Neuromuscular Screening to predict young fencers’ performance

D.O.I: https://doi.org/10.4127/jbe.2018.0134

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ABSTRACT

The aim of this study was to investigate sport specific correlates of fencing performance, in both young male and female fencers. All assessments (anthropometry, arm strength, leg power, flexibility, fencing movement reaction times in visual stimuli velocity of arm extension, lunge velocity, step and lunge velocity and fencing specific agility test) were conducted on 9 males and 13 female young fencers 13.4±0.85 years old (mean age ± standard deviation). Relationships were examined by calculating Pearson’s product moment correlation coefficient (r). A stepwise multiple linear regression was used to identify the best predictors of fencing performance. Females were found to have more body fat and higher BMI values compared to males. Males outperformed females in all leg power tests, while females were more flexible than males. Moreover males were faster in arm velocity, step-lunge velocity and change of direction velocity compared to females. Anthropometric parameters were not correlated to fencing performance. Long jump and squat jump were

Key Words: Fencing, Monitoring, Strength, Power, Reaction time
the best predictors of step and lunge velocity and change of direction velocity, respectively. The integration of power exercises in both the horizontal and vertical plane is recommended as regular regimen in physical condition protocols in order to optimize the fencing performance in young fencers.

INTRODUCTION

Fencing is an intense intermittent sport demanding the execution of highly controlled, explosive movements aiming to hit the opponent (26). During competition, fencers need to react at the right moment, by repeating accurate defensive and offensive kinetic patterns in different directions, requiring considerable activation of the neuromuscular system (1).

Strength, power and inter-limb coordination, underline fencing movements such as steps, bounces and lunges highlighting the importance of these dynamic characteristics on fencer’s performance (27). Lunging in fencing performed under ideal circumstances is characterized by the ability to forcefully activate, in sequence, elbow extensors of the armed hand preceding the relative activation of the hip, knee, ankle flexors and extensors muscles, thus decreasing the opponent’s time to defend (17, 29). Recently, a kinematic analysis identified that the concentric activation of the rear knee extensors is highly involved in the push-off and acceleration phase, while the eccentric contractions of the leading leg seem to be vital in the deceleration and braking phase of fencers’ body after performing a lunge preceded by a step (6).

Fencing steps and the continuous rhythmic change of direction activate the stretch-shortening cycle mechanism, influencing the following propulsive muscle contractions and are considered fundamental for elite performance (25, 28). Recently, Turner et al (28) proposed a short distance agility fencing test that simulates competition conditions, suggesting an alternative more realistic assessment model compared to previous studies that have been undertaken on fencing shuttle tests (25).

The interaction of anthropometric traits and physiological abilities has been closely associated to fencing performance. Tsolakis and Vagenas (25) showed that lunging time measured by photocells, significantly correlated to body fat and leg power (squat, countermovement jump and reaction strength index, RSI), while with respect to fencing agility testing, body height, countermovement jump and reaction strength index (RSI) provided significant correlations, thus revealing the importance of different training modalities in improving leg muscle strength. Moreover, in another recent study the best predictor of both lunging performance and agility fencing speed was the standing long jump, showing that horizontal jumping drills are also essential to increase fencers’ leg power (28).
Physical and physiological traits in elite fencing are not the only prerequisites, as muscle coordination, hit accuracy and reaction time characterize fencing performance during competition (29). In this view, professional fencers have superior neuromuscular coordination and reaction time skills compared to novice athletes (4, 29). Therefore, choice reaction time protocols can also be used effectively in talent identification programs among young fencers (2).

To our knowledge, only one study has examined the relationship between strength, power parameters and fencing performance in elite junior fencers (28). Thus, the primary aim of this study was to provide an extensive and integrated neuromuscular screening of a younger group aged 13-14 years who systematically practiced in fencing. Additionally, a secondary aim was to provide insight concerning the identification of physical and physiological characteristics that may influence specific fencing kinetic patterns such as lunge and speed of changing direction. On the basis of previous reported investigation, we hypothesized that selected kinetic fencing patterns will be positively affected by strength, power and reaction time protocols.

