

***Physical Fitness Norms For Prospective Regional-Level Pencak Silat Referees:  
A Battery Test Approach In Serang City***

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***Abstract***

*The assessment of pencak silat referee competence has long been dominated by technical and theoretical evaluations, yet it lacks standardized objective physical fitness parameters, particularly for the novice category. This study aims to develop physical condition battery test norms as a biological evaluation instrument for prospective regional-level referees in Serang City in 2026. Employing a quantitative descriptive design, the study involved 21 novice referees selected via total sampling. Data were collected through five measurement dimensions: Multistage Fitness Test (MFT), Whole Body Reaction (WBR), Balance, Push Up, and Vertical Jump. The conversion procedure involved aggregating raw scores from all instruments, which were subsequently classified using a 5-point scale Norm-Referenced Assessment (PAN) based on the Mean (22.9) and Standard Deviation (7.8). The results established five physical readiness categories: Excellent (Score  $\geq 35$ ), Good (27-34), Average (19-26), Poor (12-18), and Very Poor ( $\leq 11$ ). These findings provide an evidence-based selection framework that enables the IPSI Serang City Branch to validate the physical readiness of referees objectively prior to official championship assignments.*

***Keywords:*** *fitness norms, battery test, referee, pencak silat, physical condition.*

**INTRODUCTION**

Pencak silat is a martial art where matches occur with very high intensity and dynamics, involving explosive and intermittent physical demands (Aditia & Gilang, 2020; Sutrisno & Wibowo, 2020). In every pencak silat championship, the role of match officials, especially the referee, is vital to ensure matches run according to regulations, maintain athlete safety, and provide objective assessments. Referees are frequently required to process visual stimuli and make split-second decisions,

considering that attacking and defensive techniques are executed in mere milliseconds (Hidayat & Mulyana, 2018). Following the updated competition regulations by the International Pencak Silat Federation (PERSILAT), match intensity has become even higher (PB IPSI, 2022). Referees are required to move actively throughout the fight to obtain the best visual perspective. Physical fatigue in referees can directly lead to decreased concentration levels, which ultimately risks inaccurate decision-making (Weston et al., 2012).

The complexity of refereeing in pencak silat is further exacerbated by the continuous evolution of competition rules. The central IPSI frequently evaluates and updates these regulations to enhance match dynamics, compelling referees to continually upgrade their theoretical understanding and practical application (PB IPSI, 2022). Adapting to these annual regulatory changes requires not only cognitive sharpness but also superior physical conditioning, allowing referees to maintain the optimal positioning needed to enforce the latest rules accurately (Pratama, 2022; Weston et al., 2012).

Experience is highly necessary for pencak silat referees, especially in terms of determining and maintaining the safety of the fighters. However, another critical aspect is a referee's fitness and physical condition, which will undoubtedly affect their concentration level (Aditia & Gilang, 2020; Pratama, 2022). This aligns with recent findings by Erickson et al. (2019), asserting that cardiovascular adaptation due to physical training consistently correlates with increased brain anatomical structure volume and cognitive processing efficiency. The relationship between physical fitness levels and cognitive functions, specifically attention and concentration, has become a crucial focus in sports physiology and neuroscience studies (Hidayat & Mulyana, 2018). Improvements in cardiorespiratory fitness have been proven to directly optimize cerebral blood flow, which distributes oxygen and glucose supplies to the prefrontal cortex area, the control center for the brain's executive functions.

Preliminary field observations conducted in Serang City reveal that referee development, particularly at the regional or novice level, predominantly focuses on the theoretical understanding of rules and hand gestures. Consequently, novice referees prepared for regional championships lack comprehensive parameters to

assess their overall physical readiness. Unlike previous studies that mostly focused on single physical tests or athlete profiles (Araujo et al., 2014; Setiawan, 2019), few studies have developed specific standard norms for pencak silat referees using a multidimensional battery test approach. Therefore, developing a complete fitness profile through a physical condition battery test is essential. This study aims to comprehensively develop physical fitness norms for prospective regional-level pencak silat referees in Serang City to contribute as a scientific recruitment guideline.

## **METHODS**

### **Research Design**

This study utilized a quantitative approach with an exploratory descriptive method. This design was chosen as it aligns with the primary goal of capturing the factual profile of the subjects' physical abilities for subsequent classification into standard norms. Data collection was conducted in Serang City in early 2025 at adequate sports facilities to ensure valid testing. The population in this study consisted of all prospective regional-level (novice) pencak silat referees under the Serang City IPSI Branch. Given the limited population size, a total sampling technique was used, involving 21 individuals. This was done to obtain normative data representing the characteristics of all referees in the region.

