JTIKOR
(Jurnal Terapan Ilmu Keolahragaan)

e-ISSN: 2549-6360 | homepage: ejournal.upi.edu/index.php/JTIKOR/index
email: jtikor@upi.edu | DOI: 10.17509/jtikor.v6i1.31191

Original Arcticle | JTIKOR 6(1): 1-4 (April 2021) | DOI: 10.17509/jtikor.v6i1.31191

Anthropometric, Biomotor, and Physiological Factors for Indonesian Fencing Athletes Talent Identification

Dery Rimasa , Novrizal Achmad Novan, Komarudin

1 Program Studi Pendidikan Kepelatihan Olahraga, Fakultas Pendidikan Olahraga dan Kesehatan, Universitas Pendidikan Indonesia, Jawa Barat, Indonesia

Info Artikel

Sejarah Artikel

Didaftarkan: Januari 2021
Diterima: Maret 2021
Dipublikasikan: April 2021

Akses Artikel

Korespondensi

Deri Rimasa
Email: dery.rimasa@upi.edu
Alamat: Program Studi Pendidikan Kepelatihan Olahraga, Fakultas Pendidikan Olahraga dan Kesehatan Universitas Pendidikan Indonesia, Jl. Dr. Setiabudhi No.229 Bandung, Jawa Barat, Indonesia.

Abstrak

Tujuan: Perkembangan prestasi olahraga anggar melalui identifikasi bakat atlet anggar tampaknya bukan merupakan proses penting bagi pelatih atau klub untuk membantu mengembangkan program mereka. Tujuan penelitian ini adalah untuk mengetahui indikator-indikator yang mempengaruhi faktor-faktor keberhasilan atlet anggar agar hasilnya dapat diaplikasikan sebagai pengembangan melalui suatu model untuk mengidentifikasi bakat atlet anggar Indonesia. Populasi yang digunakan dalam penelitian ini adalah 100 ahli olahraga anggar di Indonesia yang terdiri dari 47 atlet anggar tingkat provinsi, 32 atlet nasional, 16 pelatih nasional, dan lima wasit nasional. Metode deskriptif kuantitatif digunakan dalam penelitian ini. Subjek mengisi bobot kriteria dalam kuesioner terkait skala faktor yang memberikan bobot pada indikator terpenting dalam aspek antropometri, biomotor, dan fisiologis. Pengolahan data statistik dilakukan melalui Analytical Hierarchy Process (AHP) dengan menggunakan software expert choice sehingga dapat dihasilkan model cerdas untuk mengidentifikasi bakat atlet anggar di Indonesia berdasarkan pembobotan masing-masing kriteria. Hasil penelitian menunjukkan bahwa faktor penyumbang terbesar dalam penentuan bakat calon atlet adalah antropometri sebesar 75%, faktor biomotor sebesar 13%, dan faktor fisiologis sebesar 12%. Mengakui karakteristik identifikasi bakat sebagai pertimbangan untuk pengembangan atlet yang sukses akan mengarah pada pemahaman yang lebih besar tentang bagaimana karakteristik bakat atlet dikembangkan.

Kata Kunci: Anggar, athlete development, faktor sukses, identifikasi bakat, beladiri

Abstract

The development of fencing sports achievements through talent identification of fencing athletes does not appear to be an important process for coaches or clubs to help develop their programs. The purpose of this study was to determine the indicators involved in influencing the success factors of fencing athletes so that the results can be applied as development through a model for identifying Indonesian fencing athletes' talents. The population used in this study was 100 fencing sports experts in Indonesia that consist of 47 fencing athletes at the provincial level, 32 national athletes, 16 national coaches, and five national referees. The quantitative descriptive method was used in this research. Subjects filled the criteria weights in a questionnaire related to a factor scale that gave weight to the most important indicators in the anthropometric, biomotor, and physiological aspects. Statistical data processing is carried out through the Analytical Hierarchy Process (AHP) using expert choice software so that an intelligent model can be produced to identify the talents of fencing athletes in Indonesia based on the weighting of each criterion. The results show that the greatest contributing factors in determining the talents of prospective athletes are anthropometrics by 75%, biomotor factors by 13%, and physiological factors by 12%. Recognizing talent identification characteristics as consideration for successful athlete development will lead to a greater understanding of how the talent characteristics of athletes are developed

Keywords: Fencing, talent identification, success factor, martial Arts, athlete development

Introduction

The talent identification process is an inseparable program for the development of sports achievement and generally described as an individual identification process that can predict athletes that they will excel in certain sports which will certainly contribute to their future achievements (Woods et al., 2016). Many athletes spend their back-breaking training from childhood to make themselves one of the elite athletes of the future. With the support of talent identification programs that are carried out as early as possible, they can develop their achievements to the maximum, so that at the right time they can obtain their highest results at the level of international competitions and perform a high level of skill (Walker et al., 2010).

