RELATIONS BETWEEN AGILITY TESTS AND MOTOR REACTION TIMES IN YOUNG SPORTSMEN

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ABSTRACT:
In sporting activities, reducing motor reaction times and therefore moving in different directions as needed quickly and precisely is considered by many coaches to be an integral part of motor and sports performance. **Objectives:** The present study aims to analyze the relationships between the motor reaction time and agility in children. The assessment involved motor tests and modern technological systems. **Methods:** 44 students were recruited, including 21 girls (age: 11.52 ±0.51 years) and 23 boys (age: 11.48 ±0.51 years) practicing sports. The data resulting from the Hexagon Agility Test (HAT) to evaluate agility and tests with led lights system (FitLight Sports Corp, Ontario, Canada) for the assessment of reaction times, were correlated. **Result:** Positive and significant correlations (r: .916; p<0,05 e r: .888; p<0,05) were carried out between the HAT and reaction time. **Conclusion:** There are significant relationships between agility and reaction times in young sportsmen.

KEYWORDS:
Agility, Reaction Time, Motor Test Children;

1. INTRODUCTION

The definition of the relationships between motor coordination, react capacity and agility is still the subject of study in the field of physical education and sports science. Reducing motor reaction times to adapt specific motor task to the environment is an unavoidable factor in social life and in sport. Several authors consider the react capacity as an important factor in motor coordination model [1–3]. In many sports, motor reaction speed is essential in more diversified situations, because athletes must make quick decisions to be more likely to succeed in their actions [4–6]. Agility (or coordination) is a complex quality, specific and transversal that is closely related with the speed, motor creativity and the rapidity of information processing processes [7]. A modern definition of agility in sport defines it as: "a rapid movement of the whole body with a change of speed or direction in response to a stimulus" [8]. Agility is therefore an important quality that contributes significantly to success in sports results [9,10]. The ability to quickly and accurately change direction as needed is considered by many to be an integral part of motor and sports performance [11–14] and is closely related to the motor reaction capacity. In the light of what has been described, it seems clear that the react capacity in the shortest time and the speed in changes of direction are important qualities for performance in many sports games and in multi-directional sports and it is important to stimulate it from the youngest age groups. The present study aims to analyze in young sportsmen, the relationships between motor reaction capacity to visual stimuli and agility, if evaluated with standardized motor tests and technological tools that use light stimuli that measure motor reaction times (perception- action). The reaction time and the speed of the motor response are relevant cognitive components that need to be investigated when assessing motor agility. Motor reaction time (RT) can be defined as the time from the appearance of a stimulus (signal) until a response is given and is considered a good measure to evaluate the cognitive system's capacity to process information [15,16]. In sports practice, the reaction time is often recognized by a total identifiable time as that necessary to perceive, identify, process an external stimulus and respond with the movement, and has two partial components which are the reaction time and the movement time. In the present study, the reaction time is considered as the time required from the presentation of the visual stimulus to its achievement through a rapid movement of the upper (hand) or lower (foot) limbs: RTs = Reaction time + Movement time. It has been shown that physical activity and sport can be related to the improvement of RT [6,15–17].

2. METHODS

2.1 Sample

During a summer campus Foggia city (southern Italy) – coordinated by the University of Foggia, Faculty of Motor and Sport Science, 44 students were recruited through a utility sampling of which 21 girls and 23 boys (age = 11.51 ±0.51 years; height = 146.48 ±5,94 cm; body mass = 41.16 ±4.12 kg) who regularly practiced sports activities. Participants and their parents were informed of the study objectives and the effects of the results for improving sports performance. Informed consent was requested for data collection.

2.2 Methodology

In the last 24 hours before the test, participants did not engage in strenuous physical activity. In the last 3 hours prior to the test, participants had no food or drink other than water. Before the tests, 15 minutes of warm-up and dynamic stretching were performed. Each test was explained and demonstrated. Before each test, subjects underwent practical tests to become familiar with the testing procedures. All tests were counterbalanced before and after the test to ensure that the effects of the tests were minimized. Before carrying out the tests, each subject was verbally instructed and encouraged to give maximum effort during the entire test.

