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Correlation between tactical performance and physical fitness in basketball during Physical Education classes using a multivariate training programme

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ABSTRACT

Multivariate training programmes are widely recognised as an effective strategy for developing the skills necessary for good performance in the collective modalities addressed in physical education. The aim of this study was to verify the correlation between tactical performance and physical fitness levels in young secondary school students during the teaching of the didactic unit of basketball using a multivariate training programme. A group of forty-seven students from a Portuguese school volunteered to participate in the study. A correlational study was used to verify the association between tactical performance and physical fitness while teaching the Basketball Didactic Unit based on TGFU (i.e., 6 weeks) in two different moments. All subjects were randomly divided into two groups (control and experimental) and assessed at two different moments: before the teaching of the didactic unit (pre-test) and at the end of the teaching of the didactic unit (post-test). Tactical performance in basketball was assessed using the Game Performance Assessment Instrument (GPAI), while physical fitness was assessed using some physical tests from the FitEscola battery. Overall, the multivariate training programme did not differentiate the magnitudes of the correlations between the variables analysed. However, it is confirmed that the multivariate training programme seems to emerge as a positive and differentiating pedagogical strategy that should be integrated into physical education classes.

KEYWORDS: multivariate training program; physical education; pedagogy; didactic unit; physical fitness; tactical performance.

INTRODUCTION

Today, physical education (PE) plays an extremely important role in promoting the health of the world's population. A sedentary lifestyle is a global problem that can contribute to the development of numerous physical and psychological pathologies (Branquinho, Forte, & Ferraz, 2022; Raudsepp & Kais, 2019). Therefore, participation and positive experiences during childhood through PE, sports clubs or non-organized physical activities are crucial for developing healthy habits that can persist into adulthood and combat this scourge (Chen, Hammond-Bennett, Hypnar, & Mason, 2018; Li & Moosbrugger, 2021). PE can also contribute to the development of the student's personality, social involvement, and various skills (i.e., teamwork, self-motivation, communication skills, responsibility, leadership, patience, courage, creativity, critical spirit and moral thinking, self-confidence, self-knowledge, self-discipline) (Ho et al., 2017).

The primary goals of PE are to improve the strength and overall well-being of the students as well as to provide the acquisition of relevant knowledge, physical activity experience,

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athletic competence and interpersonal social skills. These courses have a significant impact on students' engagement in physical activity and lifelong habits, especially after graduation (Hortigüela Alcalá, & Hernando Garijo, 2017; Huang, 2017; Kao & Luo, 2020; Luo, 2019; Moreno, González-Cutre, Martín-Albo, & Cervelló, 2010). In addition, as explained by Metzler and Colquitt (2021), numerous factors, including instructional objectives, curriculum organisation, and the pedagogical framework chosen, have a significant impact on students' acquisition of knowledge in the area of PE.

According to Scarpa and Nart (2012), the level of enjoyment students derive from physical activity plays a critical role in whether they begin or continue such activity. Team-based sports offer students the opportunity to learn in a motivating way. Evidence suggests that team-based physical education (i.e., handball, volleyball, football, and basketball) is one of the most beneficial strategies for increasing physical activity levels in the classroom (Brusseau & Kulinna, 2015; Harvey & García-López, 2017), largely due to students' motivation for the task (Ferraz, Silva, Marinho, Neiva, & Branquinho, 2021; Tendinha et al., 2021). These games are based on fundamental principles such as positive interdependence, individual skills, social skills related to face-to-face interaction, and group reflection (Johnson & Johnson, 1994), where each member of the group is expected to contribute and strive for the goal. Working with diverse team members is considered an essential skill in today's society (Lee, Kim, & Byun, 2017). These benefits include increased motivation to learn (Ning & Hornby, 2014), improved motor skills (Johnson & Johnson, 2002), improved learning outcomes (Adu & Galloway, 2015), development of creativity (Gossett & Fischer, 2005), critical thinking skills (Lin & Jou, 2013), refinement of social skills (Arisoy & Tarim, 2013), and promotion of problem-solving skills (Gorucu, 2016).

In addition, recent research has reported that physical activity can stimulate mental abilities, such as effectiveness and efficiency of decision-making processes, ease of problem solving, innovative thinking and memory retention capacity (Metzler & Colquitt, 2021; Mitsea, Drigas, & Skianis, 2022; Tomporowski, McCullick, & Pesce, 2015). This trend has been reported in previous research, which concluded that children generally respond more quickly and accurately to a variety of cognitive tasks after participating in a physical education class (Ellemberg & St-Louis-Deschênes, 2010; Hillman et al., 2009; Pesce, Crova, Cereatti, Casella, & Bellucci, 2009).