Fencing, like most other sports, depends on many factors for success, including technical, tactical, psychological, and physical factors (Enrique et al., 2007a). Moreover, fencing is a blended mix of athletics, swordsmanship, and tactical maneuverability. To destroy an opponent's defense, the fencer needs a series of well-programmed moves. By combining strategic moves, the player can manipulate their opponent and create space to deliver clean stabs without being parried. On the other hand, the priority system is assigned to foil and saber games (Roi & Bianchedi, 2008a). In this context, when both players touch at the same time, regardless of who touched the opponent first, the winner will be determined by the priority rule that made the touch. This makes the main problem why the factors criteria on physical, physiological characteristics and the relationship between performance/skills are difficult to assess in fencing.

Therefore, on a physical basis, fencers need a set of abilities that describe the characteristics leading to their success in performance skills (Mohamed & Larion, 2018a). However, the analysis of style in each of the different weapons disciplines can differentiate between an advanced and a novice fencer. Although talent identification and development programs have been carried out as programs in many sports, this is still confusing because specifically in fencing there is no way in which talent should be identified, and no uniform theoretical framework is accepted to regulate the current practice. Based on this, contextually more representative assignments should be developed and used in a multidimensional design to increase the effectiveness of talent identification and development programs (Vaeyens et al., 2013).

The development of sports talent identification has advanced in several countries because it is very much needed and can effectively identify sports talent and development. For example, in 1994 a talent search scheme was issued in Australia to identify and develop talents for preparing for the 2000 Sydney Olympics. It is stated that the talent identification program should be considered as a combined process that emphasizes direction and development, not just the practice of identification and elimination (7). At the higher levels of a sports organization, science-based achievement support systems are now the basis for the preparation of elite athletes. However, due to the lack of a scientific basis for most talent identification programs, many experts suggest that research efforts should shift away from talent identification and detection towards talent development and mentoring (Durand-Bush & Salmela, 2002). The consequences for one's participation in sports and the identification of talents are enormous. It is recognized that gifted individuals will only realize their full potential when they are provided with appropriate and stimulating opportunities for talent development (Abbott et al., 2007b; Ward et al., 2007).

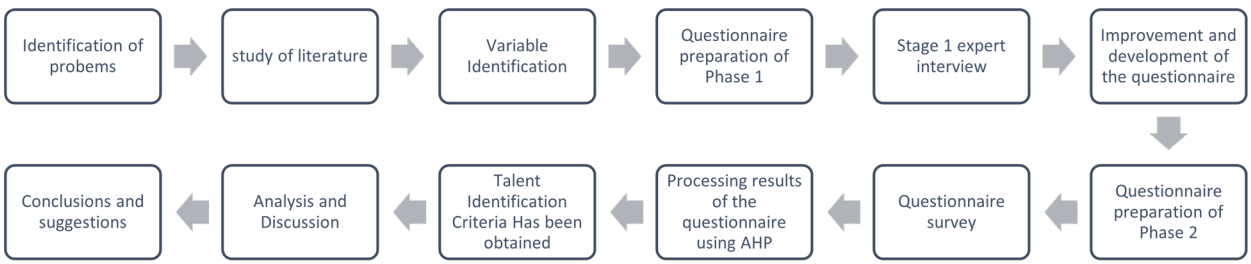


Figure 1. Flow diagram of the search strategy

Methods

Study Design

Quantitative descriptive research method with analytical survey techniques was used to find out the most important physical aspects of the talent identification model for fencing based on the expert choice. The Flow of research can be seen at **Figure 1** Gambar 1.

Participant

The research subjects include 100 fencing experts in Indonesia, which are spread in several provinces in Indonesia, and consist of 47 provincial-level fencing athletes, 32 national fencing athletes, 16 national coaches, and five national referees.

Instruments

The instrument used was An Analytical Hierarchy Process with Software Expert Choice V1, the discussion was administered using questionnaire via online-distributed form along with the Covid-19 pandemic which did not allow researchers to travel across provinces in Indonesia. Subjects filled the criteria weights in a questionnaire related to a factor scale that gave weight to the most important indicators in the anthropometric, biomotor, and physiological aspects.

Results and Discussions

From calculations using the analytical hierarchy process, Figure 2 showed the percentage of anthropometric sub-criteria with overall inconsistency 0.02. Including leg length 36.9%, arm span 24.3%, height 20.2%, body weight 6.6%, body fat 6.1%, and body mass index (BMI) 5.9%. By prioritizing leg length as the best choice of experts, of course, the importance of this sub-criteria is clearly illustrated considering that fencing mostly involves leg movements during the game. Moreover, the influence of anthropometric variables reflected basic characteristics of the human body that described by the skeleton length including leg length (Ochoa et al., 2013), and this determines the best way whether a certain group of individuals qualifies for fencing.

