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EFFECTS OF SPEED TRAINING OVER THE AGILITY, QUICKNESS AND ACCELERATION FOR YOUNG BASKETBALL PLAYERS

UČINKI HITROSTNEGA TRENINGA NA GIBČNOST, HITROST IN POSPEŠEK PRI MLADIH KOŠARKARJIH

ABSTRACT

The aim of this study was to identify the effects of speed training over the agility, quickness and acceleration for young basketball players. A total of 26 young basketball players (mean ± SD; age: 15,35 ± 0,49 years) volunteered to participate (speed training group (STG; n = 13) and control group (CG; n = 13). We applied the agility (T test), quickness (5 m speed), and acceleration (10 m and 15 m speed). Our results shown that there is significant differences in pre and post training for agility, quickness, acceleration (10 m) in STG and CG but 15 m acceleration is insignificant in STG. There is insignificant differences in pre and post training acceleration (15 m) in STG and CG. Consequently, the speed training method can be implemented during group sessions in a structured fashion, allowing coaches to optimize the time spent on such physical conditioning activities.

Key words: high-intensity interval training, promptness, speed change, swiftness

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IZVLEČEK

Namen te raziskave je bil ugotoviti učinke hitrostnega treninga na gibčnost, hitrost in pospešek pri mladih košarkarjih. V raziskavi je prostovoljno sodelovalo 26 mladih košarkarjev (povprečje ± st. odklon; starost: 15,35 ± 0,49 let), in sicer v skupini hitrostnega treninga (STG; n = 13) in kontrolni skupini (CG; n = 13). Izvedli smo teste gibčnosti (T-test), hitrosti (hitrost na 5 m) in pospeška (hitrost na 10 m in 5 m). Rezultati so pokazali značilne razlike v vrednostih pred treningom in po njem, in sicer za gibčnost, hitrost in pospešek (10 m) pri STG in CG, vendar pa je pospešek na 15 m pri STG neznačilen. Razlike v vrednostih pospeška (15 m) pred treningom in po njem so neznačilne pri STG in CG. Zato sklepamo, da se lahko metoda hitrostnega treninga izvaja med skupinskimi treningi na strukturiran način, pri čemer lahko trenerji optimizirajo čas, ki ga porabijo za tovrstne aktivnosti za fizično kondicijo.

Ključne besede: visoko intenzivni intervalni trening, hitrost, sprememba hitrosti, urnost

INTRODUCTİON

Many basketball movements that are performed either with the ball or without it (such as short sprints, abrupt stops, fast changes in direction, acceleration, different vertical jumps) have a very explosive character (Erculj, Blas, & Bracic, 2010). Basketball is an intermittent important sport incorporating quick and repeated changes in the movement direction (Apostolidis, Nassis, Bolatoglou, & Geladas, 2004). Quickness is of multiple skills which consist of explosiveness, reactivity and acceleration (Murphy, Lockie, & Coutts, 2003). The importance of developing good conditioning programs based on speed training over the agility, quickness and acceleration endurance of basketball is considered a key factor to success. Basketball requires tremendous endurance, speed, acceleration, agility, power, flexibility, neuromuscular efficiency, muscular strength and speed of each individual player (Siegler, Gaskill, & Ruby, 2003). Training loads have an important effect on an athlete's performance and can be a determinant factor in achieving success (Balčiūnas, Stonkus, Abrantes, & Sampaio, 2006). Basketball practice must have agility, acceleration, and speed exercises with an emphasis on technique, sprint and strength training, and the development of perception and decision making. Agility has a special importance in basketball, because of a great number of atypical game situations that demand multiple rapid change of direction in the relatively small space of the court (Young & Farrow, 2006; Jakovljevic, Karalejic, Pajic, Macura, & Erculj, 2012). In the context of field sport athletes, sprint acceleration is often defined as "sprint performance over smaller distances, such as 5m or 10m (Murphy, Lockie, & Coutts, 2003). Speed is as vital to a athletes as is quickness and agility. The ability to accelerate, decelerate, and change direction efficiently is imperative to successful team sports performance. The ability to accelerate, quickness, and agility are important, and speed drills can enhance this quality (Miller, Hilbert, & Brown, 2001). Quickness encompasses both aspects of speed and agility while incorporating flexibility, strength, and neuromuscular coordination by allowing the athlete to move at a higher rate of speed (Brown, Ferrigno, & Santana, 2000). Acceleration and agility are essential abilities for basketball players. In basketball games, elite basketball players execute a lot of changes in speed and direction and acceleration, emphasizing the importance of these physical characteristics (Chen et al., 2018). Team sports where quickness and acceleration are much more used than maximal speed, training programs that upgrade slow stretch-shortening cycle performance are expected to have more impact on overall success (Jovanovic, Sporis, Omrcen, & Fiorentini, 2011). Generally, youth training requires a specific and different approach to design an implementation of physical preparation which is agility, acceleration, and quickness all can be developed in the young team-sports player (Gamble, 2008). Despite the wide range of methods used to enhance sprint acceleration, typical modalities most often include resistance training, plyometrics, resisted sprinting, and sprint drills (Cronin, & Hansen, 2006; Delecluse, 1997; Martinez-Valencia et al., 2015). Previous study reported that only 5% of stride/sprints performed by the basketball players lasted more than 4 seconds, and therefore it seemed that the highest intensity sprints consisted of quick acceleration and deceleration without developing a full speed (Ziv, & Lidor, 2009). Does the speed training drills of 15 years-old basketball players improve acceleration, agility, and quickness? To answer this question, the aim of this study was to identify the effects of speed training over the agility, quickness and acceleration endurance for basketball players, to help coaches to improve their training and testing athletic performance.