For a competent learning process, the literature regularly presents new methodological teaching approaches, such as the Teaching Games for Understanding (TGFU), introduced by Bunker and Thorpe in 1982. This methodology provides an instructional model for teaching team games in the realm of PE. The game plays a central role, with lessons beginning and ending with a mini-game and technical skills practised in between (Thorpe, 1990). This is modified according to the objectives of the lesson and the age and ability of the students while effectively maintaining student engagement (Kirk & MacPhail, 2002). The implementation of TGFU has been shown to effectively promote students' cognitive and psychomotor development (Allison & Thorpe, 1997; Gray & Sproule, 2011; Turner & Martinek, 1999), as well as their emotional growth (Chatzopoulos, Drakou, Kotzamanidou, & Tsorbatzoudis, 2006; Chen & Light, 2006; Jones, Marshall, & Peters, 2010; Mandigo, Holt, Anderson, & Sheppard, 2008). They also emphasised that the programme's structured teaching leads to higher levels of student motivation, enjoyment, and learning.

In terms of curriculum, the teaching of team sports (e.g., basketball) aims to enable students to perform a combination of actions that allow the development of specific skills (i.e., physical, tactical, and technical) (Góis, Gouveia, Sarmento, Peralta, & Marques, 2020). Skills can be essentially perceptual (i.e., tactical understanding), motor (i.e., physical fitness), or a combination of both, while the technique is characterised by the effective and efficient execution of specific movements required by the sport (e.g., running, throwing) (Gudmundsson & Horton, 2017). It is important to note that any physical or technical action always has an underlying tactical intent (Griffin, Mitchell, & Oslin, 1997), which emphasises the importance of the tactical component in learning and reinforces the need to consider it in the teaching process.

To this end, multivariate training programmes are widely recognised as an effective strategy for developing the skills necessary for good performance in the collective modalities addressed in physical education (Biddle & Mutrie, 2007; Silva et al., 2022). These programmes are designed to improve technical and tactical skills in team games that are an integral part of the PE curriculum (Capel, 2013; Sproule et al., 2011). Success in team games, such as basketball, is closely related to a student's level of physical fitness and proficiency in technical and tactical aspects (Gabbett, Jenkins, & Abernethy, 2009). Therefore, the teaching of team games should be designed to recognise this relationship (Mancha-Triguero, Reina, García-Rubio, & Ibáñez, 2021).

In addition, an individual's level of physical fitness (i.e., speed, strength, agility, coordination) appears to significantly influence the effectiveness of technical and tactical actions in volleyball (Boichuk et al., 2020), Frisbee (Portillo, Bravo-Sánchez, Abián, Dorado-Suárez, & Abián-Vicén, 2022) and handball (Cetin & Ozdol, 2012; Śliż et al., 2022). In contrast,

a study that examined a different modality (i.e., football) concluded that physical fitness did not affect tactical understanding and technical skills (Borges et al., 2017). To date, there appears to be no consensus regarding the effect of physical fitness level on tactical behaviour during participation in team games. In addition, as far as is known, no research has been conducted on the potential relationship between physical activity level and tactical performance in basketball, particularly in the context of physical education, where the learning context is promoted. This is due to the fact that the typology of exercises most commonly used in teaching the modality generally involves problems with infinite solutions, making it difficult for students to find the best option (i.e., tactical behaviour), and their physical fitness can be beneficial to the learning process.

Therefore, the aim of this study was to verify the correlation between tactical performance and physical fitness levels in young secondary school students during the teaching of the didactic unit of basketball, using a multivariate training programme.

METHODS

Participants

A group of forty-seven students from a Portuguese school volunteered to participate in the study. Due to their age, all guardians were formally informed of the study, both verbally and in writing, and signed an informed consent form authorising the voluntary participation of their children. Inclusion criteria for the study were: 1) being healthy; 2) having no injuries; 3) participating regularly in physical education classes. There were no exclusion criteria. To participate in the study, students had to be healthy and participate in physical education classes, and there were no exclusion criteria. The G*Power 3.1 software (Kang, 2021) was used to calculate the sample. An a priori analysis was performed, and it was determined that 47 subjects would be needed for the study (effect size dz= 0,40, error probability α= 0,05, power= 0,90). The students and the teacher were informed of the known health risks before the study began and that they could withdraw from the study at any time, even after it began. All procedures were conducted in accordance with the recommendations of the Declaration of Helsinki for research involving human subjects.