MATERIALS AND METHODS

Participants

A total of 21 young fencers (9 males and 13 females, aged 13.4±0.85 yrs) were measured during the transitional period immediately after the end of the annual competitive period. All participants were members of the National Development System of the Hellenic Fencing Federation. Selection criteria were set according to the ranking list in the Greek Championship by including the 8 first fencers from each weapon. The physical characteristics of the participants are given in Table 1. All participants trained three times in a week, for approximately 2.5 hours per day, under the supervision of the national team coach and the use of individualized training programs specifically designed for these age groups. All athletes participated in about 10 competitions per year. Prior to data collection and after thorough briefing and presentation of the aim and the risks being involved, an informed consent was obtained from each participant. This study was approved by the Review Board, of the 1st Orthopaedic Clinic, Medical School, University of Athens and all the procedures were in accordance to the Helsinki declaration of 1975, as revised in 1996. During this period all fencers according to the national developmental program were obliged to participate in a specific conditioning program aiming to improve their physical condition and contained alternatively light forms of cross training, medium intensity plyometric drills and team games. Moreover, typical mechanical fencing lessons including specific technical and tactical fencing patterns were adapted.
Table 1
Anthropometric characteristics of the participants (mean ± sd).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Age (years)</th>
<th>Height (cm)</th>
<th>Body mass (kg)</th>
<th>Body fat (%)</th>
<th>BMI (Kg/cm²)</th>
<th>Arm span (cm)</th>
<th>Leg length (cm)</th>
<th>PHV (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males N=9</td>
<td>mean 13.4</td>
<td>162.3</td>
<td>50.2</td>
<td>15.3</td>
<td>18.9</td>
<td>166.9</td>
<td>82.1</td>
<td>14.35</td>
</tr>
<tr>
<td></td>
<td>SD 0.7</td>
<td>10.1</td>
<td>9.0</td>
<td>2.0</td>
<td>1.8</td>
<td>12.6</td>
<td>5.9</td>
<td>0.4</td>
</tr>
<tr>
<td>Females N=13</td>
<td>mean 13.4</td>
<td>164.4</td>
<td>56.5</td>
<td>23.9**</td>
<td>20.8*</td>
<td>167.1</td>
<td>80.2</td>
<td>11.97**</td>
</tr>
<tr>
<td></td>
<td>SD 1.0</td>
<td>7.5</td>
<td>7.0</td>
<td>2.7</td>
<td>2.2</td>
<td>7.7</td>
<td>4.1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

BMD: Body mass index. PHV: Peak height velocity
*p = 0.05**p = 0.001 males vs females

Study design

All measurements were undertaken at the same time of the day (16.00 - 21.00) in the National Fencing Hall of the Hellenic Olympic Complex (OAKA). The first part of the study involved thorough anthropometric assessments, while field and specific fencing tests were performed after a standardized warm-up including 10 min of jogging at their own pace, dynamic stretching activities of the upper and lower extremities and 2-3 trials for each test. All fencers were familiarized with the testing procedure, since they performed it on an everyday basis in the form of exercises for training and qualitative monitoring purposes. Subjects were instructed to avoid any fatiguing activity 24 hours before performing the tests. All measurements were performed twice on the dominant side as defined with regard to the arm hand and systematically balanced to minimize carry over effects. Each player was verbally instructed and encouraged during each test.

Anthropometric data

Anthropometric and body composition measurements included height (Ht), sitting height (SH), body weight (Wt) percent body fat and Body Mass Index (BMI). Height (Ht) and Body weight (Wt) were measured to the nearest 0.1 kg and 0.5 cm, respectively. Skinfolds were measured with a Harpenden skinfold caliper and fat percentage was estimated by Slaughter’s equation (21). Body mass index (BMI) was obtained by the formula BMI = Wt (kg) · Ht (m)⁻². Peak Height Velocity (PHV) was estimated according to the Mirwald and Baily (16) equations for boys and girls respectively.
PERFORMANCE MEASUREMENTS

Jumping performance

Jumping performance was determined using an optical measurement device (Optojump, Microgate, Italy). Testing procedures for performing Squat Jump (SJ), Countermovement Jump (CMJ), Drop jump from 40 cm (DJ) and the derived indexes (RSI) of each test have been previously reported elsewhere (26). Interclass coefficients of variation (ICC) for SJ, CMJ, and DJ, were 0.96, 0.95, 0.90 (p<0.001), respectively.

