Differences in the indicators of speed and agility of students of the Faculty of physical education of the 3rd year of study in different years of entering the university

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Abstract

Background and purpose

Coordinated movement takes place under the great influence of the CNS and its highest centers, whose numerous functions are still not sufficiently explored. Agility is the ability to maintain body position in a controlled manner with a rapid change of direction during successive movements. The research aim of the study was to determine the speed and changing the direction of movement as well as existing differences between students using the Illinois Agility Test (IAT).

Material and methods

The research included 114 students divided into 4 groups: I group (2011/12y) =28; II group (2012/13) =30; III group (2015/16) =29; IV group (2016/17) =27., who at the time of measurement corresponded to the 3rd year of study (20-21 years old). The IAT was used to assess motor agility and the average test results (sec.) and the average movement speed during the test (m/s) were determined.

Results

Analysis of variance (ANOVA) was applied, which detected statistically significant differences at the multivariate level (Wilks=0.717; F=16312; p<0.002). At the univariate level, there are differences between the IAT results (F=5.827; p<0.001), where the Tukey HSD test confirmed statistically significant result (sec.) differences between the I group of students (Result=16.97sec) with the II group (Result=18.00sec.), with III group (Result=17.71sec.), and with IV group (Result=18.04sec.) for (p<0.05). Using the same methodology, statistically significant intergroup differences in IAT speed (m/s) were recorded (F=6.743; p<0.001), which was confirmed by the Tukey HSD test, only between the I group of students (Speed=3.84m/s) with the II group (Speed=3.61m/s), III group (Speed=3.69m/s) and for IV group (Speed=3.61m/s) for (p<0.05).

Conclusion

Differences between the groups are evident for results (sec.) and speed (m/s) and statistically significant were achieved only between the I group with the II, III and IV group. The best results of the Illinois Agility Test (sec.) and Speed (m/s) were achieved by the students of group I and the weakest students of group IV. Statistically significant differences were not recorded between II, III and IV groups.

Key words: speed, change of direction (COD), Illinois agility test (IAT)
Анотація

Ратко Павлович. Відмінності показників швидкості та спритності студентів факультету фізичного виховання 3 курсу навчання в різні роки вступу до університету

Обґрунтування і мета

Координований рух відбувається під великим впливом ЦНС і її вищих центрів, численні функції яких ще недостатньо вивчені. Спритність — здатність контролювано зберігати положення тіла зі швидкою зміною напрямку під час послідовних рухів. Метою дослідження було визначити швидкість і зміну напрямку руху, а також існуючі відмінності між учнями за допомогою Іллінського тесту спритності (IAT).

Матеріал і методи


Результати

Було застосовано дисперсійний аналіз (ANOVA), який виявив статистично значущі відмінності на багатофакторному рівні (Wilks=0,717; F=16312; p<0,002). На однофакторному рівні є відмінності між результатами IAT (F=5,827; p<0,001) для групи (Tukey HSD підтвердив статистично значущі відмінні на рівні значущості (с) між I групою студентів (Результат=16,97с) з ІІ групи (Результат=18,00сек.), III групи (Результат=17,71сек.), IV група (Результат=18,04сек.) для (p<0,05). За цею ж методикою зафіксовано статистично значущі міжгрупові відмінності швидкості IAT (м/с) (F=6,743; p<0,001), що підтверджено тестом Іллінського тесту на спритність (сек.) та швидкість (м/с) досягли учні І групи з найслабші учні ІV групи. Між ІI, ІII та IV групами статистично значущих відмінностей не зафіксовано.

Висновок

Відмінності між групами очевидні за результатами (сек.) і швидкістю (м/с), і статистично значущі були досягнуті лише між І групою та ІІ, ІІІ та ІV групою. Найкращі результати Іллінського тесту на спритність (сек.) та швидкість (м/с) досягли учні І групи та найслабші учні ІV групи. Між ІI, ІII та IV групами статистично значущих відмінностей не зафіксовано.

Ключові слова: швидкість, зміна напрямку (COD), Іллінський тест спритності (IAT)

Аннотация

Ратко Павлович. Различия показателей скорости и ловкости студентов факультета физической культуры 3 курса в разные годы поступления в университет

Обоснование и цель

Согласованное движение происходит под большим влиянием ЦНС и ее высших центров, многочисленные функции которых еще недостаточно изучены. Ловкость — это способность сохранять положение тела контролируемым образом с быстрой сменой направления во время последовательных движений. Цель исследования заключалась в том, чтобы определить скорость и изменение направления движения, а также существующие различия между учащимися с помощью Іллінського теста на ловкость (IAT).