Procedures

This research used a correlational design to verify the existence of correlations between tactical performance and physical fitness during the teaching of the Basketball Didactic Unit based on TGFU (i.e., 6 weeks) in two different moments. All subjects were randomly divided into two groups (control and experimental) and assessed at two different moments: before the teaching of the didactic unit (pre-test) and at the end of the teaching of the didactic unit (post-test). Tactical performance in basketball was assessed using the Game Performance Assessment Instrument (GPAI), while physical fitness was assessed using some tests from the FitEscola battery (i.e., sit-ups, push-ups, horizontal impulse, shuttle test, 40m sprint and agility). All students had the same educational opportunities, but the intervention group also used a multivariate training programme at the beginning of the physical education class instead of the traditional warm-up. This research used a correlational design to verify the existence of correlations between tactical performance and physical fitness during the teaching of the Basketball Didactic Unit based on the TGFU (i.e., 6 weeks) at two different times. All subjects were randomly divided into two groups (control and experimental) and evaluated at two different times: before teaching the didactic unit (pre-test) and at the end of teaching the didactic unit (post-test). Tactical performance in basketball was assessed using the Game Performance Assessment Instrument (GPAI), while physical fitness was assessed using some tests from the FitEscola battery (i.e., sit-ups, push-ups, horizontal jump, shuttle test, 40 m sprint and agility). All students had the same educational opportunities, but the intervention group also used a multivariate training program and small-sided basketball games (SSGs) at the beginning of physical education class instead of the traditional warm-up. The multivariate training program was designed based on adaptations to previous protocols (Branquinho et al., 2020; Ferraz, van den Tillaar, & Marques, 2012). This was applied for 6 weeks (Table 1) and incorporated 4 stations (Figure 1) that contained the following exercises: Station 1 - maximum speed and push-ups; Station 2 - running with changes of direction, horizontal impulse and the squat jump; Station 3 - sprint and Russian twist; Station 4 - jump and plank shoulder taps. In addition, the students also performed 3 vs 3 SSGs in midfield, without teacher intervention, considering the learning acquired from the didactic unit.

Instruments

Tactical performance

The GPAI (Oslin, Mitchell, & Griffin, 1998) was used to assess the students' tactical performance in the two moments analysed (i.e., pre-test and post-test). Students were instructed to perform 3 vs. 3 formats, which were filmed with a common

Table 1. Multivariate training program.

	S	R	PUSH-UP	Change of Direction	Horizontal Impulse	SQUAT JUMP	Sprint	RUSSIAN TWIST	JUMP	Plank Shoulder Taps	Max. Sprint 4X10m
Week 1	S1	2	4 x 10	4 x 8	4 x 4	4 x 10	4 x 1	4 x 20	4 x 5	4 x 20	4 x 1
Week 2	S2	2	4 x 10	4 x 8	4 x 4	4 x 10	4 x 1	4 x 20	4 x 5	4 x 20	4 x 1
	S3	2	4 x 10	4 x 8	4 x 4	4 x 10	4 x 1	4 x 20	4 x 5	4 x 20	4 x 1
Week 3	S4	2	4 x 10	4 x 8	4 x 4	4 x 10	4 x 1	4 x 20	4 x 5	4 x 20	4 x 1
	S5	3	6 x 10	6 x 8	6 x 4	6 x 10	6 x 1	6 x 20	6 x 5	6 x 20	6 x 1
Week 4	S6	3	6 x 10	6 x 8	6 x 4	6 x 10	6 x 1	6 x 20	6 x 5	6 x 20	6 x 1
	S7	3	6 x 10	6 x 8	6 x 4	6 x 10	6 x 1	6 x 20	6 x 5	6 x 20	6 x 1
Week 5	S8	3	6 x 10	6 x 8	6 x 4	6 x 10	6 x 1	6 x 20	6 x 5	6 x 20	6 x 1
	S9	4	8 x 10	8 x 8	8 x 4	8 x 10	8 x 1	8 x 20	8 x 5	8 x 20	8 x 1
Week 6	S10	4	8 x 10	8 x 8	8 x 4	8 x 10	8 x 1	8 x 20	8 x 5	8 x 20	8 x 1
	S11	4	8 x 10	8 x 8	8 x 4	8 x 10	8 x 1	8 x 20	8 x 5	8 x 20	8 x 1

R: Repetition; S: Session.