Meanwhile, from calculations using the analytical hierarchy process Figure 3 showed the percentage of biomotor sub-criteria with overall inconsistency 0, 05 including SAQ (Speed, Agility, Quickness) 32.2%, coordination 19.1%, muscle power 18.6%, flexibility 9.7%, stability 8.9%, strength endurance 5.7%, and muscle strength 5.7%. The footwork skill in fencing (SAQ) is a specific complex skill, and it should be done early in training as a foundation. With the basic footwork skills, it can be seen the importance of SAQ in this sport. This allows most coaches to alter and innovate in their training program considering these exercises have various forms of mobility, which are not only limited to linear movements, but also lateral and vertical movements (Jovanovic et al., 2011; Polman et al., 2009).

Furthermore, from calculations using the analytical hierarchy process Figure 4 showed the percentage of physiological sub-criteria with overall inconsistency 0.06 including aerobic power 30.3%, aerobic capacity (VO2Max) 17.8%, anaerobic capacity 38.9%, and vital capacity 13%. Rapid and frequent movements during the lunge to attack the opponent will provide a short burst of activity which implies that fencing is demanding for sources that release anaerobic energy. During bouts, fencing performs many high-intensity activities in a short time, so fencing constitutes a major source of anaerobic energy. The fencer required to demonstrate repetitive lunge ability in bouts that should be considered fundamental to performance, and the lunge is the most common form of attacking the opponent (Auili et al., 2013a).

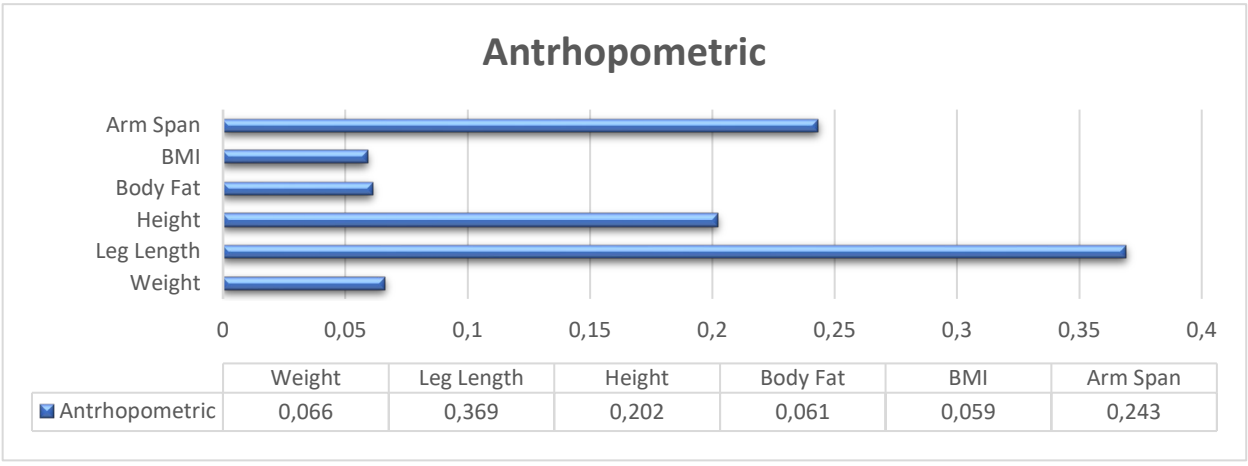
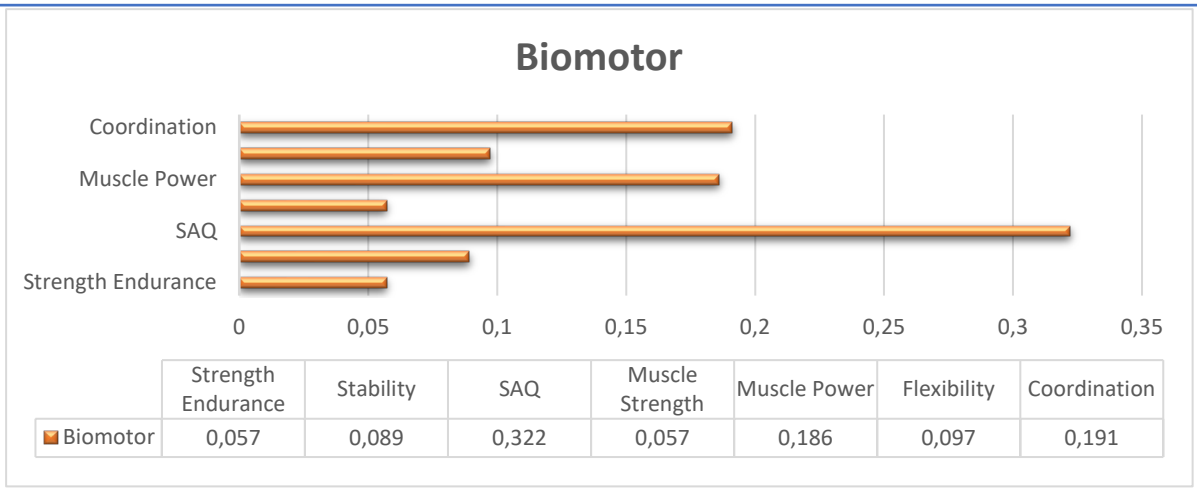
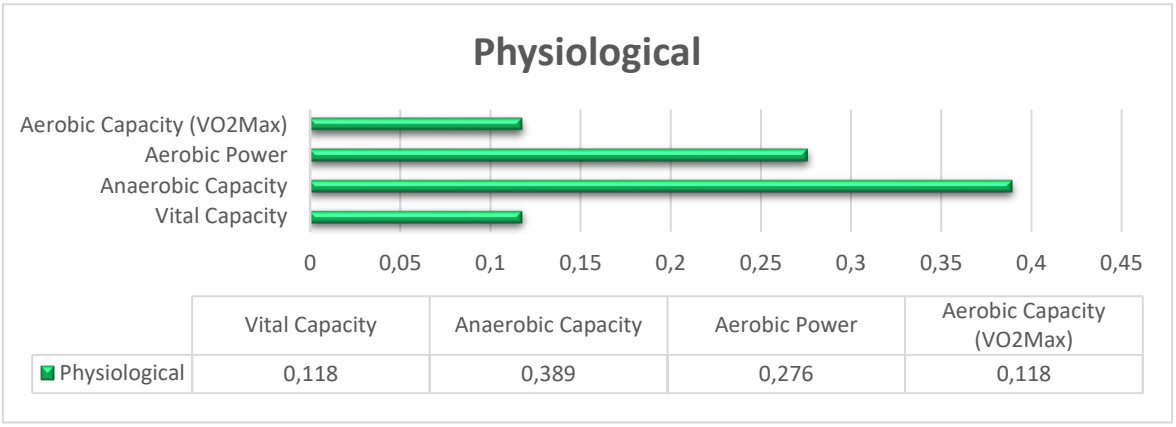