Материал и методы


Результаты

Был применен дисперсионный анализ (ANOVA), который выявил статистически значимые различия на многомерном уровне (Wilks=0,717; F=16312; p<0,002). На однофакторном уровне имеются различия между результатами IAT (F=5,827; p<0,001), где тест Тьюки HSD подтвердил статистически значимые различия результата (сек.) между студентами I группы и группы (Результат=16,97сек) с II группа (Результат=18,00с), с III группой (Результат=17,71с) и с IV группой (Результат=18,04с) для (p<0,05). По той же методике зафиксированы статистически значимые межгрупповые различия скорости ИАТ (м/с) (F=6,743; p<0,001), что подтверждалось тестом Тьюки HSD, только между I группой студентов (Скорость=3,84 м/с). /с) со II группой (Скорость=3,61м/с), III группой (Скорость=3,69м/с) и с IV группой (Скорость=3,61м/с) для (p<0,05).

Выводы

Различия между группами очевидны по результатам (сек.) и скорости (м/с) и статистически значимы только между I группой со II, III и IV группами. Найлучших результатов Іллінського теста на ловкость (сек.) и скорость (м/с) добились студенты I группы и самые слабые студенты IV группы. Статистически значимых различий между II, III и IV группами не зафиксировано.

Ключевые слова: скорость, изменение направления (COD), Іллінський тест на маневренность (IAT)
Introduction

Coordination is a complex basic motor ability, so it is often called motor intelligence (the ability to cope with new motor situations), it is more than 80% genetically conditioned. As the ability, it participates in almost all motor activities, especially in sports games, athletics, martial arts, sports and rhythmic gymnastics, etc. However, it is the ability with a rather limited transfer. It develops rapidly until puberty, after which ability performance drops, development stagnates due to acceleration of growth and development, and the maximum development reaches around 25 years of age [1, 2]. Coordinated movement takes place under the great influence of the CNS and its highest centers, whose numerous functions are still not sufficiently explored. It can be defined as a purposeful and controlled energetic, temporal and spatial organization of movement into one unit [3]. Locomotor activities of athletes during competition are always related to solving a whole series of newly developed coordinated movements with the aim of concretizing them in the activity itself. When performing complex movements, the work of a large number of elementary movements is usually coordinated into unique movements, whereby entire compositions of movements can be created that require the presence of conscious activity. Agility is the ability to maintain and control the position of the body with an explosive change of direction during the performance of a motor task. It implies a very fast manifestation of force with an appropriate output power, as the possibility of efficient use of the myotatic-plyometric cycle in ballistic movements. According to (4), agility is the motor ability to maintain or control the body position during a rapid change of direction successive movements. It requires progressive strength development as well as the ability to efficiently perform concentric-eccentric muscle cycles in various movements. Agility, acceleration, COD, stopping and sprinting are considered important technical abilities, skills and the most important factors of the training process in sports games. Sprinting ability and COD during fast running are determinants of performance in many sports as often evidenced by analysis of movements in time and space [5]. In many sports, competitors are forced to speed up, slow down and change direction during the game play. Most often, these quick movements are performed in a combination of passing, guiding the ball (dribbling), shooting, throwing the ball, during a game or training process [6, 7, 8]. The athlete’s ability to accelerate, move in the right direction with his quick change of direction and control of space requires a lot of skills. The development of balance, including speed and explosive power, defines one of the basic characteristics of agility. She is also an important performance in collective (team) sports, to avoid an opposing player during an attack or to exert pressure on an opponent during his defense. Accelerating and stopping or decelerating a football player, basketball player, handball player, player in one line to avoid their opponents is a demanding ability that is manifested based on the prediction of the movements of the opposing players. It is often unpredictable. Agility means changing direction (COD) from point A to point B as quickly as possible, in a very light and controlled manner, and is highly correlated with the speed of change of current position. [2]. It is necessary to have an appropriate and adequate physical profile of the competitor, which will enable and define a significant physical ability through high-quality training load, which will support every motor component of the athlete. [9]. Fitness (motor) components of an athlete define speed, strength, endurance and flexibility. Depending on their mutual combinations, some new specific abilities will be produced (speed power, strong endurance, agility) [10]. Athletes with good agility generally also have a good level of development of other abilities in the domain of energy and central regulation of movement, good visual perception and forecast of events during the activity [11]. So, although agility implies efficient and quick stopping and the possibility of continuing movement, there is a high degree of complexity of this motor component.