Data were collected via one-day testing covering the Physical Condition Battery Test. Five instruments were measured: (1) 1-minute Push Up for arm strength, (2) Vertical Jump for leg explosive power, (3) Stork Stand Test (Balance) for equilibrium, (4) Whole Body Reaction (WBR) for motor reaction speed, and (5) Multistage Fitness Test (MFT) for aerobic endurance. These specific instruments were selected over other validated alternatives because they comprehensively represent the unique multidimensional physiological demands of pencak silat officiating. Furthermore, the selection of these test components was also based on the specific requirements and formal requests from the IPSI Serang City Branch to ensure alignment with local administrative and technical standards. Based on the sport's biomechanical characteristics, referees require explosive evasive mobility, robust postural stability to maintain visual angles, rapid neuromuscular responses,

and sustained aerobic capacity to prevent central fatigue during prolonged tournament brackets (Morrow et al., 2015; Sutrisno & Wibowo, 2020). The procedures for the aforementioned tests are described as follows: To measure the strength and endurance of the upper extremity muscles, the researchers used a 60-second Push-Up test. This test is performed starting in a prone position, supported by the toes and palms shoulder-width apart. Subjects are instructed to lower their body until the chest almost touches the floor, then push back up until the arms are fully extended while keeping the back posture straight. The recorded score is the accumulation of valid movement repetitions over a full minute (ACSM, 2018).

The measurement of leg explosive power is evaluated using the Vertical Jump instrument. This test measures the difference between the maximum standing reach and the highest jumping point the subject can achieve. Subjects are given three attempts, bending their knees as a preparatory phase (eccentric phase) before executing a maximum vertical jump. The best value from the three attempts is recorded as the final result (Haff & Triplett, 2015).

The ability to maintain the body's center of gravity on a static support base is measured through the Stork Stand Test. In this measurement, the subject stands on one foot on their tiptoes, while the sole of the other foot is placed on the inside of the supporting knee, with both hands on the hips. The duration of balance is recorded from the moment the heel is lifted until the subject loses balance, indicated by the dropping of the heel, releasing of the hands, or shifting of the lifted foot (Johnson & Nelson, 1986; Lacy & Williams, 2018).

Furthermore, the processing speed of peripheral and central nervous signals is evaluated using the Whole Body Reaction (WBR) test. Subjects are asked to respond to an unexpected stimulus (visual or audio) as quickly as possible by shifting movement from the sensor area. The instrument automatically records the time delay (reaction time) in milliseconds required by the subject from the appearance of the stimulus to the occurrence of a reactive motor movement (Magill & Anderson, 2017).

The last measurement series, maximal cardiorespiratory endurance capacity (VO<sub>2</sub> Max) is estimated through a standard field test, namely the Multistage Fitness Test (MFT). This 20-meter interval shuttle run test requires subjects to run to the

rhythm of an audio cue, the intervals of which become increasingly faster at each level. The measurement is stopped when the subject is no longer able to keep up with the rhythm or fails to reach the boundary line twice consecutively. The final level and shuttle achieved are then converted into an estimated VO2 Max value for the subject (Léger & Lambert, 1982).

To account for the different units of measurement across the five instruments (e.g., repetitions, centimeters, seconds, and milliseconds), the raw data obtained from the field were initially converted into standardized scale scores based on a predefined physical fitness rubric. These converted scores were subsequently aggregated to calculate the Total Score for each subject. All descriptive statistical analyses, including the calculation of the Mean ( $\mu$ ) and Standard Deviation ( $\sigma$ ), were performed using IBM SPSS Statistics version 26.0 software. Furthermore, the categorization of the Total Score was processed using a 5-scale Norm-Referenced Assessment (PAN) based on the normal distribution curve (Sudijono, 2011). The explicit mathematical formulation used to determine the boundary intervals for each norm category is presented as follows:

**Table 1.** Mathematical Formulation Used To Determine The Boundary Intervals For Each Norm Category

<i>Category</i>	<i>Mathematical Formula</i>
<i>Excellent</i>	$X \geq \mu + 1.5\sigma$
<i>Good</i>	$\mu + 0.5\sigma \leq X < \mu + 1.5\sigma$
<i>Average</i>	$\mu - 0.5\sigma \leq X < \mu + 0.5\sigma$
<i>Poor</i>	$\mu - 1.5\sigma \leq X < \mu - 0.5\sigma$
<i>Very Poor</i>	$X < \mu - 1.5\sigma$

(Note:  $X$  represents the individual's accumulated Total Score,  $\mu$  represents the population Mean, and  $\sigma$  represents the Standard Deviation).