METHODOLOGY

Participants

A total of 26 young basketball players (mean ± SD; age: 15,35 ± 0,49 years; weight: 71,43 ± 11,07 kg; body height: 1,79 ± 0,07 m; sports age: 4,58 ± 1,39 years) volunteered to participate in this study after having all risks explained to them before the investigation. They were divided randomly into 1 of 2 groups: speed training group (STG; n = 13) and control group (CG; n = 13). The mean (SD) age was 15.31 ± 0,48 years, height was 1.79 ± 0,07 m, sports age was 4,77 ± 1,17 years, and weight was 69.88 ± 12.84 kg for the speed training group; the mean (SD) age was 15.38 ± 0.50 years, height was 1.80 ± 0.07 m, sports age was 4.38 ± 1,61 years, and weight was 72.98 ± 9.24 kg for the control group. Following randomization, the 2 groups did not differ significantly ($p>0.05$) in any of the dependent variables. The subjects in the control group did not participate in the speed training and participated only in the regular team training. Prior to data collection, all participants signed a university approved consent form. After receiving a detailed explanation of the study's benefits and risks, all subject signed an informed consent document that was approved by the local ethics committee. None of the subjects reported any medical or orthopedic problems that would compromise his participation and performance in the study.

Procedures

To evaluate the effect of speed training over the agility, quickness and acceleration, we applied a testing procedure that included measurements of the agility, quickness and acceleration. The tests should yield information about the warm-up procedure; about basketball skills; and about power, speed, and endurance. Subjects' height is measured with an instrument sensitive to 1 mm. Their body weight is measured with a weigh-bridge sensitive up to 20 g while they are dressed in only shorts (and no shoes). Height variable is in terms of meters, and body weight variable is in terms of kilograms. The T test was used to evaluate agility of the subjects and the 5 m quickness test was used to evaluate the quickness, and the 10 m and 15 m acceleration test was used to evaluate the acceleration. Each subject was familiarized with the testing procedures prior to data collection. Testing was conducted before and after 8 weeks of speed training. Subjects abstained from physical activity not related to the study during the testing period. Furthermore, during the testing periods and throughout the 8 weeks of speed training subjects were instructed to maintain normal dietary habits. The methodology used during the tests is summarized in the following paragraphs

Agility test

The T-test was used to measure agility in this study because it uses most of the basic movements (such as forward sprinting, left and right shuffling, and backpedaling) performed during a game (Delextrat, & Cohen, 2009). Based on the protocol outlined by Pauole at al., (2000), subjects began with both feet behind the starting line A. At his or her own discretion, each subject sprinted forward to cone B and touch the base of it with the right hand. Facing forward and without crossing feet, they shuffled to the left to cone C and touch its base with the left hand. Subjects then shuffled to the right to cone D and touch its base with the right hand. They shuffled back to the left to cone B and touch its base. Finally, subjects ran backward as quickly as possible and return to line A. Any subject who crossed one foot in front of the other, failed to touch the base of the cone, and/or failed to face forward throughout had to repeat the test. The recorded score for this test was the better of the two last trials and times were recorded to the nearest one-hundredth of a second using an electronic timing system (Brower Timing Systems; accuracy of 0.01 second) placed 0.4 m above the ground.

