T-Test S. A t-test comparison of the pre- and post-scores for the EG showed a significant difference in all the tests that were administered in this study. In addition, the EG improved significantly more compared to the CG in all the measures that were investigated. Not only do the results of the ES indicate the statistical significance of the effects regarding the EG, but they can also provide evidence of the extent of the influence of the training program on the participants' potential performance improvements. These enhancements support the plyogility training program that uses FITLIGHT technology to enhance the specified basketball abilities. Each of these skills was implemented into the program in detail using FITLIGHT technologies: auditory and visual attention (RRH, RLH), reactive agility, dribbling, shooting, hand-eye coordination, and the ability to perform movements directly and intensively. These results are similar to those of other studies conducted, the development of which justified using FITLIGHTÂ® in a sport-specific training setting. Previous research also demonstrated that it could enhance the level of reaction time, hand-eye coordination, and agility among young and professional athletes (Hassan et al., 2022; Steff et al., 2024). Also, when using new technologies in the athlete development program, Hadzovic et al. (2023) focused on the necessity of properly developed familiarization protocols and conducting valid testing procedures. Moreover, the findings by Coh et al. (2018) allowed emphasizing that reactive agility should be regarded as an independent construct when compared to non-reactive change-of-direction speed, further confirming the importance of cognitive-motor integration in the training practices of contemporary basketball. The introduction of reactive components to the design of skill training exercises produced a positive effect as well, according to Maulana et al. (2025), and these findings vindicate the rationale behind the delivery of dynamic stimulus-response drilling exercises to improve technical execution of skills in the context of sporting performances.

The adoption of training programs specific to basketball has helped to improve performance in the skills of players significantly and positively, especially when the programs are accompanied by plyometric and agility drills. The repeated measures ANOVA demonstrated that both successful basket scoring and dribbling scores increased significantly as a result of the developed 12-week intervention (3 sessions per week, including sport-specific exercises), which illustrates the effectiveness of the studied training method applied to technical skills execution (Borkar & Badwe, 2023). Moreover, plyometric training is always associated with enhanced physical fitness and motor skills related to basketball. The evidence, which has been collated in systematic reviews, has identified that these types of training produce small to moderate effect sizes across the spectrum of performance measurement, such as sprint speed, change-of-direction agility, and ball-handling proficiency (Deng et al., 2023; Putro et al., 2025). These results strengthen the argument for why explosive movements should be included in the routine basketball conditioning. Nevertheless, these interventions are effective, but it is important to address training protocols according to needs and stages of readiness. Otherwise, there is a risk of overdoing it or becoming stagnant in the performance, which are the possible detriments of the overall intended gains of specific conditioning (Leon Muñoz et al., 2024; Cao et al., 2024; Prieto et al., 2021).

Research indicates there is a growing body of evidence that has shown that the FITLIGHTR system can be used to improve both visual and auditory attention in the training of plyometric agility (plyogility), which is essential in achieving good performance in basketball. Such exercises need athletes to act on visual stimuli quickly but also engage in dynamic exercise, thus enhancing their perception of the surrounding environment and making decisions when presented with a challenging situation. In a study by Hassan et al. (2022), the implementation of reactive agility drills through the FITLIGHT® system provided a notable enhancement in the visual reaction time, where male basketball players decreased by 23-31 percent upon intervention. This was also noted by the participants as they experienced increased cognitive engagement, compared to other traditional drills, during these sessions, which offers the possibility of more decision-making and situational awareness in real-life gameplay (Hassan et al., 2022; Silvestri et al., 2023). Additionally, studies have shown that the implementation of light-reactive technology-based physical training like FITLIGHT can play a great role in enhancing the attentional focus, hand-eye coordination, and speed of response in basketball players. Indicatively, a study by Hassan et al. (2023) reported that light stimulation exercises improved positive effects on visual and auditory alertness, relations, and speed of skilled hand movements, especially among wheelchair basketball players. The results indicate that FITLIGHT-augmented plyogility education is a potentially good strategy to support multisensory attention, particularly along with sport-simulated motor exercises. The real-time feedback system within the system assists the athletes to work on their precision about time and space, since time and space are vital in advanced basketball performance.