## RESULTS

This study, conducted in 2026, evaluates 21 prospective novice pencak silat referees in Serang City. Before dissecting the fitness norms, mapping the subjects' demographic profiles is absolutely necessary to understand their physical background completely. Based on cross-tabulation results, participants consisted of quite varied age and gender backgrounds, although still dominated by a particular

group.

Out of a total of 21 subjects, the gender composition showed a male (L) dominance with 15 individuals (71.4%), while female referees (W) numbered 6 individuals (28.6%). The participants' age range spanned from the youngest at 21 years old to the oldest reaching 41 years old, with an overall mean age of 29.1 years and a standard deviation of 6.27 years.

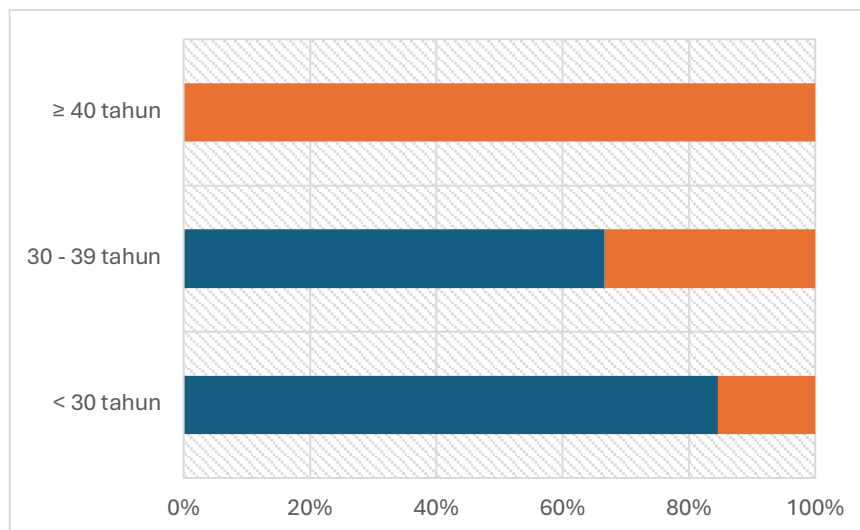
To facilitate analysis, the subjects' ages were classified into three biological clusters: Early Adulthood (< 30 years), Middle Adulthood (30–39 years), and Pre-Elderly ( $\geq$  40 years). The distribution of the number of subjects along with the average Total Score achievement of the battery test in each cluster is presented in Table 2.

**Table 2.** Demographic Characteristics of Pencak Silat Referees in Serang City in 2026

Age	Gender male	Gender female	total	%
< 30 years	11	2	13	61,9
30 - 39 years	4	2	6	28,6
$\geq$ 40 years	0	2	2	9,5
<b>Total</b>	15	6	21	100

When examined from a separate gender perspective, male subjects cumulatively recorded an average Total Score of 25.33, while female subjects were far below with an average of 16.67. With a distribution of 61.9% of pencak silat referees recorded in the <30 years age group, >80% are dominated by males and the rest are females; whereas in the 30-39 years age group, >70% are dominated by males and the rest are females; and for the age  $\geq$  40 years, no male gender is recorded, there are only female referees.

This demographic gap is the foundation of why the standardization of norms cannot be generalized without considering the physiological phenomena behind it.



**Figure 1.** Demographic Diagram of Pencak Silat Referees in Serang City in 2026

Based on tests conducted on 21 prospective novice pencak silat referees in Serang City in 2026, a range of accumulated values was obtained from the five battery test instruments (MFT, WBR, Balance, Push Up, Vertical Jump).