Figure 2. The results of anthropometric factors using expert choice software



	Strength Endurance	Stability	SAQ	Muscle Strength	Muscle Power	Flexibility	Coordination
Biomotor	0,057	0,089	0,322	0,057	0,186	0,097	0,191

Figure 3. The results of biomotor factors using expert choise software



	Vital Capacity	Anaerobic Capacity	Aerobic Power	Aerobic Capacity (VO2Max)
Physiological	0,118	0,389	0,276	0,118

Figure 4. The results of Physiological factors using expert choice software

Several variables in the evaluation of sports coaching impact involved elements of anthropometry, body composition, and strength (Zampagni et al., 2008). Therefore, researchers have studied various types of sports to develop methods of monitoring, evaluating, and identifying the talents of athletes (Peyer et al., 2011). Anthropometric characteristics and body structure of athletes, in general, have been shown to have a significant contribution to motor performance. In other words, most research on fencing is frequently using common descriptors that include % body fat, body mass, height, limb length, and segment circumferences (Roi & Bianchedi, 2008b). The results of the analysis from table 1 are taken from 100 respondents to give weight to the anthropometric criteria which are shown through the sub-criteria of height, weight, arm span, leg length, BMI, and body fat.

Anthropometric Criteria

Hierarchical Weighted Factor Matrix data processing for all normalized anthropometric criteria must be known and detailed so that information from each criterion can be analyzed.

Table 1 showed that leg length is 1/3 times more essential than body height, 1.5 times more essential than bodyweight, one time more essential than arm span, seven times more essential than the body mass index, and five times more essential than body fat. Leg length is measured as height minus sitting height. In other words, the longer fencer leg length certainly provides a wider range when doing lunges to attack the opponent. Also, this study is supported by the findings of other experts who stated the international fencer from a study was found to be significantly taller and heavier than the national fencer (Gravina et al., 2008). Each time bout, the fencer can move linearly around 250-1000m, strike 140 times, and change direction 400 times (Roi & Bianchedi, 2008b). So that with a longer leg length, the fencer will more easily approach the opponent considering that precise spacing at a certain distance when attacking the opponent will provide many advantages.