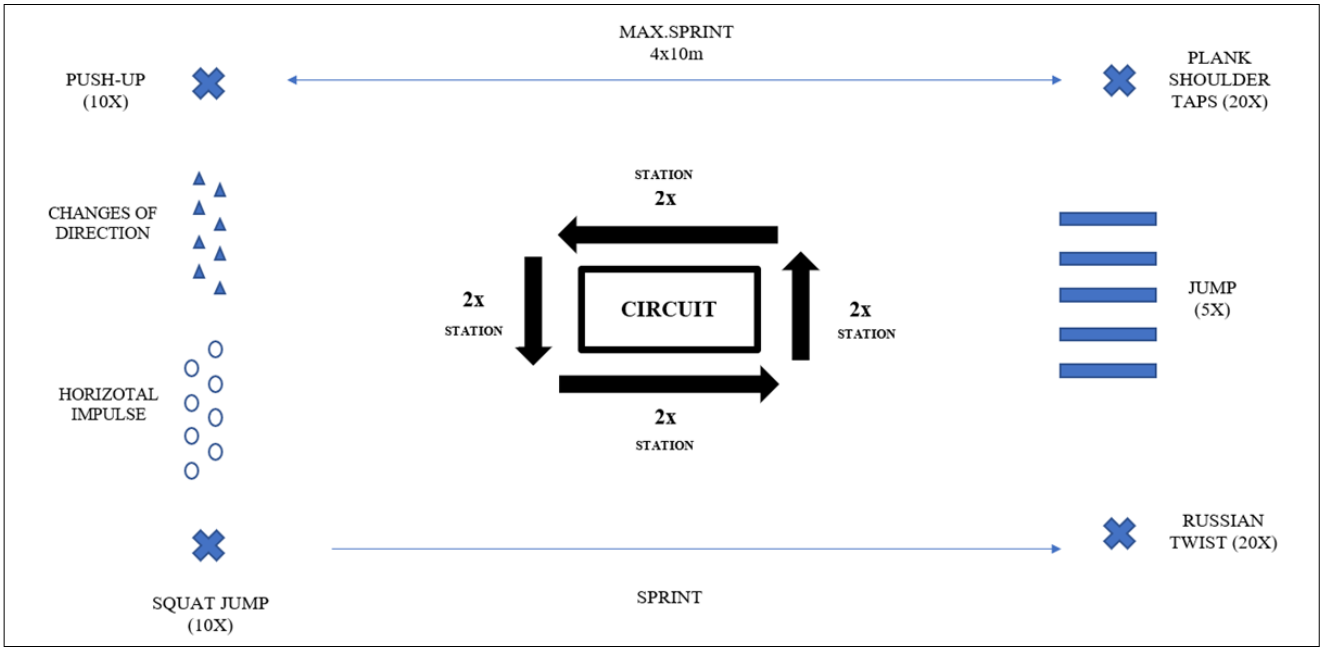


Figure 1. Graphic representation of the multivariate training program.

video camera and later analysed by two experts. The experts were selected based on the following criteria: i) at least 10 years of professional experience in the modality; ii) current experience as a high-performance basketball coach; iii) at least a Master's degree with scientific research in the modality. The GPAI record sheet was used by all experts during the assessment. To validate the observations made, coders were required to achieve interobserver agreement greater than 80% using Kendall's W coefficient of agreement (Oslin et al., 1998). The experts coded and calculated measures of appropriate and inappropriate actions in four game components: decision-making, skill execution, support actions, saving/marking based on an adaptation of a previously defined and validated protocol (Oslin et al., 1998) (Table 2). These four game components were selected as being the most important for assessing general and non-specific game skills in young people.

Physical fitness

The FITescola test battery was used to assess physical fitness. The tests used are described in detail below.

Table 2. Definition of appropriate and inappropriate actions for applying the GPAI.

Components of game	Assumption	AA	IA
Decision-Making	At reception, he fits in with the basket in a basic offensive posture.	Fulfils the assumption	Does not meet the assumption
	Shoots when he is within range of the basket and the defender is not pressing him.		
	Passes when he has an unmarked teammate in a more offensive position.		
	If he has none of the above options, he dribbles away from the defender.		
Skill Execution	Throwing: Throwing arm extension, wrist flexion.		
	Passing: Passing to a teammate; the ball reaches the teammate in good condition.		
	Dribbling: Does not look at the ball; does not "carry" the ball.		
Support Actions	Attempts to create passing lines.		
	Does not come within 3m of the person with the ball.		
Saving/marking	When he loses the ball, he takes a basic offensive stance and looks for his immediate opponent.		
	Places himself between his opponent and the basket.		

AA: Appropriate action; IA: Inappropriate action.

Sit-ups

The sit-up test consists of performing the maximum number of sit-ups at a predetermined cadence (Henriques-Neto, Minderico, Peralta, Marques, & Sardinha, 2020). The purpose of this test is to evaluate the strength of resistance of the abdominal muscles. This action was repeated at a predetermined cadence of 20 sit-ups per minute. The number of times the participants performed this action correctly was recorded.

Push-ups

The push-up test consists of performing the maximum number of push-ups (arm flexion and forearm extension) at a predetermined cadence (Henriques-Neto et al., 2020). This test aims to evaluate the endurance strength of the upper limbs. This action was repeated at a predetermined cadence of 20 push-ups per minute. The number of times the participants performed this action correctly was recorded.

Horizontal impulse

The horizontal impulse test consists of reaching the maximum distance in a long jump with feet together (Henriques-Neto et al., 2020). The purpose of this test is to evaluate the explosive strength of the lower limbs. A horizontal line is drawn at the starting point, with reference lines every 10 cm. Starting from a standing position, the subject must bend the knees, pull the arms behind him and jump in length as far as possible. Two jumps must be performed. The best result of the two measurements in cm is recorded.

Shuttle Test

The shuttle test consists of performing the maximum number of routes performed over a distance of 20 m at a predetermined cadence through an audio device (Mayorga-Vega, Aguilar-Soto, & Viciana, 2015). The student must remain on the test as long as possible, stopping when he or she fails to reach the line before the sound signal on two occasions, not necessarily consecutive. The first fo ul is counted towards the score.

40 m sprint

The test consists of running a 40-meter race in the shortest possible time according to a previously described protocol (Wang et al., 2016). The purpose of this test is to measure the student's acceleration capacity and speed. Two attempts per student are required. The registered value is the best result of the two evaluations in hundredths.

Agility 4 x 10m

The agility test (4 x 10 m) consists of completing a predetermined route, combining the maximum speed of execution with the coordination translated into the movement of grasping, carrying and placing a sponge in a predetermined place (Vicente-Rodríguez et al., 2011). In order to evaluate the student's agility, the test aims to characterise the acceleration capacity, the coordination of the required movements and their speed of execution. Two tests must be performed, and the value recorded is the best result of the two evaluations, expressed in hundredths.