**Table 3.** Data of Prospective Novice Pencak Silat Referees in Serang City in 2026

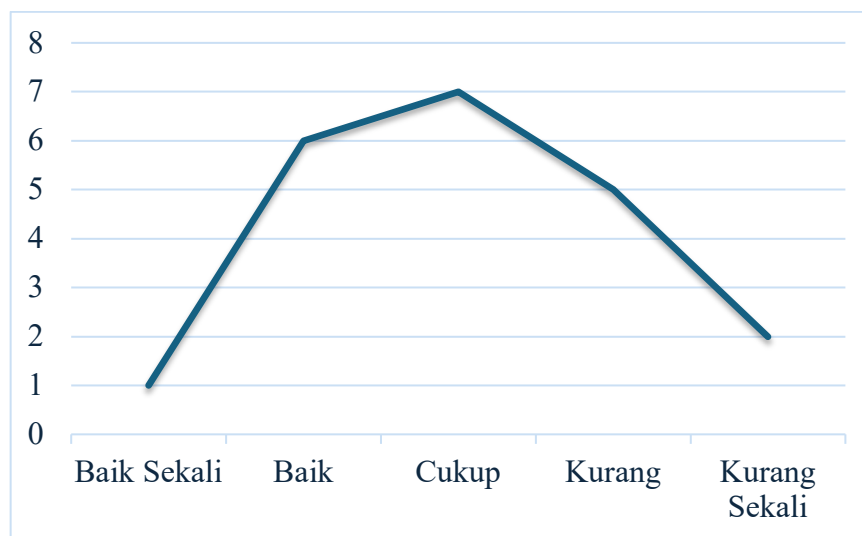
Data Description	Value
Sample Size (n)	21
Minimum Value	9
Maximum Value	37
Mean ( $\mu$ )	22,9
Standard Deviation ( $\sigma$ )	7,8

The descriptive statistical calculation of the Total Score showed a Minimum Value of 9 and a Maximum Value of 37. The Mean value of the entire population was 22.9 with a Standard Deviation of 7.8.

**Tabel 4.** Physical Condition Battery Test Norms for Novice Pencak Silat Referees in Serang City in 2026

Category	Score Range
Excellent	$\geq 35$
Good	27 - 34
Average	19 - 26
Poor	12 - 18
Very Poor	$\leq 11$

The norm distribution was then organized into standard normal curve intervals to establish physical condition classifications. The Excellent category has a threshold of  $X > 34.6$  with an accumulated score range of  $\geq 35$ . The Good category is set at scores 27-34. The Average category is set at scores 19-26. The Poor category ranges from 12-18, and the Very Poor category is for scores  $\leq 11$ .



**Figure 2.** Data Distribution Diagram of Prospective Novice Pencak Silat Referees in Serang City in 2026

From the frequency distribution of the 21 samples, 1 individual was in the Excellent category, 6 in Good, 7 in Average, 5 in Poor, and 2 in the Very Poor category.

## DISCUSSION

The research results indicate that the physical condition of novice referees in Serang City is predominantly within the Average (33.3%) and Good (28.5%) categories. However, a significant gap remains to be evaluated, with 33.3% of the sample (7 individuals) falling into the Poor and Very Poor categories. These findings highlight the urgency of adopting holistic evaluation instruments. Single physical test approaches have proven unable to entirely capture the multidimensional nature of a referee's overall fitness and performance capabilities (Morrow et al., 2015; Weston et al., 2012); thus, a comprehensive battery test serves as the optimal methodological solution to address this limitation. The implementation of the battery test in this study highlighted a crucial multidimensional factor: a referee cannot rely solely on visual reaction speed (WBR) without the foundational support of cardiorespiratory endurance (MFT) and robust postural balance (Magill & Anderson, 2017; Weston et al., 2012). This aligns with studies by Castagna et al. (2007) and Hidayat & Mulyana (2018), which confirm that without adequate aerobic capacity, central fatigue in match officials can trigger slowed conscious nerve responses and lead to misinterpreted rules during critical moments. Furthermore, balance is a vital variable because, in high-intensity matches, athletes frequently launch combination attacks that force referees to move backward or sideways explosively. Postural stability ultimately represents a referee's authority and positional awareness on the mat (Sutrisno & Wibowo, 2020).

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a referee's authority and positional awareness on the mat (Sutrisno & Wibowo, 2020).

The demographic review in this study presents a finding that seems counter-intuitive. Generally, it is assumed that a younger age will always yield superior physical fitness. However, the data shows that the Middle Adulthood age group (30-39 years) actually recorded the highest average Total Score (26.17), surpassing the Early Adulthood group (< 30 years), which recorded a score of 23.23. This phenomenon aligns with previous studies in match officiating physiology, which suggest that referees often reach their peak overall performance in their thirties (Castagna et al., 2007; Weston et al., 2012). As match officials mature, they develop superior movement economy, tactical positioning, and neuromuscular pacing. These acquired experiential adaptations allow them to execute physical tasks and manage match demands more efficiently than their younger counterparts, who may rely solely on raw physical capacity without optimal energy expenditure strategies.