According to Young [12], agility is influenced by abilities such as running speed and technique, anthropometric characteristics and lower limb musculature. The speed of the change of direction is influenced by factors that are subordinated to quality synergistic muscle kinetic movements in terms of straight sprinting, muscle force reactivity, myometric force and coordinated limb balance [13]. The ability to repeat sprints, explosiveness and speed, and change direction in response to an audio or visual stimulus is the main success factor in field sports [14,15,16]. Most of the high-intensity activities take place during the decisive moments during the sports game and the creation of conditions for the resulting success [17, 18]. Team sports players must be technically capable in multidirectional movement, most often in a very small area, which is limited by the dimensions of the field [19], which also includes the ability to perceptual reasoning and most often change the direction of movement [20, 21]. Agility is a key factor when performing different jumps, performing jump shots and changing the speed of movement during the game. Good agility of athletes, their technical performance and biomotor movements increase in sports games because agility
is closely related to changes in speed. The ability to accelerate and change direction is a key prerequisite for the achievement of high performance by athletes in team sports. In this regard, the COD IAT is a reliable test that is often applicable and developed to detect the speed of COD athletes [22]. Previous research [23] discovered variable determinants of agility in athletes of both sexes. Researchers suggest that speed and strength are important predictors of agility in female athletes, while balance is important in male athletes. The study [24] shows better results of male than female athletes in COD tests, but not in the Zigzag exercise. Significant correlations between agility performance and anaerobic power using COD were found in female soccer players but not in the male players [25] in determining winners in karate fights [26]. Research [27, 28] shows better agility in male than female soccer players and also in elite handball players. Subak et al. [16] on a sample of 123 respondents of both sexes determine correlations between body composition, body height, body mass with the Agility Illinois test. The results showed that height is the dominant factor in IAT performance. A significant positive correlation was achieved between height (in women it is negative), body mass, fat percentage, fat mass and visceral fat levels. Total body water (%) had a negative relationship with the duration of the IAT. The Illinois Agility test on sand has proven to be a good and reliable tool in the recovery process of basketball players compared to exercises conducted in water [10]. A significant difference was found in the results of exercise methods (exercises in water and exercises on sand) on the agility of basketball players. Of exercising on the sand proved to be more effective than the method of exercising in the water for agility.

Students of physical education and sports represent a physically active population engaged in numerous sports activities, in various sports games and basic sports. As part of curricular and extracurricular activities, agility is manifested through various forms of movement. It can be concluded that agility is represented at a high level with the possibility of its acceleration.

The purpose of the study is to determine the level of speed of changing the direction (COD) of movement (agility) as well as existing differences between students using the Illinois Agility Test (IAT).

Materials and methods

Participants

The longitudinal study included 114 physical education and sports students. Illinois Agility Test (IAT) measurements were performed successively every year, in the 3rd year of study. The groups were formed, so that at the time of measurement, the students belonged to the same age group (20-21 years old): I group (2011/12y) =28; II group (2012/13) =30; III group (2015/16) =29; IV group (2016/17) =27. The average IAT results (sec.) and the average movement speed during the test (m/s) were determined. All participants were informed about the nature of the research and all measurement procedures. The consent was voluntary and everything was in accordance with the Declaration of Helsinki.

Experimental design study

The length of the IAT track was dimension (length 10 meters, width 5 meters). It was marked with cones (with four central cones 3.3 m apart and four corner cones placed 2.5 m from the central cones) (Fig. 1). IAT was measured according to the Roozen protocol [29].

Data analysis

The central and dispersion parameters (Mean, SD, Min., Max., Range, CI%) were calculated for Illinois Agility Test (IAT). The normality of the distribution of results was determined by the Kolmogorov-Smirnov test (p>0.05). Differences between students in were determined by analysis variance (ANOVA), and the significance and size of intergroup differences were determined by Post-hoc test (Tukey HSD test). All data were processed with the statistical package Statistica 10.0
Results

The basic statistical parameters of the Illinois Agility Test (IAT) of the subjects are contained in Table 1. There are evident numerical differences between the groups of subjects in the average results of the IAT (sec.) and the average speed (m/s). The IAT results are in the range (16.97 sec. to 18.04 sec.) with an average test performance speed (3.84 m/s to 3.61 m/s). The best IAT result was achieved by the subjects of group I and the weakest subjects of group IV, with a difference of 1.10 seconds. while the difference in speed was 0.23 m/s. The best result of the IAT (Min.=15.68 sec.) was recorded in the III group of students, where the highest speed of performing the IAT was achieved with 4.15 m/s.