Statistical analysis

Descriptive statistics are presented as mean± one standard deviation (SD) with a 95% confidence interval (CI). Kolmogorov-Smirnov and Levene tests were used to

determine the normality and homogeneity of data distribution. The Pearson correlation coefficient was calculated to analyse the relationship between the variables analysed within each group and between groups. Effect sizes (ES) were calculated based on Cohen's d and were classified as follows: 0.2-0.6 (trivial); 0.6-1.2 (small); 1.2 (large); and greater than 2.0 (very large) (Hopkins, 2019; Hopkins, Marshall, Batterham, & Hanin, 2009). Statistical significance was set at $p< 0.05$. Statistical analyses were performed using SPSS for Windows version 26.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

Pearson parametric correlations between the GPAI indexes and the physical fitness measures in the control group (CG).

Figure 2 shows the Pearson parametric correlations between the GPAI indexes and the physical fitness measures in the CG for the pre-intervention moment (Figure 2A), the post-intervention moment (Figure 2B) and both intervention moments (Figure 2C). The Pearson correlation matrix showed trivial to very high correlations for the pre-intervention moment ($r= -0.74$ to 0.92; $p< 0.05$ to $p< 0.001$), the post-intervention moment ($r= -0.84$ to 0.84; $p< 0.05$ to $p< 0.001$) and both intervention moments ($r= -0.55$ to 0.89; $p< 0.05$ to $p< 0.001$).

Pearson parametric correlations between the GPAI indexes and the physical fitness in the intervention group (IG).

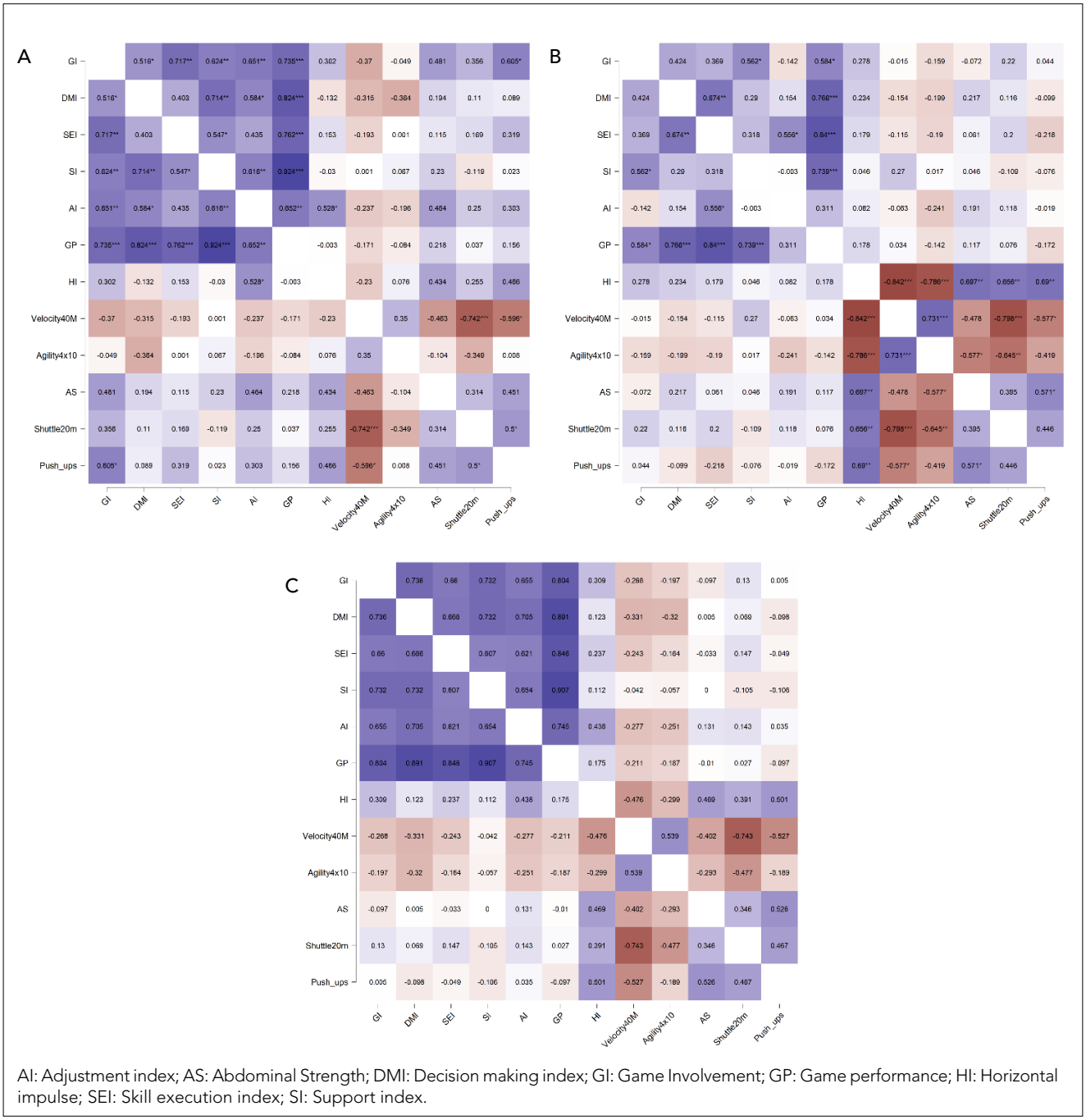
Figure 3 shows the Pearson parametric correlations between the GPAI indexes and the physical fitness measures in the IG for the pre-intervention moment (Figure 3A), the post-intervention moment (Figure 3B) and both intervention moments (Figure 3C). The Pearson correlation matrix showed trivial to very high correlations for the pre-intervention moment ($r= -0.86$ to 0.92; $p< 0.05$ to $p< 0.001$), the post-intervention moment ($r= -0.86$ to 0.89; $p< 0.05$ to $p< 0.001$) and both intervention moments ($r= -0.55$ to 0.89; $p< 0.05$ to $p< 0.001$).