This phenomenon can be explained through the theory of neuromuscular maturity (Haff & Triplett, 2015). Although ages under 30 have the potential for faster elasticity and recovery, the 30s age group in the context of martial arts practitioners has often reached the phase of muscle adaptation maturity (muscle maturity) and biomechanical efficiency. Years of movement experience allow this age group to conserve energy through movement economy when undergoing physical tests such as Push Up and Balance, enabling them to obtain optimal accumulated scores without excessive fatigue (Magill & Anderson, 2017).

Nevertheless, the decline in physiological function (aging effect) is unavoidable once referees enter the age of 40 and above. The data indicates that the Pre-Elderly group ( $\geq 40$  years) experiences a drastic plummet in performance to an average figure of 10.50 (Very Poor Category). The decline in fast-twitch muscle fibers governing explosive power (Vertical Jump) and lung work capacity (MFT) makes referees at this age the most high-risk group (ACSM, 2018; Haff & Triplett, 2015). This demands that the Serang City IPSI begin implementing strict field assignment age limit regulations, or shift senior referees to roles that do not require high mobility, such as the Board of Judges or Arena Observers.

The distribution of the number of subjects examined by gender also reveals a sharp gap. Female referees (W) recorded an average score of 16.67 (Poor Category), lagging quite far behind the average of male referees (L) who were at a score of 25.33 (Average/Good Category). This gap is most evident in test instruments based on aerobic capacity and upper-body strength. This disparity is consistent with previous findings by Setiawan (2019) and Kusuma (2021), who reported similar physiological gaps among regional martial arts referees, emphasizing that female officials often face greater challenges in meeting standard anaerobic and aerobic thresholds compared to their male counterparts.

Anatomically, males naturally have higher levels of testosterone and hemoglobin, which facilitates superior oxygen distribution ( $VO_{2max}$ ) and muscle hypertrophy (ACSM, 2018; Morrow et al., 2015). However, pencak silat matches—both in the men's and women's classes—operate with the same arena dimensions, round duration, and attack intensity (PB IPSI, 2022). Female referees are required to possess mobility and reaction times (WBR) as sharp as male referees when avoiding collisions or separating athletes (Sutrisno & Wibowo, 2020). Therefore, the compilation of this combined test battery norm acts as a biological equalizer. The norm does not categorize passing based on gender, but rather on the work demands in the arena. This implies that if female referee candidates wish to obtain the same license and assignment in high-level regional championships, they require a physical conditioning program intervention that is far more intensive than males, particularly in the endurance and core muscle aspects, in order to achieve the minimum passing threshold (Average Category).

## **CONCLUSION**

This study concludes that the physical condition battery test instrument is highly effective in comprehensively mapping the functional and biological profile of prospective regional-level pencak silat referees. Through score range calculations, fitness norm classifications have been structured into five objective categories: Excellent ( $\geq 35$ ), Good (27-34), Average (19-26), Poor (12-18), and Very Poor ( $\leq 11$ ). From the demographic data review of 2026, it was found that the peak of movement efficiency actually occurs in the 30-39 years age group, while the age group above 40 years and the female gender group urgently require specific

physical training program interventions to meet the workload in the arena.

These developed norms confirm that visual reaction speed must absolutely be balanced by cardiorespiratory endurance capacity, postural stability, and leg explosive power to prevent central fatigue that triggers decision-making errors. This classification table is highly recommended to be adopted as a formal screening instrument by the Serang City IPSI Branch Management to ensure the readiness and professionalism of referee assignments in various official championships.