2.3 Motor test: Hexagon Agility Test (HAT)

L'Hexagon agility test (HAT) is described as "a measure of agility and speed of the feet involving balance and coordination capacity" [18,19]. It has been shown that the HAT, as a field test, has excellent test-retest reliability when rigorous test procedures are followed [20,21]. In this study, a modified version of the original HAT was used [20] for example, including two sequences instead of three and using a light signal for starting. The test involves the subject facing forward, in the center of a hexagon drawn on the ground with adhesive tape. The length of each side is 24 inches (60.96 cm), each inner angle is 120 degrees. At the center of the hexagon is positioned solidly on the ground, a conductance platform connected to a chronometric detection system (Chronojump system, Barcellona). The platform is connected directly to a portable PC, all managed by a software (Chronojump software 2.2, Barcellona) which allows to detect the times in thousandths of a second. Starting from the center of the hexagon, the test involves 6 subsequent round-trip jumps, successively overcoming each side, the first jump is towards the front line, then the lateral one and so on. The test is performed both clockwise and counterclockwise. A 1 minute pause was performed between one round and the next. The average time is calculated as a score, given by the sum of the total times of the hourly and anticlockwise lap divided by 2. Two total trials were administered for each participant interspersed with 2 minutes rest. The best average time between the two tests was taken into consideration.

2.4 Cognitive Motor - Test

The measurement of the simple reaction times for the dominant upper and lower limbs respectively was carried out through the use of 2 tests: Reaction Time simple upper limb dominant (RTs UL) and Reaction Time simple lower limb dominant (RTs LL), [22]. Both tests use a mobile equipment (FITLIGHT Trainer ™ Sports Corp, Canada) consisting of a control tablet and moving discs, each disc (diameter: 10 cm) in relation to the program used, emits light signals through LED lights or sound and it is also equipped with proximity sensors. The system allows you to measure and record times in thousandths of a second at each contact. RTs UL [22] is a test that evaluates the simple reaction times (ICC/Rho: 0.81* (95% CI: 048-0.94), $p < .001$), of the upper limbs. The subject standing, is positioned with the palm of the dominant hand (defined as the hand that he uses intuitively for sports activities, eg. throwing, pushing) resting on a table adjusted at the elbow. A sensor is positioned on the same table at a distance from the subject, equal to the length of the forearm. RTs LL [22] evaluate the simple reaction times of the lower limbs (ICC/Rho: 0.89* (95% CI: 0.67-0.97), $p < .001$). The subject is standing, feet parallel (distance between the feet equal to the width of the shoulders), a sensor has been placed in front of the participant's feet. The sensor distance is normalized to the length of each participant's dominant foot, which is measured as the distance from the apex of the big toe to the heel. For both tests the task is to deactivate the sensor as soon as it lights up, as quickly as possible by swiping over it with the dominant hand (RTs UL) or with the dominant foot (RTs LL), contact with the sensor was not required. Each test for each test consists of a total of 20 led switching on with variable (random) intermediate time intervals. The response time in seconds, thousandths is measured on all repetitions. The result of the test is given by the average of the reaction times. Each participant for each test is given two tests with a 3 minute break in between, the shortest mean time in seconds of the two tests for each test was recorded and used in the analysis.

2.6 Statistical analysis

IBM SPSS vers. 25 for windows software was used for statistical analysis. Data are reported as mean ± standard deviation (SD). The relationships between the proposed tests (RTs UL vs HAT and RTs LL vs HAT) were analyzed using: Pearson's correlation (r) and coefficient of determination (r^2: used to interpret the significance of the relationship). Significance was assumed to be 5% ($p \leq 0.05$). Before using the parametric tests, the hypothesis of normality was tested using the Shapiro-Wilk test.

3. RESULTS

No discomfort or adverse effects during test were noticed or reported. The results of the average times (Mean ± SD) and the Min and Max values of the tests administered to the entire sample (N = 44) without distinction of gender (table 1). The time range for RTs UL dominant varies from 0.342 to 0.523 s, those of RTs LL dominant vary from 0.447 to 0.612 s while HAT times vary from 4.203 to 7.482 s.