DISCUSSION

The aim of this study was to verify the correlation between tactical performance and physical fitness levels in young secondary school students during a basketball didactic unit using a multivariate training programme. Overall, there did not appear to be any significant differences between the groups in terms of the implementation or absence of the multivariate training programme. However, tactical components and physical fitness were positively associated with optimising game performance. The results show positive correlations between improved decision-making, support actions, and overall match performance in both groups. A balanced pedagogical approach that considers both aspects could lead to improved performance.

Overall, and for both groups, there appear to be no differences in a differentiated analysis, regardless of whether the multivariate training programme was used or not. According to the results obtained, the application of the multivariate training programme during the didactic unit based on the TGfU does not seem to increase the degree of association between the variables of physical fitness and tactical performance. Therefore, the multivariate training programme did not differentiate the magnitudes of the correlations between the variables analysed. However, it is confirmed that the multivariate training programme seems to emerge as a positive and differentiating pedagogical strategy that should be integrated into physical education classes (Silva et al., 2022).

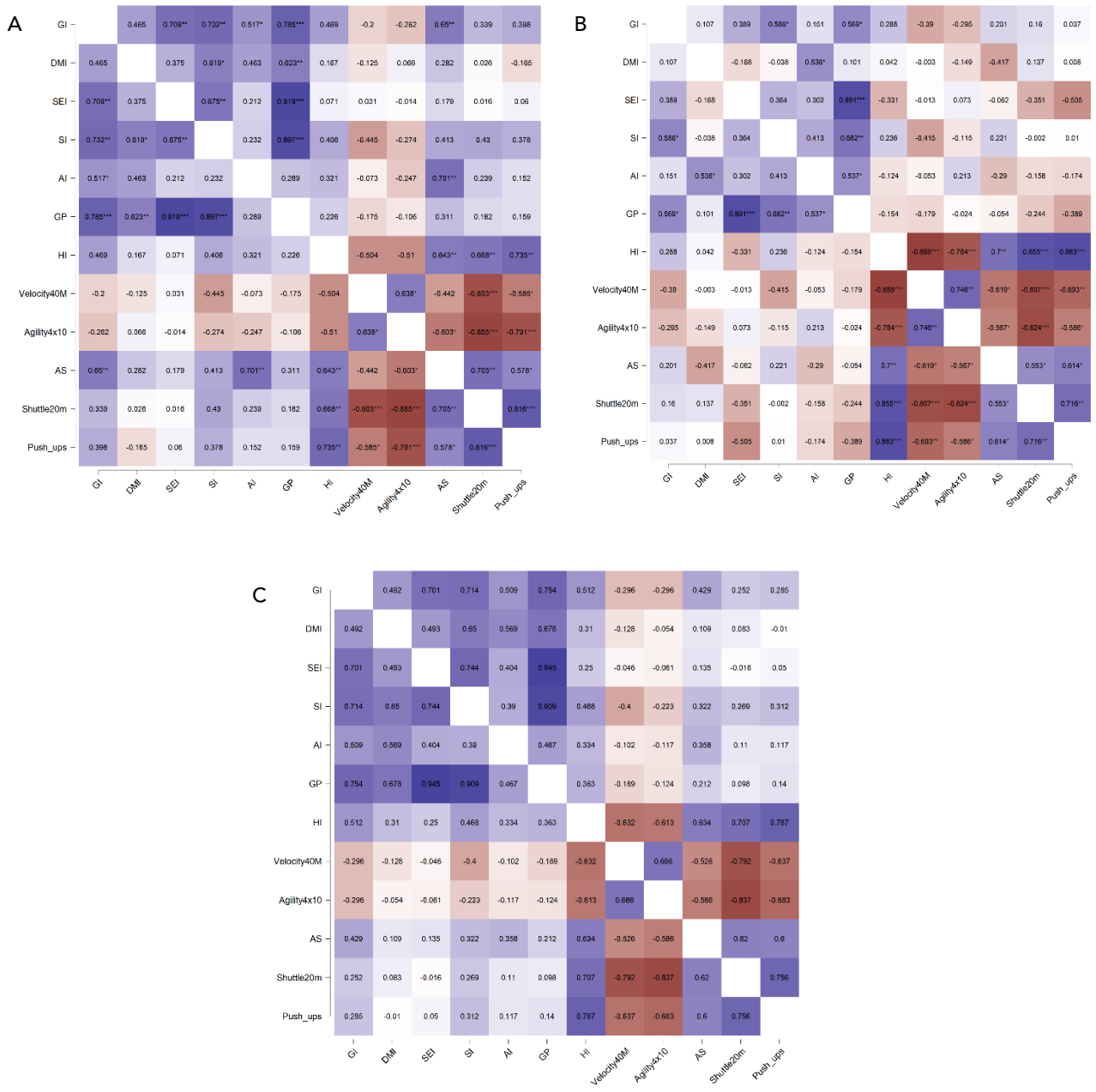
The results observed in both groups (overall graph) show an interesting relationship between speed, agility, and all tactical performance variables. A strong correlation between speed and agility suggests a link between these physical attributes. Increasing one tends to increase the other. This finding highlights the complementary nature of speed and agility in athletic performance. According to Coburn and Malek (2012) and Köklü, Alemdaroğlu, Özkan, Koz, & Ersöz (2015), these phenomena can be explained by the fact that both abilities require the use of explosive power and fast twitch muscle fibres. However, there is a curious, strong negative correlation between tactical performance and speed/agility. This relationship may imply a trade-off between physical fitness and tactical performance, where a focus on improving tactical performance may sacrifice speed and agility and vice versa. These findings confirm that although speed and agility are two important skills for game performance in basketball (Gudmundsson & Horton, 2016), players with higher speed and agility are less able to respond to the tactical needs of the game due to greater irregularity in their collective behaviour, which tends to lead to greater collective disorganisation (Ferraz et al., 2021). Ferraz et al. (2018), in a study of small-sided games in football, showed that higher game speeds may have affected the stability of players' interpersonal distances. It seems, therefore, that fast games require a faster ability to identify this information, which can influence the players' positional behaviour. Therefore, in the context of teaching a didactic unit of physical education in a school context and trying to improve performance in the game, these physical components can be used with some caution.