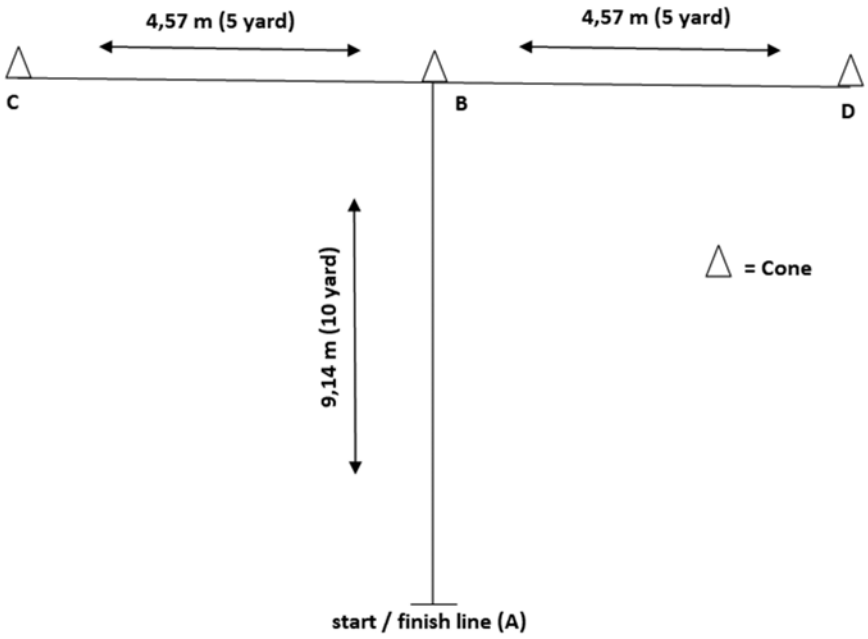

Figure 1. T - Test for Agility

Figure 1. T – test for Agility

Acceleration test

Photocells were placed at the start, 5 m (quickness), 10 m (acceleration), and 15 m (acceleration) in order to collect sprint times over the 3 distances. The starting position was standardized for all subjects. Athletes started in a 2- point crouched position with the left toe approximately 30 cm back from the starting line and the right toe approximately in line with the heel of the left foot. All subjects wore rubber-soled track shoes. Therefore, Quickness was evaluated using a 5-m test. Acceleration was evaluated using a 10-m and 15-m test. Test was applied three times, with a 3-minute interval, and the best result was recorded for statistical analysis (Bloomfield, Polman, O'donoghue, & Mcnaughton, 2007).

Statistical Analysis

The SPSS statistical program (version 13.0) was used for data analysis. Standard statistical methods were used for the calculation of means and SD. The Kolmogorov-Smirnov test was used to determine if dependent variables were normally distributed. The Levene test was used to determine if there was homogeneity of variance. Paired t-tests were used to determine significant differences over time for each dependent variable. Unpaired t-tests were used to compare the speed training and control groups. A 2-way, random model intraclass correlation coefficient (ICC) was used to determine test-retest reliability of the agility and the acceleration. The observed power and effect size for the agility and the acceleration was 0.94 and 0.73 and 0.98 and 0.87, respectively. For all analyses, the criterion for significance was set at an alpha level of $p = 0.05$.

Overview of Speed Training

Table 1. A speed training program was applied to the subjects 3 days a week (Monday, Wednesday, and Friday) for 8 weeks.