Stiffness (Repeated Jump Height, RJH)

Stiffness was estimated using an optical measurement device (Optojump, Microgate, Italy). Each participant was asked to perform 7 consecutive jumps and mean jumping height was recorded. This test accounts for reactive force index after recording contact and flight times. Interclass coefficient of variation (ICC) for RJH was 0.90 (p<0.001).

Speed

Speed was determined by a timed 10m sprint. The time required to complete the trial was recorded by two sets of Microgate, Italy photocells. Two attempts were given interspersed by 3 min of rest. Interclass coefficient of variation (ICC) was 0.93 (p<0.001).

Long jump (LJ)

Lower-limb power was measured with a standing long jump test (LJ). Participants were instructed to jump as far as possible, while swinging their arms and land on both feet. The distance was measured using a flexible tape measure, placed along the ground from the take-off line to the landing point nearest to the take-off line. Interclass coefficient of variation (ICC) was 0.95 (p<0.001).

Hand grip strength (HGS)

Maximal isometric grip strength was measured using a Jamar Analogue Hand Dynamometer. Participants with the dominant arm flexed in the angle of 90° and placed by the side of the body, squeezed the dynamometer with a 3 sec maximum effort (14). Interclass coefficient of variation (ICC) was 0.94, (p<0.001)

Sit and reach test (SR)

Participants having their knees fully extended and hands parallel to the measur-
ing line, remaining at the same level, reached slowly forward as far as possible on a YMCA sit and reach box (foot-line at 22 cm at the level of the feet). The measuring position was maintained for at least two seconds. Interclass coefficient of variation (ICC) was 0.97, p<0.001.

**Change of Direction Velocity (CODV), 4-2-2-4 m fencing test**

Velocity of changing directions was measured using Microgate, Italy photocells with a 4-2-2-4 m shuttle test as described by Turner et al (28). Interclass coefficient of variation ICC was 0.91, (p<0.001).

**Visual Reaction Jump (VRJ)**

An Optojump, Migrogate, Italy device was used to evaluate the reaction time and movement time of the participants. The visual signal was presented as a change in the color of the PC portable screen. Participants from a semi squat position (approximately 110° from the vertical plane) on guard position had to perform a jumping start. According to the testing protocol, 3 trials interspersed by a 5-10s rest were performed and the mean value was recorded for further statistical processing. Interclass coefficient of variation ICC was 0.88, (p<0.01).

**Visual Choice Reaction Tests**

All measurements were undertaken with a Fitlight wireless reaction training system (EFS Training Science, USA), comprised of 6 RGB LED powered lights controlled by a tablet. The six led lights were placed on the vertical plane in a specific pattern that simulates the fencers body while in combat (on a standing board, in adjustable height in order to simulate head, chest, right and left arm and leg). Specifically, the central led device was placed at the height of the participant’s shoulder while performing a lunge. Two additional led lights were placed at a distance of 20cm on the right and on the left hand side of the central device. One additional light was placed 20cm above and two below the central light, respectively. The lights were activated 10 times in a randomized order with 5 sec rest between each flash. Two choice reaction fencing tests were performed. Participants had to react after the visual signal by performing a lunge (Visual Choice Reaction Lunge, VCRL) in the case of the first test and a step–lunge (Visual Choice Reaction Step and Lunge, VCRSL) in the case of the second. Mean movement time required to reach the led device was recorded. Each test was performed twice. Interclass coefficient of variation ICC was 0.86, (p<0.01).

**Velocity of lunge**

Fencers standing on their guard fencing position performed an explosive exten-
sion of the armed hand (Arm Velocity, AV), an extension of the arm followed by a lunge (Lunge velocity, LV) and an extension of the arm followed by a step and lunge (step-lunge velocity, SLV) with maximal effort in a randomized order. All measurements were made on a fencing piste, so as to simulate real time competition conditions. Velocity was determined using a robotically controlled encoder (1080 Motion Inc, North America). The encoder tip was held by the participant’s hand by a specific strap allowing movement transfer on the sagittal plane. All tests were performed twice and the best result was used for statistical processing. A 15s rest was taken between trials, while the rest between two consecutive tests was approximately 60s. The test-retest reliability for the arm, arm-lunge and arm-step and lunge tests was estimated to be 0.95, 0.91, 0.90, and 0.91 respectively (p< .001).