AI: Adjustment index; AS: Abdominal Strength; DMI: Decision making index; GI: Game Involvement; GP: Game performance; HI: Horizontal impulse; SEI: Skill execution index; SI: Support index.

Figure 2. Pearson parametric correlations between the GPAI indexes and the physical fitness measures in the control group (CG) according to: (A) pre-intervention moment, (B) post-intervention moments; (B) overall population (Pre- vs post-intervention moments). Correlation is significant at: ***$p < 0.001$; ** $p < 0.01$, * $p < 0.05$. The correlation magnitude was classified as: trivial if $r \leq 0.1$, small if $r = 0.1$-0.3, moderate if $r = 0.3$-0.5, large if $r = 0.5$-0.7, and very large if $r = 0.7$-0.9 and almost perfect if $r \geq 0.9$.

The analysis also revealed an interesting relationship between push-ups and abdominal strength (AS). Improved push-up performance was associated with an increase in abdominal muscle strength, suggesting a possible interaction between fitness measures and horizontal force generation. However, these physical fitness variables do not have a significant relationship with tactical variables. Previous research has also shown no clear correlation between fitness levels and performance in small-sided games (Sabarit et al., 2020). However, it can be inferred that the below-average performance observed in the technical and tactical aspects of the game has implications for physical



AI: Adjustment index; AS: Abdominal Strength; DMI: Decision making index; GI: Game Involvement; GP: Game performance; HI: Horizontal impulse; SEI: Skill execution index; SI: Support index.

Figure 3. Pearson parametric correlations between the GPAI indexes and the physical fitness measures in the intervention group (IG) according to: (A) pre-intervention moment, (B) post-intervention moments; (C) overall population (Pre- vs post-intervention moments). Correlation is significant at: ***p< 0.001; **p< 0.01, *p< 0.05. The correlation magnitude was classified as: trivial if r≤ 0.1, small if r= 0.1-0.3, moderate if r= 0.3-0.5, large if r= 0.5-0.7, and very large if r= 0.7-0.9 and almost perfect if r≥ 0.9.

performance, particularly in terms of how players allocate their physical effort in relation to the rhythm and intensity of the game (Smith, Marcora, & Coutts, 2015; Smith et al., 2016). It seems that skill and decision-making deficits can affect how players allocate their energy and effort during the game. The results also showed that push-ups and SEI were strongly associated in the IG after the implementation of the multivariate programme training. These results also highlight the importance of upper limb strength in achieving the goal of the game, especially in this age group (pre-pubertal and

pubertal). In this context, the implementation of a multivariate training programme that emphasises upper limb strength training could be very useful (Silva et al., 2022).