Leg length in fencing has recently been studied extensively with the conclusion that isometric contraction affects leg strength (Ntai et al., 2017). However, fencing is a sport that produces significant asymmetry (Roi & Bianchedi, 2008b). In the span of the arm, using weapons for a long time produces significant asymmetry both in strength and in the muscle cross-sectional area of the

Table 1. Hierarchical Weighted Factor Matrix for All Normalized Anthropometric Criteria

Anthropometric	Height	Weight	Arm Span	Leg Length	BMI	Body Fat	Mean
Height	0,170	0,214	0,259	0,116	0,278	0,188	0,202
Weight	0,057	0,071	0,086	0,070	0,056	0,063	0,066
Arm Span	0,170	0,214	0,259	0,348	0,167	0,313	0,243
Leg Length	0,511	0,357	0,259	0,348	0,389	0,313	0,369
BMI	0,034	0,071	0,086	0,050	0,056	0,063	0,059
Body Fat	0,057	0,071	0,052	0,070	0,056	0,063	0,061

Table 2. Hierarchical Weighted Factor Matrix for All Normalized Biomotor Criteria

Biomotor	Muscle Power	Strength Endurance	Muscle Strength	SAQ (Speed Agility Quickness)	Flexibility	Stability	Coordination	Mean
Muscle Power	0,158	0,176	0,176	0,102	0,220	0,273	0,200	0,186
Strength Endurance	0,053	0,059	0,059	0,061	0,024	0,091	0,067	0,057
Muscle Strength	0,053	0,059	0,059	0,061	0,024	0,091	0,067	0,057
SAQ (Speed Agility Quickness)	0,474	0,294	0,294	0,306	0,366	0,273	0,200	0,322
Flexibility	0,053	0,176	0,176	0,061	0,073	0,091	0,067	0,097
Stability	0,053	0,059	0,059	0,102	0,073	0,091	0,200	0,089
Coordination	0,158	0,176	0,176	0,306	0,220	0,091	0,200	0,191

forearm (Margonato et al., 1994). The leg length, which is responsible for walking on the piste and for a constant change direction and speed, has different requirements for dynamic forces (Auili et al., 2013b). It is crucial to make fast and precise moves and be able to surprise your opponent. Thus, it has been shown that the determining factors for executing a good lunge attack performance are the distance and speed achieved, even if the effect of training on simple movements can only be seen in more complex and global movements (Yiou & Do, 2000).

The fencer cannot master a performance skillfully without the support of the physical qualities required during bouts. Essentially, physical abilities such as repeating sprints at high intensity, muscle strength, and endurance, speed, agility, speed, and flexibility are required in fencing (Enrique et al., 2007b). Once the fencer believes to make a quick decision, it is important to react immediately before the opponent overtakes him, this requires good coordination to achieve speed and accuracy. The reaction time of the fencer when performing skills that require simple and complex responses was the study of various kinds of research. Several studies have shown that increasing difficulty recognizing stimuli and selecting the best response, develops motor and nerve reaction times (Pierson, 1956; Sanderson, 1983; Singer, 1968). The results of the analysis from table 2 are taken from 100 respondents to give weight to the biomotor criteria which are shown through the sub-criteria of coordination, flexibility, muscle power, muscle strength, SAQ, stability, and strength endurance.

Biomotor Criteria

Hierarchical weighted factor matrix data for all normalized Biomotor criteria makes it easier for us to analyze each criterion.

Table 2 showed that The SAQ is three times more essential than muscle power, five times more essential than strength endurance, five times more essential than muscle strength, five times more essential than flexibility, three times more essential than stability, one time more essential than coordination. Through the SAQ ability, the fencer will react more quickly to stimuli, initiate movements faster, and improve direction changes (J. Sheppard & Young, 2006). It is also a basic coordination requirement so that fencers can improve their motor control and agility (Young & Farrow, 2006). Fencing emphasized that the most important characteristic of fencers is the speed of their movement in response to an opponent's actions. Along with this, moving forward and backward footwork, as well as performing the lunge action every few steps are routine skills for the fencer. Thus, the SAQ is used to improve speed performance and the capacity to develop maximum strength during high-speed movement, because it manipulates and makes

Table 3. Hierarchical Weighted Factor Matrix for All Normalized Physiological Criteria

Physiological	Aerobic power	Vital capacity	Anaerobic capacity	Aerobic capacity (vo2max)	Mean
Aerobic power	0,3	0,375	0,375	0,167	0,276
Vital capacity	0,1	0,125	0,125	0,167	0,118
Anaerobic capacity	0,3	0,375	0,375	0,5	0,487
Aerobic capacity (vo2max)	0,3	0,125	0,125	0,167	0,118

better use of the stretch-contraction cycle of the muscle (Mohamed & Larion, 2018b).