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## REFERENCES

- ACSM. (2018). *ACSM's Guidelines for Exercise Testing and Prescription* (10th ed.). Lippincott Williams & Wilkins.
- Aditia, D., & Gilang, R. (2020). Analisis Tingkat Kebugaran Jasmani Wasit Pencak Silat. *Jurnal Kepeleatihan Olahraga*, 12(1), 34-41.
- Araujo, G. De, Gobatto, F. M., Papoti, M., Camargo, B., & Gobatto, C. (2014). Anaerobic and Aerobic Performances in Elite Basketball Players. *Journal of Human Kinetics*, 42, 137–147. <https://doi.org/10.2478/hukin-2014-0068>
- Arikunto, S. (2013). *Prosedur Penelitian: Suatu Pendekatan Praktik*. Jakarta: Rineka Cipta.
- Azwar, S. (2015). *Sikap Manusia: Teori dan Pengukurannya*. Yogyakarta: Pustaka Pelajar.
- Castagna, C., Abt, G., & D'Ottavio, S. (2007). Physiological aspects of soccer refereeing performance and training. *Sports Medicine*, 37(7), 625-646.
- Erickson, K. I., Hillman, C., & Stillman, C. M. (2019). Physical activity, cognition, and brain outcomes: a review of the 2018 physical activity guidelines. *Medicine & Science in Sports & Exercise*, 51(6), 1242-1251.
- Haff, G. G., & Triplett, N. T. (Eds.). (2015). *Essentials of Strength Training and Conditioning* (4th ed.). Human Kinetics.
- Hidayat, Y., & Mulyana, R. (2018). The effect of fatigue on decision-making in

- combat sports referees. *International Journal of Sports Science*, 10(3), 88-95.
- Hoffmann, J. J., Reed, J. P., Leiting, K., Chiang, C. Y., & Stone, M. H. (2014). Repeated sprints, high-intensity interval training, small-sided games: Theory and application to field sports. *International Journal of Sports Physiology and Performance*, 9(2), 352–357.
- Johnson, B. L., & Nelson, J. K. (1986). *Practical Measurements for Evaluation in Physical Education* (4th ed.). Burgess Publishing.
- Krustrup, P., Mohr, M., & Bangsbo, J. (2002). Activity profile and physiological demands of top-class soccer assistant refereeing in relation to training status. *Journal of Sports Sciences*, 20(11), 861-871.
- Kusuma, D. A. (2021). Evaluasi Whole Body Reaction pada Atlet dan Wasit Bela Diri. *Jurnal Keolahragaan*, 9(1), 45-53.
- Lacy, A. W., & Williams, S. M. (2018). *Measurement and Evaluation in Physical Education and Exercise Science* (8th ed.). Routledge.
- Léger, L. A., & Lambert, J. (1982). A maximal multistage 20-m shuttle run test to predict VO<sub>2</sub> max. *European Journal of Applied Physiology and Occupational Physiology*, 49(1), 1-12.
- Magill, R. A., & Anderson, D. (2017). *Motor Learning and Control: Concepts and Applications* (11th ed.). McGraw-Hill Education.
- Mallo, J., Navarro, E., Aranda, J. M., & Helsen, W. F. (2009). Physical demands of top-class soccer assistant refereeing during high-standard matches. *International Journal of Sports Medicine*, 30(5), 331-336.
- Morrow, J. R., Mood, D. P., Disch, J. G., & Kang, M. (2015). *Measurement and Evaluation in Human Performance* (5th ed.). Champaign, IL: Human Kinetics.
- Nurhasan. (2001). *Tes dan Pengukuran dalam Pendidikan Jasmani*. Jakarta: Direktorat Jenderal Olahraga.
- PB IPSI. (2022). *Peraturan Pertandingan Pencak Silat Antarabangsa*. Jakarta: PB IPSI.
- Pratama, R. (2022). Standarisasi Kebugaran Perangkat Pertandingan Pencak Silat. *Jurnal Ilmu Keolahragaan*, 15(2), 101-110.
- Setiawan, A. (2019). Profil Kondisi Fisik Wasit Daerah. *Jurnal Sport Science*, 8(2), 112-120.
- Sudijono, A. (2011). *Pengantar Evaluasi Pendidikan*. Jakarta: Rajawali Pers.
- Sugiyono. (2017). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta.
- Sutrisno, E., & Wibowo, A. (2020). Analisis biomekanika dan fisiologi pergerakan wasit pencak silat. *Jurnal Pendidikan Jasmani dan Olahraga*, 5(2), 145-152.
- Weston, M., Castagna, C., Impellizzeri, F. M., Bizzini, M., Williams, A. M., & Gregson, W. (2012). Science and medicine applied to soccer refereeing: an

update. *Sports Medicine*, 42(7), 615-631.

Widiastuti. (2015). *Tes dan Pengukuran Olahraga*. Jakarta: PT RajaGrafindo Persada.