To determine differences between groups (Table 2), analysis of variance (ANOVA) was applied, which detected statistically significant differences at the multivariate level (Wilks=0.717; F=16312; p<0.002). At the univariate level (Table 3; Figure 2, 3, 4), there are differences between the IAT results (F=5.827; p<0.001), where the Tukey HSD test confirmed statistically significant result differences between the I group of students with the II, III and IV groups for (p<0.05) (I vs. II=0.008; I vs. III=0.033; I vs. IV=0.004). Using the same methodology, statistically significant intergroup differences in IAT speed were recorded (F=6.743; p<0.001), which was confirmed by the Tukey HSD test, only between the I group of students with the II, III, IV groups for (p<0.05) (I vs. II=0.003; I vs. III= 0.041, I vs. IV = 0.002). Statistically significant differences were not recorded between II, III and IV groups.

Table 1
Descriptive statistic (Illinois Agility Test-IAT)

<table>
<thead>
<tr>
<th>Group</th>
<th>IAT</th>
<th>Mean±SD</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Results (s)</td>
<td>16.97±0.70</td>
<td>15.91</td>
<td>18.19</td>
<td>2.28</td>
</tr>
<tr>
<td></td>
<td>Speed (m/s)</td>
<td>3.84±0.15</td>
<td>3.57</td>
<td>4.09</td>
<td>0.52</td>
</tr>
<tr>
<td>II</td>
<td>Results (s)</td>
<td>18.00±1.03</td>
<td>16.32</td>
<td>19.70</td>
<td>3.38</td>
</tr>
<tr>
<td></td>
<td>Speed (m/s)</td>
<td>3.61±0.21</td>
<td>3.30</td>
<td>3.98</td>
<td>0.68</td>
</tr>
<tr>
<td>III</td>
<td>Results (s)</td>
<td>17.71±1.29</td>
<td>15.68</td>
<td>20.10</td>
<td>4.42</td>
</tr>
<tr>
<td></td>
<td>Speed (m/s)</td>
<td>3.69±0.27</td>
<td>3.23</td>
<td>4.15</td>
<td>0.92</td>
</tr>
<tr>
<td>IV</td>
<td>Results (s)</td>
<td>18.04±0.78</td>
<td>16.90</td>
<td>20.11</td>
<td>3.21</td>
</tr>
<tr>
<td></td>
<td>Speed (m/s)</td>
<td>3.61±0.15</td>
<td>3.23</td>
<td>3.85</td>
<td>0.62</td>
</tr>
</tbody>
</table>

Multivariate Test of Significance (ANOVA) p<0.05

<table>
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<tr>
<th>Test</th>
<th>Value</th>
<th>F</th>
<th>Effect - df</th>
<th>Error - df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>Wilks</td>
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<td>16312</td>
<td>2</td>
<td>63</td>
</tr>
<tr>
<td>Group</td>
<td>Wilks</td>
<td>0.717</td>
<td>4</td>
<td>6</td>
<td>126</td>
</tr>
</tbody>
</table>

Analysis of Variance (p<0.05)

<table>
<thead>
<tr>
<th>Illinois Agility test (IAT)</th>
<th>SS-Effects</th>
<th>MS-Effects</th>
<th>MS-Error</th>
<th>F</th>
<th>p</th>
<th>Levene-s test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Results (sec.)</td>
<td>15.058</td>
<td>5.019</td>
<td>0.861</td>
<td>5.827</td>
<td>0.001</td>
<td>2.81 0.068</td>
</tr>
<tr>
<td>Speed (m/s)</td>
<td>0.746</td>
<td>0.249</td>
<td>0.037</td>
<td>6.743</td>
<td>0.001</td>
<td>2.59 0.060</td>
</tr>
</tbody>
</table>

Table 3
Post-hoc test; Tukey HSD test; p<0.05

<table>
<thead>
<tr>
<th>Group</th>
<th>Results IAT (sec.)</th>
<th>Speed IAT (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean I=16.97</td>
<td>Mean II=18.00</td>
</tr>
<tr>
<td>I</td>
<td>Mean III=17.77</td>
<td>Mean IV=17.98</td>
</tr>
<tr>
<td></td>
<td>Mean I=3.84</td>
<td>Mean II=3.61</td>
</tr>
<tr>
<td></td>
<td>Mean III=3.67</td>
<td>Mean IV=3.62</td>
</tr>
<tr>
<td>I</td>
<td>0.008</td>
<td>-</td>
</tr>
<tr>
<td>II</td>
<td>0.008</td>
<td>-</td>
</tr>
<tr>
<td>III</td>
<td>0.033 0.925</td>
<td>-</td>
</tr>
<tr>
<td>IV</td>
<td>0.004 1.000 0.929</td>
<td>-</td>
</tr>
</tbody>
</table>

Plot of Means and Conf. Intervals (95.00%) IAT (sec.)