Recent studies have shown a significant relationship between kinematic strategy, upper limb muscle activation, and fencing performance (Guilhem et al., 2014a). Besides, the positive relationship between fencing experience and information processing speed also had a critical effect on coordination performance. On the other hand, experienced athletes can ignore most signals while focusing on stimuli that are relevant to the implementation of effective technical and tactical actions (Milic et al., 2020). Furthermore, fencers are forced to reduce decision-making times as well as sensorimotor response times in their motor phase of motion by continuously performing under time pressure. As a result of muscular coordination, neuromuscular factors connected to the technical movement, there seems to be a strong correlation between reaction times, and hit accuracy (Auili et al., 2013b).

While fencing skills regarded reaction and dimensional perspective as the majority determinants, it is also important to consider the contribution of other parameters to performance. Physical demands are influenced by factors where the age, gender, level of training, technical and tactical skills used to face the opponent is critical to successful fencing. Hence, the fencer metabolic involvement is very high, but always submaximal when the fencer is superior to the opponents' technical and tactical abilities (Roi & Bianchedi, 2008b). Several studies have found a correlation between the repetition of sprint ability (shows speed endurance) in certain sports and anaerobic power tests. Therefore, that association makes fencing an anaerobic power-based sport (da Silva et al., 2010; Guilhem et al., 2014b; Pyne et al., 2008; Turner et al., 2016).

Physiological Criteria

Hierarchical weighted factor matrix data for all normalized Physiological criteria makes it easier for us to analyze each criterion.

Table 3 showed that anaerobic capacity is one time more important than aerobic power, three times more important than vital capacity, three times more important than aerobic capacity. Fencing requires basic alactic anaerobic strength, besides high-intensity training in short-duration sports requires an immediate supply of energy (Krishnan et al., 2017). One of the basic skills of fencing that distinguishes the elite and beginner fencer related to muscle power and leg power is the lunge when attacking (Roi & Bianchedi, 2008b). Thus, from the three factors that have been measured, it can be concluded that the contribution of the anthropometric criteria is 0.747 (75%), Biomotor 0.134 (13%), and Physiological 0.119 (12%). In future research, considering that fencing includes many short high-intensity explosive activities, and also the extent to which fencing uses anaerobic energy pathways should be further explored.

Conclusion

In conclusion, the relationship between physical abilities and perceptual-motor skills is closely related to successful performance in fencing (Tsolakis et al., 2010). Moreover, Strength and anthropometric variables that reflect physical ability have been used in a variety of sports to assess the impact of an exercise program (Fry et al., 2006). It is also used to develop methods of identifying talent that simultaneously improve fencer performance at various levels of competition (J. M. Sheppard et al., 2008). Based on opinions collected from fencers, coaches, and national referees in Indonesia. The results discussed in the study can be a valuable tool in identifying the talents of Indonesian fencer. Hopefully, it can provide feedback for fencing coaches in recruiting talented athletes by recognizing their particular characteristics, as well as provide numerical values for performance parameters from various criteria that are factors of success, track their progress and compete easily with other fencers.

Acknowledgments

The authors would like to thank Fencing sports activists in Indonesia, the Sports Coaching Education Program, and the University of Indonesia for enabling us to complete this extraordinary research.

References

Abbott, A., Collins, D., Abbott, A., & Collins, D. (2007a). Eliminating the dichotomy between theory and practice in talent identification and development : considering the role of psychology Eliminating the dichotomy between theory and practice in talent identification and development : considering the role of ps. January 2015, 37–41. https://doi.org/10.1080/02640410410001675324

Abbott, A., Collins, D., Abbott, A., & Collins, D. (2007b). Eliminating the dichotomy between theory and practice in talent identification and development : considering the role of psychology Eliminating the dichotomy between theory and practice in talent identification and development : considering the role of ps. January 2015, 37–41. https://doi.org/10.1080/02640410410001675324

Auili, A., Tancredi, V., Triossi, T., De Danctis, D., Padua, E., D'arcangelo, G., & Melchiorri, G. (2013a). Perfrmance anaylsis in Saber. Journal of Strength and Conditioning Research / National Strength & Conditioning Association, 27(3), 624–630.

Auili, A., Tancredi, V., Triossi, T., De Danctis, D., Padua, E., D'arcangelo, G., & Melchiorri, G. (2013b). Perfrmance anaylsis in Saber. Journal of Strength and Conditioning Research / National Strength & Conditioning Association, 27(3), 624–630.

da Silva, J. F., Guglielmo, L. G. A., & Bishop, D. (2010). Relationship Between Different Measures of Aerobic Fitness and Repeated-Sprint Ability in Elite Soccer Players. Journal of Strength and Conditioning Research, 24(8), 2115–2121. https://doi.org/10.1519/JSC.0b013e3181e34794

Durand-Bush, N., & Salmela, J. H. (2002). The development and maintenance of expert athletic performance: Perceptions of world and olympic champions. Journal of Applied Sport Psychology, 14(3), 154–171. https://doi.org/10.1080/10413200290103473

Enrique, L., Francisco, S., Enrique, N., Oscar Martínez, de Q., & Raquel, de A. (2007a). Analysis of the Fencing Lunge Flight Phase in Epee. 12th Annual Congress Ofthe ECSS, 1(July), 2007.