WEEKS	Monday	Wednesday	Friday
First Week	6 x 30m 80% Distance for sense of acceleration	6 x 30m 90% Distance for sense of acceleration	6 x 40m 80% Distance for sense of acceleration 6 x five steps standing 4 x five steps standing
Second Week	6 x 40m 80% Distance for sense of acceleration	6 x 40m 90% Distance for sense of acceleration 2x40 m 80% Distance for capacity to accelerate 6 x triple jump standing 4 x five steps standing	4 x 50m 80% Distance for sense of acceleration 4 x 40m 100% Distance for capacity to accelerate 6 x triple jump standing 4 x five steps standing
Third Week	4 x 50m 80% Distance for sense of acceleration 4 x 35m 100% Distance for capacity to accelerate 6 x five steps standing 4 x five steps standing	4 x 50m 90% Distance for sense of acceleration 4 x 35m 100% Distance for capacity to accelerate 6 x five steps standing 4 x five steps standing	6 x 30m 100% Distance for capacity to accelerate 6 x five steps standing 4 x five steps standing
Fourth Week	4 x 50m 80% Distance for sense of acceleration 4 x 30m 100% Distance for capacity to accelerate 6 x five steps standing 4 x five steps standing	4 x 50m 90% Distance for sense of acceleration 4 x 25m 100% Distance for capacity to accelerate 6 x five steps standing 4 x five steps standing	4 x 25m 100% Distance for capacity to accelerate 6 x five steps standing 4 x five steps standing
Fifth Week	4 x 60m 80% Distance for sense of acceleration 4 x 20m +10m Distance for maximum speed 6 x five steps standing 4 x five steps standing	3 x 60m 80% Distance for sense of acceleration 3 x 20m 100% Distance for capacity to accelerate 3 x 20m +10m Distance for maximum speed 6 x five steps standing 4 x five steps standing	4 x 20m 100% Distance for capacity to accelerate 4 x 20m +10m Distance for maximum speed 6 x five steps standing 4 x five steps standing
Sixth Week	4 x 60m 90% Distance for sense of acceleration 4 x 20m +15m Distance for maximum speed	4 x 15m 100% Distance for capacity to accelerate 4 x 20m +15m Distance for maximum speed	4 x 15m 100% Distance for capacity to accelerate 4 x 20m +15m Distance for maximum speed
Seventh Week	4 x 60m 90% Distance for sense of acceleration 4 x 30m +20m Distance for maximum speed	4 x 10m 100% Distance for capacity to accelerate 4 x 30m +20m Distance for maximum speed 6 x five steps standing 4 x five steps standing	4 x 10m 100% Distance for capacity to accelerate 4 x 30m +20m Distance for maximum speed
Eighth Week	4 x 60m 90% Distance for sense of acceleration 4 x 30m +20m Distance for maximum speed	4 x 10m 100% Distance for capacity to accelerate 4 x 30m +20m Distance for maximum speed 6 x five steps standing 4 x five steps standing	4 x 120m 100% Distance for capacity to accelerate 4 x 30m +20m Distance for maximum speed

RESULTS

Table 2. Data summary for the speed training group and control group.

Variables	Speed training group (n = 13)	Control group (n = 13)
	Mean±SD	Mean±SD
Age (year)	15,31 ± 0,48	15,38 ± 0,50
Height (m)	1,79 ± 0,07	1,80 ± 0,07
Weight (kg	69.88 ± 12.84	72.98 ± 9.24
Sports age (year)	4,77 ± 1,17	4,38 ± 1,61

As shown Table 2. The mean (SD) age was 15.31 ± 0,48 years, height was 1.79 ± 0,07 m, sports age was 4,77 ± 1,17 years, and weight was 69.88 ± 12.84 kg for the speed training group; the mean (SD) age was 15.38 ± 0.50 years, height was 1.80 ± 0.07 m, sports age was 4.38 ± 1,61 years, and weight was 72.98 ± 9.24 kg for the control group.

Table 3. Comparison of speed training group and control groups with respect to the pretraining and posttraining.