Fig. 2. Differences between groups in Result IAT (s)
Discussion

Agility as a sub-segment of coordination is very important and present in motor movement structures. It depends on the central and energy levels of regulation, which are under the influence of the central nervous system.

Psychomotor and neurophysiological adaptations improve the activity of motor units that increase agility performance. Moreover, agility task required rapid switching from plyometric to myometric muscle action in the leg extensors [4]. It is the ability to quickly change the direction of movement, the position of the body in space and time, easily and controlled as possible, without losing balance. It mainly refers to the visual reaction, speed, speed that a successful athlete should have [2].

The aim of study was to determine the level of speed of COD of movement (agility) as well as existing differences between students using the IAT. The result of the current study show significant differences between the subjects in the IAT and the speed of the test execution. Given that the IAT results are quite homogeneous, the Post-hoc test (Tukey HSD) confirmed statistically significant differences only between the I group versus the results of the II, III and IV groups. This is a confirmation that four different generations of physical education and sports students are quite uniform when it comes to agility as a motor ability. This is perhaps expected considering the nature of the studies and the activities that the respondents encounter during their studies. Also among students, there are quite a few athletes from different sports who are actively training, where agility is represented to a greater or lesser extent.

As a result, we have minimal intergroup differences in IAT performance and performance speed. The result is the conclusion that the degree of agility development is mostly correlated with the sport that the respondents train or with a specific training process [30].

The average IAT results of group I (16.97 sec. vs. 3.84 m/s) compared to group IV (18.04 sec. vs. 3.61 m/s) are numerically lower (better). The results are a consequence of the degree of motivation during testing, partly morphological characteristics, weaker motor skills and the condition of the nervous system of the younger generation of students (IV group), insufficiently good selection of candidates for college admission, less competition for faculty, etc. However, all these factors are in the genesis of the development of physical culture, sports in the youngest (children), including future candidates who enroll in this sports faculty. The situation in the country in terms of mass physical culture is absent, and information technologies are on the rise. The consequences are evident, weaker motor movement, weaker test results participants. However, the average results of our cause IAT show above the average value (for I group) and the average value of IAT (II, III, IV group) [31]. Also, the current sample of students records weaker IAT results (numerically higher) than the results of some earlier studies [2, 32], but and better results than the results of earlier research [33, 34]. Agility is necessary in sports that involve body movements with very fast
leg movements and rapid changes in body position in space. It plays an important role in the activities of changing the movement of the body with a good balance, and a competitor who has good agility will perform movements much more efficiently. [10]. Certain agility movements are highly dependent on plyometric movements, which enables a significant development of agility performance [4]. The plan and program of the faculty define different forms of movement (sports games, athletics, martial arts, gymnastics, ...), so that the implementation of these programs develops components of agility at the energetic and central level of regulation.

Agility is also related to anaerobic processes in the body, considering the time duration that corresponds to the anaerobic-aerobic work regime. The study [35] shows a very significant positive relationship between agility and aerobic-anaerobic performance. In the current study, body mass and the majority of respondents were not analyzed as a possible factor of differences in the performance of the IAT. However, the relationship between height and agility has not been significantly proven, but certain studies suggest a negative correlation of body mass and fat percentage on agility performance [36, 37]. On the other hand, a positive relationship between students body weight and agility duration test has been proven, and some studies [16] suggest a significant positive influence of the percentage of water in the body on agility results.

Conclusions

Differences of results and speed between the groups are evident, and statistically significant were achieved only between the First group (2011/12year, Result=16.97sec., Speed=3.84m/s) with the II group (2012/13year, Results=18.00sec., Speed=3.61m/s), with the III group (2015/16year, Result=17.71sec., Speed=3.69m/s) and IV group (2016/17year, Result=18.04sec. Speed=3.61m/s) for significance p<0.05. The agility of all students was average with the possibility of correction towards better results.

The best results of the IAT (sec.) and Speed (m/s) were achieved by the students of group I (2011/12y) and the weakest students of group IV (2016/17y), where there is an evident decline in this motor ability (agility) for 1.07sec and 0.23m/s. Given that these are physical education and sports students, a physically quality sample and motorically intelligent in the sense of manifesting different motor movement structures, then these results are a positive trend in terms of the realization of agility. Their upgrading is possible in terms of concretization of motor tasks, which implies the targeted improvement of certain motor structures, in our case agility. This study is just one signpost for some future research that would include a larger number of respondents and their anthropometric parameters.

Conflict of Interest

The authors hereby declare that they don’t have any financial and personal conflict of interest.

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