In both groups (pre- and post-tests), it was observed that overall game performance (GP) had a strong positive correlation with decision-making (DMI) and actions of support (SI). This suggests that students who demonstrate improved decision-making skills and provide effective support during the game are more likely to achieve higher overall game performance, which is consistent with the findings of Gabriele and Maxwell (1995) and Griffin, Oslin and Mitchell (1995). As noted by Arias-Estero & Castejón (2014) and Oslin et al. (1998), it can be said that the support index makes a significant contribution to GP, as well as skill execution, adaptability, and game engagement. This study also provides strong evidence to support the hypothesis that improvements in tactical performance variables, particularly SEI, SI, and DMI, lead to significant improvements in overall game performance.

Also, considering that the players in the pre-test have a lower level of physical fitness, it can be deduced that the students are likely to have a higher level of physical fatigue when playing. Physical fatigue affects the players' ability to perform certain movements aimed at blocking passing lines close to the opponent and maintaining defensive stability in lateral areas. Instead, players prioritise actions that are further away from the ball, focusing on reducing the opponent's width or depth and limiting the effective playing space. This behaviour suggests a shift towards increasing marking in sectors further away from the ball, possibly to prioritise key aspects of the game, such as goal protection. Similar tendencies have been observed in studies of individuals performing mentally demanding tasks, where they prioritise essential actions over less important ones (da Costa, da Silva, Greco, & Mesquita, 2009; Sampaio, Lago, Gonçalves, Maçãs, & Leite, 2014; van der Linden, 2011).

There was also a positive correlation between game involvement (GI) and the number of push-ups performed. This positive correlation suggests that physical fitness, particularly upper body strength as indicated by push-up performance, may contribute to increased engagement and active participation in the game. According to Faigenbaum, Lloyd, MacDonald, and Myer (2016), core strength training should be a fundamental component of conditioning programmes at every stage of long-term athlete development. It can help young athletes withstand the rigours of prolonged training and competition. This finding is consistent with the notion that higher levels of physical fitness may have a positive impact on engagement in the game and the ability to execute tactical manoeuvres effectively.

According to the results, the horizontal jump is negatively associated with both speed and agility. Notably, an inverse relationship was observed between push-up performance and agility, demonstrating that as agility decreases, push-up performance tends to increase and vice versa. This suggests that when attempting to improve tactical performance, students should favour weight-based activities such as push-ups over agility-related exercises. The results suggest that improving decision-making abilities, support skills, and upper body strength can have a positive impact on game performance and engagement. From a pedagogical perspective, the ability to make precise decisions in complex game situations under pressure and time constraints is a crucial component of game performance (Höner, Larkin, Leber, & Feichtinger, 2020), and the relationship between the components of physical performance must always be well manipulated.

Another interesting analysis is the post-tests conducted on the control group, which revealed that overall game performance (GP) increased in conjunction with skill execution (SEI), decision-making (DMI), and support actions (SI), showing strong positive correlations. Individuals who excel in SEI, DMI and SI are more likely to achieve superior overall in-game performance, as evidenced by the robust and flawless correlation observed between these metrics. In addition, post-tests in the IG also showed significant improvements in overall game performance (GP), which was strongly associated with increases in skill execution (SEI) and support actions (SI). Improvements in skill execution (SEI), support actions (SI), and overall game performance (GP) are strongly related. This phenomenon can be explained by previous studies that have shown a correlation between players with higher levels of inhibitory control and their superior performance in game-related tactical situations (Albuquerque, dos Santos Gonzaga, Greco, & da Costa, 2019). The ability to accurately understand game scenarios requires players to be able to inhibit impulsive reactions and adapt their actions according to the demands of the game (Huijgen et al., 2015). This could include tasks such as anticipating passing opportunities, identifying numerical advantages in attack, coordinating defensive transitions, and understanding movements into unoccupied areas (Carnevale et al., 2022). Furthermore, decision-making has been identified as an important skill, and numerous cross-sectional studies have examined decision-making performance, consistently demonstrating that it is a differentiating factor between skilled and less skilled players in team sports (Lorains, Ball, & MacMahon, 2013; Woods, Raynor, Bruce, & McDonald, 2016).

CONCLUSION

In summary, this study investigated the relationship between tactical performance and physical fitness levels in young secondary school students during a basketball teaching programme. The results indicated that the implementation of a multivariate training programme did not significantly affect the correlation between physical fitness and tactical ability.

However, it is confirmed that the multivariate training programme seems to emerge as a positive and differentiating pedagogical strategy that should be integrated into physical education classes. Also, it was evident that both tactical components and physical fitness play an important role in optimising match performance. The study also highlighted the importance of multivariate training programmes that integrate tactical skill development and physical fitness enhancement. The results underlined the link between physical fitness and tactical performance, highlighting the need for comprehensive training to optimise game performance. Decision-making skills were identified as crucial, and cooperative actions to support teammates were found to influence effective decision-making and overall game performance. Teachers should consider the results of this study for a differentiated pedagogical implementation to improve students' physical fitness and game performance. In addition, this study suggests that the physical fitness programmes to be implemented need to be properly designed in order to improve tactical performance, but more research is needed in this area.

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