**STATISTICAL ANALYSIS**

All data were analyzed using SPSS for Windows (version 19). Data are presented as means and standard deviations (SD) and were analyzed for normality with Kolmogorov-Smirnov test. Differences between genders were tested with a t-test for independent samples. Test–retest reliability for all the dependent variables measured in this investigation was determined by calculating the intraclass correlation coefficient (ICC) using a 2-way mixed model. Relationships between measures of selected fencing kinetic patterns velocity, arm strength and leg power performance were examined by calculating Pearson’s product moment correlation coefficient (r). Moreover, a stepwise multiple linear regression was used to identify the best predictors of armed hand velocity (AV), lunge velocity (LV) step-lunge velocity (SLV) and velocity of changing direction (CODV), respectively. Calculation of effect sizes (n²) was undertaken (3). The magnitude was interpreted following Hopkins guidelines (8). For each analysis statistical significance was set at the α = 0.05 probability level.

**RESULTS**

All data were normally distributed and the ICC presented in the method section. The comparison between the two genders for selected anthropometric measures and physiological performance characteristics are presented in Tables 1, 2, 3, 4 and Figure 1 respectively. Significant between gender differences were observed in BMI (p=0.05, n²=0.96), % fat (p=0.001, n²=3.56) and PHV (p=0.001, n²=5.50) (Table 1). Males outperformed females in most of the selected physiological parameters such as SJ (p=0.008, n²=1.30), CMJ (p=0.008, n²=1.29),
VRJ ($p=0.001$, $n^2=1.17$), RJH ($p=0.05$, $n^2=0.91$), LJ ($p=0.001$, $n^2=87.79$), 10 m sprint ($p=0.005$, $n^2=1.37$), while females were more flexible compared to males ($p=0.001$, $n^2=1.34$).

Table 2
Selected performance measurements in long jump, 10 m sprint, Sit and Reach test and isometric hand grip strength of males and females young fencers

<table>
<thead>
<tr>
<th>Variables</th>
<th>Long jump (m)</th>
<th>10 m sprint (s)</th>
<th>Sit and reach (cm)</th>
<th>Hand grip strength (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males N=9</td>
<td>mean 1.92*</td>
<td>1.92**</td>
<td>25.90*</td>
<td>31.60</td>
</tr>
<tr>
<td></td>
<td>SD 0.20</td>
<td>0.13</td>
<td>4.70</td>
<td>6.80</td>
</tr>
<tr>
<td>Females N=13</td>
<td>mean 1.64</td>
<td>2.08</td>
<td>35.30</td>
<td>31.15</td>
</tr>
<tr>
<td></td>
<td>SD 0.12</td>
<td>0.10</td>
<td>8.70</td>
<td>7.20</td>
</tr>
</tbody>
</table>

*p = 0.001**p = 0.005 males vs females

SJ: squat jump, CMJ: countermovement jump, DJ: drop jump, RJH: repeated jump height, VRJ: visual reaction jump

Fig. 1 Jumping performance differences between male and female young fencers
Table 3
Drop jump contact time (DJCT), Repeated jumps contact times (RJCT) and Reaction Strength Indexes for Drop jump (RSIDJ) and repeated jumps (RSIRJ) of males and females young fencers

<table>
<thead>
<tr>
<th>Variables</th>
<th>DJCT (ms)</th>
<th>RJCT (ms)</th>
<th>RSIDJ (ms)</th>
<th>RSIRJ (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males N=9</td>
<td>mean 0.26</td>
<td>0.22</td>
<td>0.95</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>SD 0.05</td>
<td>0.02</td>
<td>0.30</td>
<td>0.30</td>
</tr>
<tr>
<td>Females N=13</td>
<td>mean 0.26</td>
<td>0.22</td>
<td>0.80</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>SD 0.08</td>
<td>0.03</td>
<td>0.30</td>
<td>0.30</td>
</tr>
</tbody>
</table>

Males had also superior performance in fencing tests such as in LV (p=0.05, n²=0.83) SLV (p = 0.002, n² =1.52) and CODV (p = 0.05, n² =2.21), as shown in (Table 4).