An expanding literature base shows the benefits of applying FITLIGHT technology in training activities and training programs in different sports, especially in the improvement of motor performance and cognitive processing (Hassan et al., 2022; Martin-Niedecken et al., 2023). This intervention, as a mix of visual stimuli and moving patterns of movement, has already demonstrated enhancing executive functions of executive attention, faster decision-making, and spatial orientation. In a study of 49 male basketball players (Silvestri et al., 2023), executive functioning measured changes in a 3-week FITLIGHT practice had demonstrable effects, with participants reporting more perceived cognitive load than drills. Although the group using FITLIGHT-based exercise had these advantages, the levels of enjoyment were lower in that group, implying that although the intervention was useful, at the execution stage, it might have exerted a higher cognitive load. In the same manner, Hassan et al. (2022) studied the effects of FITLIGHT training in a bigger sample population of 154 volleyball and basketball athletes and showed that this tool considerably enhanced interactive motor skills that constitute team sport performance. In a separate study, Duda (2020) analyzed a 10-week training program with assisted learning using FITLIGHT with 24 young athletes and found significant improvement in cognitive-motor integration and in general technical performance. Another study by Martin-Niedecken et al. (2023) and Steff et al. (2024) proved again that agility drills with the use of FITLIGHT 2 showed a better improvement in reactive agility, dribbling, and shooting accuracy compared with conventional training. These findings support the hypothesis that the implementation of a plyogility training program through digital technology would enhance basketball players' auditory and visual attention, reactive agility, dribbling, and shooting skills.

Practical Implications

The study showed that application of the training program based on the use of FITLIGHT significantly increases the basketball-related skills of the learners, including auditory and visual attention, quick reactions, dribbling, and shooting. This means that technology affords a holistic approach to finding solutions that help enhance sports performance. FITLIGHT technologies gave an instant response during the training sessions, and this enabled a specialist to adjust the kind of exercises done, taking into account the level of achievements of the athletes (Silvestri et al., 2023). This technology makes it easier to have training regimes that are unique to the sportsmen and women, right from their requirements and the standards they meet in practice. This aids in the discharge of general individual training programs in line with specifications made based on the result analysis of players' assessments. The study was carried out on basketball players, and therefore it has great potential for its applicability to other sports activities that share many of the features of basketball, football, tennis, and athletics. This underlines the fact that modern technology intervenes in increasing the effectiveness of traditional training by adding an interactive feature that explains the additional, substantial enhancement of learning/performance (Hassan et al., 2023). The results also depicted an improved players' speed and advanced reaction to changes in play situations, categorizing these technologies as pivotal to sports. Therefore, it will be possible for coaches to come up with less perfunctory and more targeted technology-integrated training intervention strategies to enhance general performance at both the individual and group levels. FITLIGHT technologies also provide a reasonable and immediate way to track performance increases, and the training becomes more efficient and based on accurate results rather than estimations. In addition, it is recommended that future research should be conducted among junior and senior players to see the results of the training program between the two groups. Examining the comparative effect of the program between team and individual sports to gauge the efficacy variation. Also, increasing the usage of FITLIGHT technologies or better implementing them with other technologies such as artificial intelligence or virtual reality, to enhance the users' attention and customer experience, and to conduct a deeper exploration of the characteristics of the technological settings in improving the performance (speed of light or frequency of movements).

Study Limitations

Although the current study had positive results and a hierarchical design, it has several limitations that should be identified to present an accurate interpretation of the results and make a generalization. To start with, the sample (n = 40) is of smaller size and is confined to male basketball players of only one geographic area (Al-Ahsa, Saudi Arabia). This limits the possibility to generalize the results to larger groups such as female athletes or athletes or players of a different competitive level. Second, the duration of the intervention was 10 weeks, which might not be considered enough to evaluate long-term training adaptations or long-term retention of cognitive-motor performance enhancements. The future research involving longer follow-up durations should be considered to assess how the skills can be remembered and whether the physiological changes, including histological and morphological ones, remain overtime. Third, the test that used FITLIGHT-based plyogility method in its program achieved very fulfilling results in terms of attention level, agility, and skill performance; however, the individual variations in baseline-readiness, previous experience, as well as acquisition speeds could have interfered. Fourth, biomechanical or neuromuscular measurements, e.g., EMG activity patterns or kinematics, were not done, which might have given further insight into the underlying mechanisms behind changes in performance as a result of light-reactive training. Lastly, certain factors like nutrition, sleep quality, and psychological stress, which may influence physical and cognitive performance, were not observed in the course of the study. Such extraneous factors might have affected the behaviors of participants in the training program. These constraints also indicate that future studies should embrace bigger and heterogeneous sample sizes; prolonged length of intervention; and extensive observation of physiology, biomechanics, and lifestyle-related parameters.

Conclusions

The findings of this study confirmed the benefits of employing a CrossFit training program for eight weeks in terms of enhancing body composition (BMI, BFP, FM, BFI, and FFM) and muscle strength (VJ, MBQJ, and P), physiological adaptations (VO2 max and MK), and basketball players' rebounding and footwork skills, mainly because the training methodology incorporates the use of modern tools (weights, plyometrics, TRX, kettle bells, and battle ropes). Consequently, this research confirmed the effectiveness of CrossFit training in improving all the measured variables and, more importantly, skill performance. Therefore, training programs should consist of CrossFit training because it promotes the unique improvements that the players need. Accordingly, it is suggested that these exercises be continued as part of the training program to obtain improved outcomes and to train physical abilities in a comprehensive way; it is also necessary to include these exercises in the training programs of national teams.

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