		Pretraining			Posttraining		
Variables	Groups	Mean±SD	T	P	Mean±SD	T	P
Agility (sn)	Speed training group	9,57 ± 0,35	1,150	0,261	9,45 ± 0,36	1,375	0,182
	control group	9,70 ± 0,23			9,61 ± 0,24		
Quickness (sn)	Speed training group	1,17 ± 0,08	0,213	0,833	1,10 ± 0,05	2,675	0,013*
	Control group	1,17 ± 0,06			1,14 ± 0,03		
Acceleration for 10 m (sn)	Speed training group	1,97 ± 0,09	0,233	0,818	1,88 ± 0,08	2,131	0,044*
	Control group	1,98 ± 0,10			1,95 ± 0,08		
Acceleration for 15 m (sn)	Speed training group	2,70 ± 0,10	0,315	0,756	2,62 ± 0,10	1,521	0,141
	Control group	2,71 ± 0,15			2,68 ± 0,13		

*P<0,05

In pre training as shown in table 3, the mean (SD) agility is 9,57±0,35 (s), quickness for 5 m is 1,17±0,08 (s), acceleration for 10 m is 1,97±0,09 (s), acceleration for 15 m is 2,70±0,10 (s) for the speed training group; the mean (SD) agility is 9,70±0,23 (s), quickness for 5 m is 1,17±0,06 (s), acceleration for 10 m is 1,98±0,10 (s), acceleration for 15 m is 2,71±0,15 (s) for the control group. In post training, the mean (SD) agility is 9,45±0,36 (s), quickness for 5 m is 1,10±0,05 (s), acceleration for 10 m is 1,88±0,08 (s), acceleration for 15 m is 2,62±0,10 (s) for the speed training group; the mean (SD) agility is 9,61±0,24 (s), quickness for 5 m is 1,14±0,03 (s), acceleration for 10 m is 1,95±0,08 (s), acceleration for 15 m is 2,68±0,13 (s) for the control group. There no was a significant (p>0.05) difference in pretraining between speed training group and control group for agility, quickness, 10 m acceleration, and 15 m acceleration. Also, there no was a significant (p>0.05) difference in posttraining between speed training group and control group for agility and 15 m acceleration. On the other hand, There was a significant (p>0.05) difference in post-training between speed training group and control group for quickness and 10 m acceleration.

Table 4. Comparison of the pretraining and posttraining with respect to speed training group and control groups.

Groups	Variables	Pretraining	Posttraining	T	P
		Mean±SD	Mean±SD		
Speed training group	Agility (sn)	9,57 ± 0,35	9,45 ± 0,10	3,398	0,005*
	Quickness (sn)	1,17 ± 0,08	1,10 ± 0,05	4,351	0,001*
	Acceleration for 10 m (sn)	1,97 ± 0,09	1,88 ± 0,08	6,883	0,000*
	Acceleration for 15 m (sn)	2,70 ± 0,10	2,62 ± 0,10	4,308	0,001*
Control group	Agility (sn)	9,70 ± 0,23	9,61 ± 0,24	3,803	0,003*
	Quickness (sn)	1,17 ± 0,06	1,14 ± 0,03	2,597	0,023*
	Acceleration for 10 m (sn)	1,98 ± 0,10	1,95 ± 0,08	2,762	0,017*
	Acceleration for 15 m (sn)	2,71 ± 0,15	2,68 ± 0,13	1,938	0,077

*P<0,05

As shown in table 4, paired t-tests detected significant differences in pre and post training for agility, quickness, acceleration for 10 m, and acceleration for 15 m in speed training group ($p<0.05$). Also, there was a significant differences in pre and post training for agility, quickness, and acceleration for 10 m, in control group ($p<0.05$). On the other hand, there no was a significant differences in pre and post training for acceleration for 15 m in control group ($p>0.05$).

DİSCUSSİON

The main purpose of this study was to identify the effects of speed training over the agility, quickness and acceleration endurance for basketball players. Our results shown that there was a significant difference in posttraining between speed training group and control group for quickness and 10 m acceleration. There is significant differences in pre and post training for agility, quickness, acceleration for 10 m, and acceleration for 15 m in speed training group. Also, there was a significant differences in pre and post training for agility, quickness, and acceleration for 10 m, in control group. On the other hand, there no was a significant differences in pre and post training for acceleration for acceleration for 15 m in control group.