Table 4
Arm, lunge, step and lunge velocity and velocity of changing direction (CODV) performance measures of males and females young fencers

<table>
<thead>
<tr>
<th>Variables</th>
<th>Arm velocity (m/s)</th>
<th>Lunge velocity (m/s)</th>
<th>Step-lunge velocity (m/s)</th>
<th>CODV (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males N=9</td>
<td>mean 3.10***</td>
<td>3.60</td>
<td>4.30***</td>
<td>5.45*</td>
</tr>
<tr>
<td></td>
<td>SD 0.60</td>
<td>0.90</td>
<td>0.70</td>
<td>0.30</td>
</tr>
<tr>
<td>Females N=13</td>
<td>mean 2.80</td>
<td>2.90</td>
<td>3.30</td>
<td>6.50</td>
</tr>
<tr>
<td></td>
<td>SD 0.40</td>
<td>0.70</td>
<td>0.60</td>
<td>0.60</td>
</tr>
</tbody>
</table>

*** p = 0.002, * p = 0.05

Similar between gender abilities were observed in visual reaction tests (VRJ, VCRL, VCRSL). The only significant correlations between anthropometric characteristics and fencing tests were between fat percentage and SLV (r =-0.472, p=0.05) and CODV (r=-0.555, p=0.472). Significant correlations were observed between fencing performance tests and selected arm, leg strength and power measurements of the young fencers (n=22).
Correlation matrix between fencing performance tests and selected arm and leg strength and power measurements of the young males and females young fencers (n=22)

<table>
<thead>
<tr>
<th>S</th>
<th>CMJ</th>
<th>DJ</th>
<th>R</th>
<th>H</th>
<th>VR</th>
<th>RSIDJ</th>
<th>RSIRJ</th>
<th>LJ</th>
<th>10 m sprint</th>
<th>HGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV</td>
<td>.594*</td>
<td>.495*</td>
<td>.422*</td>
<td>.499*</td>
<td>ns</td>
<td>.435*</td>
<td>ns</td>
<td>-.444*</td>
<td>ns</td>
<td>.473*</td>
</tr>
<tr>
<td>LV</td>
<td>ns</td>
<td>Ns</td>
<td>ns</td>
<td>Ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>SLV</td>
<td>ns</td>
<td>.445*</td>
<td>ns</td>
<td>Ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>.486*</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>CODV</td>
<td>-.789**</td>
<td>-.775**</td>
<td>-.610**</td>
<td>-.508*</td>
<td>.522*</td>
<td>ns</td>
<td>-.475*</td>
<td>-.660**</td>
<td>.523*</td>
<td>ns</td>
</tr>
</tbody>
</table>

* p = 0.05, ** p = 0.01, SJ: squat jump, CMJ: countermovement jump, DJ: drop jump, R| H: repeated jump height, VR: visual reaction jump, RSIDJ: Drop jump Reaction strength index, RSIRJ: Repeated jumps Reaction strength index, LJ: Long jump, HGS: Hand grip strength

Moreover, significant correlations were also observed between AV and LV (r=0.654, p=0.01), CODV and AV (r=-0.511, p=0.05), LV (r=-0.435, p=0.05) and SLV (r=-0.635, p=0.01) respectively. A stepwise regression analysis showed that the best predictor of CODV was the SJ (R² = 0.623), while the best predictor of SLV was the LJ (R² = 0.198).

DISCUSSION

To our knowledge, this is the first study focusing on a young group of male and female fencers 13-14 years old, aiming to collectively describe anthropometric and neuromuscular performance indices and to investigate possible correlates to fencing performance (FL and CODV).

Early identification of physical characteristics has been associated with success in sports and can provide important information to talent identification, athletic monitoring during growth/maturation and individualization of the training process (9). To our knowledge only a few fencing studies have examined the anthropometric profile of young, well-trained fencers (19, 23). In Tsolakis et al. (23), a young group of 10-13 year old fencers was tested and no between gender differences in anthropometric characteristics were reported. In the present study the testing group was slightly older (12-14 year old fencers), in comparison to that of the previous aforementioned study and this probably resulted in significant anthrop-
pommetrical differences between genders. Specifically, female fencers were found to possess more body fat, a fact that resulted in higher BMI values compared to males. This finding can be attributed to the females' peak height velocity (PHV) that became apparent almost two years earlier compared to boys, revealing their maturity status, which is characterized by rapid increases in body fat (13).