Enrique, L., Francisco, S., Enrique, N., Oscar Martínez, de Q., & Raquel, de A. (2007b). Analysis of the Fencing Lunge Flight Phase in Epee. 12th Annual Congress Ofthe ECSS, 1(July), 2007.

Fry, A. C., Ciroslan, I. D., & Schilling, B. K. (2006). Anthropometric and Performance Variables. J Strength Cond Res, 20(4), 861–866.

Gravina, L., Gil, S. M., Ruiz, F., Zubero, J., Gil, J., & Irazusta, J. (2008). Anthropometric and Physiological Differences Between First Team and Reserve Soccer Players Aged 10-14 Years at the Beginning and End of the Season. Journal of Strength and Conditioning Research, 22(4), 1308–1314. https://doi.org/10.1519/JSC.0b013e31816a5c8e

Guilhem, G., Giroux, C., Couturier, A., Chollet, D., & Rabita, G. (2014a). Mechanical and muscular coordination patterns during a high-level fencing assault. Medicine and Science in Sports and Exercise, 46(2), 341–350. https://doi.org/10.1249/MSS.0b013e3182a6401b

Guilhem, G., Giroux, C., Couturier, A., Chollet, D., & Rabita, G. (2014b). Mechanical and muscular coordination patterns during a high-level fencing assault. Medicine and Science in Sports and Exercise, 46(2), 341–350. https://doi.org/10.1249/MSS.0b013e3182a6401b

Jovanovic, M., Sporis, G., Omrcen, D., & Fiorentini, F. (2011). Effects of Speed, Agility, Quickness Training Method on Power Performance in Elite Soccer Players. Journal of Strength and Conditioning Research, 25(5), 1285–1292. https://doi.org/10.1519/JSC.0b013e3181d67c65

Krishnan, A., Sharma, D., Bhatt, M., Dixit, A., & Pradeep, P. (2017). Comparison between standing broad jump test and wingate test for assessing lower limb anaerobic power in elite sportsmen. Medical Journal Armed Forces India, 73(2), 140–145. https://doi.org/10.1016/j.mjafi.2016.11.003

Margonato, V., Roi, G. S., Cerizza, C., & Galdabino, G. L. (1994). Maximal isometric force and muscle cross-sectional area of the forearm in fencers. Journal of Sports Sciences, 12(6), 567–572. https://doi.org/10.1080/02640419408732207

Milic, M., Nedeljkovic, A., Cuk, I., Mudric, M., & García-Ramos, A. (2020). Comparison of reaction time between beginners and experienced fencers during quasi-realistic fencing situations. European Journal of Sport Science, 20(7), 896–905. https://doi.org/10.1080/17461391.2019.1671498

Mohamed, S. A., & Larion, A. (2018a). Effect of S.a.Q Training on Certain Physical Variables and Performance Level for Sabre Fencers. Ovidius University Annals, Series Physical Education & Sport/Science, Movement & Health, 18(1), 46–51.

Mohamed, S. A., & Larion, A. (2018b). Effect of S.a.Q Training on Certain Physical Variables and Performance Level for Sabre Fencers. Ovidius University Annals, Series Physical Education & Sport/Science, Movement & Health, 18(1), 46–51.

Ntai, A., Zahou, F., Paradisis, G., Smirniotou, A., & Tsolakis, C. (2017). Caractéristiques anthropométriques et puissance en escrime : relation avec l'âge, le sexe et l'arme. Science and Sports, 32(3), 135–143. https://doi.org/10.1016/j.scispo.2016.06.011

Ochoa, A., Gutiérrez, G., Margain, L., & De Luna, A. (2013). Determining anthropometry related with Fencing using social data mining. Journal of Physical

Education and Sport Management, 4(3), 31–35. https://doi.org/10.5897/JPESM2011.016

Peyer, K. L., Pivarnik, J. M., Eisenmann, J. C., & Vorkapich, M. (2011). Physiological Characteristics of National Collegiate Athletic Association Division I Ice Hockey Players and Their Relation to Game Performance. Journal of Strength and Conditioning Research, 25(5), 1183–1192. https://doi.org/10.1519/JSC.0b013e318217650a

Pierson, W. R. (1956). Comparison of fencers and nonfencers by psychomotor, space perception and anthropometric measures. Research Quarterly of the American Association for Health, Physical Education and Recreation, 27(1), 90–96. https://doi.org/10.1080/10671188.1956.10612855