Agility should be superior to speed, quickness and coordination abilities. In the past, this term used to be understood as the ability to change direction, or to start and stop the movement quickly (Gambetta, 1996; Parsons & Jones 1998). In a study, Balčiūnas et al. (2006) researched the effect of 4 months of different training modalities on power, speed, skill and anaerobic capacity in 15-16 year old male basketball players. They noted that both training modalities were able to maintain initial values of speed and power, however, the anaerobic capacity and skill increased only in the players from the power endurance group. Agility is reported to be a multifactorial physical ability affected by strength, speed, balance, flexibility, and muscular coordination. Agility requires the effective utilization of strength to rapidly decelerate and reaccelerate in the new direction (Sheppard, & Young, 2006). In this study, there is significant differences in pre and post test for agility in speed training group. Study's findings of Chaouachi et al. (2009), agility should be regarded as a per se physiological ability for elite basketball players. They reported that basketball-specific agility drills should be stressed in elite basketball training and line-sprinting performances were

not related to agility performance. Previous study was compared and investigated releations between speed and agility of 12- and 14-year-old elite male basketball players. Fourteen-year-old players achieved significantly better results in all speed and agility tests compared with 12-year-old players (Jakovljevic, Karalejic, Pajic, Macura, & Erculj, 2012).). In a the study was to determine if six weeks of plyometric training can improve an athlete's agility. The plyometric training group reduced time on the ground on the posttest compared to the control group. The results of the study show that plyometric training can be an effective training technique to improve an athlete's agility (Miller, Herniman, Ricard, Cheatham, & Michael, 2006). Boland, Madden, & O'neill (2015) examineted the effects of an 8 week functional training program on an adolescent lacrosse athlete's body composition, functional movement, speed, agility, cardiovascular fitness, strength and sport specific outcomes. The study reported that agility time (T- test) was 12.1 (s) for pretest and 10.54 (s) for posttest. Our study was agility time (9.57 (s) for pretest and 9.45 (s) for posttest) and agility was improved by speed training. The effect of speed training was a 1.2% greater agility performance.

In the first case, quickness is the specific functional capacity involving the athlete's psycomotor skills, while in the second, speed of movement or locomotion indicates the degree of the athlete's special preparation. Quickness and velocity are two separete characteristics of human motor skills. Quickness is a general quality of the central nervous system and is fully expressed in motor reactions and in simple motions with no overload. The quickness characteristics of an individual are genetically predetermined, and, therefore, there is little space for improvement. Movement velocity (locomotion) is a specific human skill which may be improved by means of special training (Verkhoshansky, 1996). Quickness is the ability to read and react to a situation; it is a multidirectional skill that combines explosiveness, reactiveness, and acceleration. Also, quickness should be considered a player's ability to keep his speed under control so he can change directions with as little loss of speed and balance as possible (Moreno, 1995). In a study made by the Chaouachi et al. (2009) reported quickness for distance of 5 m (0.82 second) and acceleration for distance 10 m (1.7 second) for elite basketball players. Our study reported sprint time for distance of 5 m (1.17 Second) which is named as quickness for elite young basketball players. Our study reported that the effect of speed training was a 6 % greater quickness performance.

Acceleration is the rate of change in velocity that allows a player to reach maximum velocity in a minimum amount of time. The acceleration phase is highly dependent upon quicness and the athlete's ability to generate force and power during propulsion. The performances on the 10-m test for acceleration, the flying 20-m test for maximum speed, and the zigzag test for agility were all correlated at high levels of statistical significance ($p<0.0005$) (Little & Williams, 2005). A study investigated 117 players (soccer – 56, basketball – 17, volleyball – 20, and handball – 24) playing youth leagues U15-U17 who were assessed for 10-m sprint (acceleration), flying 30- m sprint (maximum speed), triple-jump (special explosiveness) performance, Illinois agility test (speed of whole-body change of direction) and Fitro Agility Check (agility). In the test assessing the level of simple reaction and acceleration speed (10m sprint) they found the for basketball players ($\bar{x}$= 1.9*s*) (Šimonek, Horička, & Hianik, 2017).

CONCLUSİON

This paper contains information on the possible effects that occur when the speed program is implemented in elite youth basketball players. The presented speed program can and should be individually corrected and applied in practice. To conclude, the speed training appears to be an effective way of improving quickness, agility and acceleration in young basketball players and would therefore be a good method for coaches to incorporate into their strength and conditioning programs. The results of this study can be considered important in terms of competitive young basketball performance. Basketball coaches could use this information in the process of planning the in-season training. Without proper planning of the speed training, basketball players will most likely be confronted with decrease in power performance during in-season period. For proper basketball conditioning, coaches could make training more specific in such a way that the transfer of training effects to game efficiency will be faster.

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