Leg strength and power in fencing increase significantly over time in response to specific training stimuli (19) and are considered critical elements that determine successful fencing performance (24, 28). Such attributes can effectively discriminate elite from sub-elite fencers (25). The results of the present study can only be comparable to Ntai et al (19) by confirming the existence of gender differences in almost all leg power performance characteristics. Between gender data concerning leg power, provide an important consideration in the design of individualized and specific training programs for young fencers, not only to improve training adaptations but also to prevent leg injuries, which are more prominent in females fencers (20). Additionally, female fencers in the present study were significantly more flexible than males. This characteristic allows for advanced technical abilities, while performing fencing specific kinetic patterns at an ideal range of motion enabling female fencers to attack safely from longer distances (28).

Fencing is a powerful contact sport that requires concurrent technical motor skills and sensitive performance responses to the opponents’ signals (5). Reaction and movement times have been studied in fencing as specific kinetic task responses; however studies that focus on training protocols oriented to improve the process timing and subsequent kinetic response remain inconclusive (7). It has been reported that expert fencers are faster in discriminating the correct stimulus (4), whereas other studies have shown that elite fencers have a quicker response in choice reaction protocols in comparison to novice fencers (29, 30). At the same time, there is a lack of information concerning gender differences in fencing. The results of the present study showed similar between gender abilities. Although hormone levels were not tested in this study, the PHV values indicate the lack of male hormones which could differentiate the reaction time response between genders (15).

In contrast to the widely accepted notion that height and muscularity could positively affect fencing performance, it has been recently shown that linear anthropometric traits are not related to fencing performance, an observation that is also confirmed in the present study (24, 28). However, the relative advantage that height provides in regulating the opponents distance during competition, could be a critical factor of success in fencers with excessive leg strength and power capacity (1).

Additionally concerning % body fat it was negatively correlated to lunge time and CODv revealing the adverse effect that fat mass may have in weight bearing sports.
Only a few studies exist describing the association between strength, power and SLV characteristics in fencing (24, 25, 28). Although researchers followed different testing procedures, lunge time and CODV were negative correlated to selected measures of jumping performance (SJ, CMJ, LJ and reaction strength index). In this view, although there is a scarcity of information, Turner et al. (28) identified that lunge velocity (LV) and CODV in male junior fencers averaged at 3.35 m/s and 5.45 s respectively while standing long jump could explain fencing performance. Despite the fact that the participants of the present study were younger (under 14 years of age), similar results were obtained from the males in LV (3.6±0.90 m/s) and CODV (5.45± 0.60 s), revealing the excessive fencing abilities of this age group. Moreover, concerning the regression line, long jump was also found to be the best performance predictor for SLV, in the present study. This indicates that from a training perspective, coaches should include in their training schedules horizontal leg power exercises in combination to the vertical jumping exercises so as to allow the appropriate fencing adaptations to take place (31).

Generally, it has been shown that all strength components (isometric, eccentric and concentric) are utilized during different COD tests (10). More specifically, CODV tests seem to be associated with muscle strength of the participants, movement mechanics, exit velocity and increased elastic energy utilization during the eccentric phase of braking (11, 22). On the other hand, Negra et al. (18) found significant correlation between LJ and two different agility tests in a large group of participants. The results of the present study showed that CODV of the young fencers correlated with almost all leg power parameters (explosive strength, horizontal jumps, speed and reaction jump test) while SJ was the best CODV performance predictor confirming the findings by others (11, 18, 22).

Arm velocity (AV) in the present study, was found to correlate with hand grip strength and almost all leg power and speed parameters. In combat sports, jumping performance can explain approximately 75% of the variance in punching forces, highlighting the importance of legs’ contribution in the explosive extension of the arm to the target (12). The results of the present study expand our knowledge from previous fencing studies of Tsolakis and Vagenas (25) and Turner et al. (28), giving important information to coaches of a large number of different strength abilities to be trained so as to build the optimal neuromuscular profile for this age group.

CONCLUSION

In conclusion, male and female young fencers had comparable linear anthropometric characteristics while males were faster and more explosive than girls.
in all power tests and specific fencing measurements. Neuromuscular screening in this age group reveals similar information concerning older fencers reported in previous studies investigated correlates of fencing performance (25, 28). Although improvement in sport specific parameters is difficult to observed in these age groups (23), based on the results of the present study, trainers are advised to include both horizontal and vertical strength and power exercises in their training methodologies both horizontal and vertical strength and power exercises in order to improve not only functional but specific kinetic drills at early stages, as well.

REFERENCES


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