	RTs UL (s)	RTs LL (s)	HAT (s)
Mean ± SD	0.423 ±0.052	0.524 ±0.048	5.717 ±0.939
Min	0.342	0.447	4.203
Max	0.523	0.612	7.482

Table 1. Mean values (mean ± SD) of Reaction Time simple Upper Limb dominant (RTs UL (s)), Reaction Time simple Lower Limb dominant (RTs LL (s)) and Hexagon agility test (HAT (s)) in the group of children (N = 44).

The average of the times of the RTs LL dominant test (0.524 ±0.048 s) is higher than the average of the times of the RTs UL dominant test (0.423 ±0.052 s), the difference of which is equal to 0.101 s. The correlation and the coefficients of determination between the tests HAT, RTs UL dominant and RTs LL dominant are shown in the table (table 2).

		RTs UL (s)	RTs LL (s)
HAT (s)	Correlation of Pearson (r)	,916**	,888**
	Coefficient of determination (r^2)	,8387	,7893
	Sign. (two-tailed)	,000	,000
	N	44	44

** significant at p < 0.01

Table 2. The correlation (r) and coefficient of determination (r^2) values between Hexagon agility test (HAT (s)) vs Reaction Time simple Upper Limb dominant (RTs UL (s)) and Hexagon agility test (HAT (s)) vs Reaction Time simple Lower Limb dominant (RTs LL (s)) in the group of children (N=44)

The results reported in the table (table 2) show significant correlations between HAT and RTs UL dominant ($r = 0.916$; $p < 0.01$) and between HAT and RTs LL dominant ($r = 0.888$; $p < 0.01$) detected through a bivariate correlation matrix. A significant positive correlation indicates that the minimum time value (s) of the HAT variable is associated with a minimum time value (s) of the respective other variables RTs UL dominant and RTs LL dominant (s) and the high time value (s) of the variable HAT is associated with a high time value (s) of the respective other variables RTs UL dominant and RTs LL dominant (s). This implies that as the values of RTs UL dominant and RTs LL dominant (s) increase, the values of the second HAT variable also tend to increase.

4. DISCUSSION

The average of the times (Table 1) resulting from the RTs LL dominant test (0.524±0.048 s) is higher than the average of the times of the RTs UL dominant test (0.423 ±0.052 s), the difference of which is equal to 0.101 s. The causes of this are mainly attributable to physiological factors, the bio-electrical impulses arriving at the hand travel a shorter path than the foot and a faster motor conduction speed in the upper limb [23]. The mean times of the sample analyzed for both tests, RTs LL dominant and RTs UL dominant, are in line with the times of the studies in the literature for that same age group [24]. The reaction time, understood as the time that elapses between the appearance of the stimuli and the response to them that occur in sequence, when it is low, allows an athlete to respond successfully to the stimuli during sports participation, while reaction times to slower visual stimuli have been associated with an increased risk of injury [25]. The development of the react capacity improves with increasing age, it is therefore known that the phase ranging from seven years up to the pre-pubertal and pubertal (11-12 and 13-14 years) is considered a sensitive period for development of these capacity [26]. In this study, the results obtained from the tests administered show that, as demonstrated in other similar searches, there are significant relationships between agility and react capacity to visual stimuli for both the use of the upper and lower limbs. The results analyzed show that in the sample of young athletes considered (N = 44) there are positive correlations between RTs UL vs HAT ($p < 0.01$) and RTs LL vs HAT ($p < 0.01$) (Table 2). The ability to perform movements quickly and accurately in response to external stimuli is a key factor in athletic performance [27]. The HAT test shows excellent reliability for measuring agility, which supports its use as a tool for evaluating athletic performance and lower limb agility [20].

5. CONCLUSIONS

The significant relationships observed between HAT and RT provide evidence to support the hypothesis that reaction times affect motor agility in young sportsmen. Physical exercise and motor and sports practice have positive effects on the reaction times of the upper and lower limbs [28]. Training young people on the ability to react quickly to visual stimuli through exercises involving the upper and lower limbs allows to obtain positive effects in terms of motor agility. It has been shown that the simple reaction time to visual stimuli characterizes the efficiency of the neuromotor mechanism [29]. These considerations lead us to reflect and develop further research programs aimed at analyzing the effective trainability of reaction and agility skills and whether the use of modern action perception devices, when integrated into training or teaching processes, may or may not affect on the improvement of motor performance.

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