Polman, R., Bloomfleld, J., & Edwards, A. (2009). Effects of SAQ training and small-sided games on neuromuscular functioning in untrained subjects. International Journal of Sports Physiology and Performance, 4(4), 494–505. https://doi.org/10.1123/ijspp.4.4.494

Pyne, D. B., Saunders, P. U., Montgomery, P. G., Hewitt, A. J., & Sheehan, K. (2008). Relationships Between Repeated Sprint Testing, Speed, and Endurance. Journal of Strength and Conditioning Research, 22(5), 1633–1637. https://doi.org/10.1519/JSC.0b013e318181fe7a

Roi, G. S., & Bianchedi, D. (2008a). The science of fencing: Implications for performance and injury prevention. In Sports Medicine (Vol. 38, Issue 6, pp. 465–481). Springer. https://doi.org/10.2165/00007256-200838060-00003

Roi, G. S., & Bianchedi, D. (2008b). The science of fencing: Implications for performance and injury prevention. In Sports Medicine (Vol. 38, Issue 6, pp. 465–481). Springer. https://doi.org/10.2165/00007256-200838060-00003

Sanderson, F. H. (1983). The effect of directional uncertainty on reaction time and movement time in a fencing task. Journal of Sports Sciences, 1(2), 105–110. https://doi.org/10.1080/02640418308729667

Sheppard, J. M., Cronin, J. B., Gabbett, T. J., Mcguigan, M. R., Etxebarria, Naroa., & Newton, R. U. (2008). Relative Importance of Strength, Power, and Anthropometric Measures to Jump Performance of Elite Volleyball Players. New York, 22(3), 758–765.

Sheppard, J., & Young, W. (2006). Agility literature review: Classifications, training and testing. In Journal of Sports Sciences (Vol. 24, Issue 9, pp. 919–932). Taylor & Francis . https://doi.org/10.1080/02640410500457109

Singer, R. N. (1968). Speed and accuracy of movement as related to fencing success. Research Quarterly of the American Association for Health, Physical Education and Recreation, 39(4), 1080–1083. https://doi.org/10.1080/10671188.1968.10613465

Tsolakis, C., Kostaki, E., & Vagenas, G. (2010). Anthropometric, Flexibility, Strength-Power, and Sport-Specific Correlates in Elite Fencing. Perceptual and Motor Skills, 110(3C), 1015–1028. https://doi.org/10.2466/05.25.26.pms.110.c.1015-1028

Turner, A. N., Marshall, G., Phillips, J., Noto, A., Buttigieg, C., Chavda, S., Downing, W., Atlay, N., Dimitriou, L., & Kilduff, L. (2016). Physical Characteristics Underpinning Repetitive Lunging in Fencing. Journal of Strength and Conditioning Research, 30(11), 3134–3139. https://doi.org/10.1519/JSC.0000000000001402

Vaeyens, R., Güllich, A., Warr, C. R., & Philippaerts, R. (2013). Talent identification and promotion programmes of Olympic athletes. Journal of Sports Sciences, 27(May 2013), 1367–1380. https://doi.org/10.1080/02640410903110974

Walker, I. J., Nordin-Bates, S. M., & Redding, E. (2010). Talent identification and development in dance: A review of the literature. In Research in Dance Education (Vol. 11, Issue 3, pp. 167–191). Routledge . https://doi.org/10.1080/14647893.2010.527325

Ward, P., Hodges, N. J., Starkes, J. L., & Williams, A. M. (2007). The road to excellence: deliberate practice and the development of expertise. High Ability Studies, 18(2), 119–153. https://doi.org/10.1080/13598130701709715

Woods, C. T., Raynor, A. J., Bruce, L., McDonald, Z., & Robertson, S. (2016). The application of a multi-dimensional assessment approach to talent identification in Australian football. Journal of Sports Sciences, 34(14), 1340–1345. https://doi.org/10.1080/02640414.2016.1142668

Yiou, E., & Do, M. C. (2000). In fencing, does intensive practice equally improve the speed performance of the touche when it is performed alone and in combination with the lunge? International Journal of Sports Medicine, 21(2), 122–126. https://doi.org/10.1055/s-2000-8864

Young, W., & Farrow, Damian. (2006). A Review of Agility: Practical Applications for Strength and Conditioning - ProQuest. Strength and Conditioning Journal, 28(5), 24–29.

Zampagni, M. L., Casino, D., Benelli, P., Visani, A., Marcacci, M., & De Vito, G. (2008). Anthropometric and Strength Variables to Predict Freestyle Performance Times in Elite Master Swimmers. Journal of Strength and Conditioning Research, 22(4), 1298–1307. https://doi.org/10.1519/JSC.0b013e31816a597b