Journal of Physical Education and Sports

10 (4) (2021) : 356-362

https://journal.unnes.ac.id/sju/index.php/jpes

The Analysis Biomechanics of Race Walking at the 2019 Jateng Open Championship

Lukmanul Hakim✉, Rumini Rumini, Sulaiman Sulaiman

Universitas Negeri Semarang, Indonesia

Article Info

History Articles
Received:
10 September 2021
Accepted:
13 October 2021
Published:
30 December 2021

Keywords:
Analysis, biomechanics, race walking, athletics

Abstract

Race walking is an efficient forward movement through the legs and feet supported with the hips and balanced by the arms. This race is characterized by the elements of special techniques and strictly defined by rules/conditions. The objectives of this study were: 1) Analyzing the performance of the technique of race walking through the analysis of sport biomechanics. 2) Identifying the errors of the technique of race walking. 3) Comparing the techniques of race walking from the athletes of world championship and the athletes of Jateng Open Championship in 2019. This research uses a race walking biomechanical analysis method with a mixed method of qualitative and quantitative methods with observation techniques. Check-list was used to fill the grid of the implementation of basic techniqies of race walking. Filling in the check-list carried out by expert judgment to assess the movements of the athletes. Based on the results, the male and female athletes who took part at the Central Jateng Open Championship in 2019 showed that they are in the very good category which is 8.69. The result of the technique of race walking for male with an average of 8.77 while the female was 8.61. The result of best time record for male athlete is 1 hour 49 minutes 33 seconds and the result of female athlete is 2 hours 09 minutes 52 seconds. In conclusion the technique does not always make a good timing, many factors influence the performance of the race walking such as physical, tactical, mental and external factors.

✉ Correspondence address:
Kampus Pascasarjana UNNES Jl. Kelud Utara 3, Gajahmungkur Semarang
E-mail: bruce.chenlee21@gmail.com

p-ISSN 2252-648X
e-ISSN 2502-4477

INTRODUCTION

Athletics is a physical activity or exercise, containing natural movements such as walking, running, jumping and throwing. In various ways, athletics had been practiced in the beginning of human history. Based on our history of the ancient times, athletics were carried out by people in the form of neat and orderly sports. According to Rumini (2014) Athletics is called as the "Mother of All Sports", meaning that in athletic movements there are running, walking, jumping and throwing which are the basic natural movements of human.

Race walking is an efficient forward movement (locomotion) through the legs and feet supported with the hips balanced by the arms. This competition is marked by the elements of special techniques and rules / regulations that are strictly defined. Race walking is an unusual sport from normal walking and running. The walkers have a unique style compared to normal walking. This is because race walking has some unique techniques thar are really different from other techniques in general. According to the IAAF (Pavei, Cazzola, Torre, and Minetti, 2014).

The techniques of race walking are generally divided into three, namely the front support phase, the back support phase, and the double support phase. The technique of race walking has a different technique from the running technique, because in the race walking there is no flight phase. This means that one foot must make contact with the ground.

In (IAAF RDC JKT, 2002), inadequate technique will result in errors, such as:

Knees raised too high forward will result in a lack of stride length and will make the technique inefficient. Body leaning back will make the stride length shorter. Body leaning forward will interfere with hip movement. Rocking the hips to the side will cause a decrease in stride length. Side swing forearm. Shoulders raised too high and strained will result in the step losing contact with the ground. Up and down movement of the head indicates excessive displacement of the center of gravity. A very short stride caused by hasty lifting of the hind legs.

METHODS

This research was a quantitative descriptive study using the analysis method of the mechanics of race walking with observation techniques. The instrument to observe the results of the basic techniques of race walking was a grid for the implementation of the basic technique. Filling in the grid was done by using check-list and documentation. Check-list was used to see the movements of the athletes. The assessment using check-list was carried out by the expert judgment to analyze the technical motion. So that, the results of data analysis can be classified. The documentation was in the form of photos and video from the Central Java Open event in 2019.

Video recordings were taken from the side and used 3 cameras. The positions of the camera were on the right side of the long track, the left side of the long track and around the corner.

The population of this study were the athletes who took part at the Central Java Open championship of the 20 km race walking. There were 16 athletes consisting of 10 male and 6 female athletes. The sample of the study were 8 athletes consisting of 4 male and 4 top female athletes.

The variable of this study was the analysis of biomechanics of race walking. Operationally, the variable of the study can be defined as follows: in race walking, there are some series of movements that cannot be separated from one another. According to the IAAF RDC Jakarta, (2002:81) there are several stages of movement, namely the front support stage, the back support stage and the double support stage.

This research was conducted at the Central Java Open championship event in July 4-7 2019, which took place at Tri Lomba Juang stadium, Semarang.

RESULTS AND DISCUSSION

The data collected is the movement of the technique of race walking obtained from the

research sample. To be able to analyze the motion of the technique, the sample must carry out all the stages in the race walking, so that the performance of the technique of the race walking will be known and then compared to the analysis of the walking technique of the athlete at London world Olympic championship in 2012.

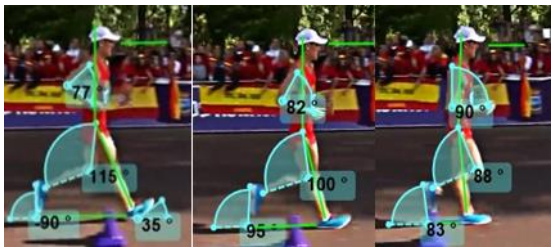

Figure 1. Overall Movement of Front Support Stage of the Olympic Champion

The ideal position in performing technical movements at the front support stage is to start by landing the heel of the forefoot on the ground and ending when the leg is in a straight line with the torso and head. The series of movements in the race walking for the front support stage have three sets of motion. The ideal flexion of the back knee is 150º - 95º and elbow is ±90º. Back knee flexion in the front support stage at the first stage has a greater value and in the last stage the value will get smaller (shrink). During the front support stage, the front leg is straight and it is not bent. If the front leg is bent, it is very fatal because it will get a disqualification warning. The ideal head position is upright, relaxed, and looking forward. At the time of hand swing, hands are not brought behind the body. The position of the hand grip should not be too clenched and not too open, meaning that the grip is relaxed. The position of the legs is in a straight line with the torso and head. The ideal position in performing technical movements at the back support stage is to start with the supporting leg in a straight line and end when the foot which is lifted off the ground.

Figure 2. Overall Movement of Back Support Stage of the Olympic Champion

The series of movements in the race walking for the back support stage have four sets of motion. The flexion of the front knee is ±95º - ±160º and the elbow is ±90º. The front knee flexion in the back support stage at the first stage has smaller value and the last stage has greater value. During the back support stage, the supporting leg is straight and should not be bent. The torso is in a straight line with the head and legs. The ideal position of the head is upright, relaxed, and looking forward. At the time of the hand swing, the hands are not brought behind the body. The grip position of the arm should not be too clenched and not too open, meaning that the grip position is relaxed.

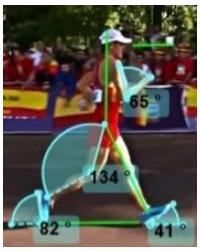

Figure 3. Overall Movement of Double Support Stage of the Olympic Champion

The ideal position in performing technical movements at the double support stage is when the front supporting leg and back supporting leg are straight or not bent, the front supporting foot in the heel position touches the ground and the back supporting foot in the heel position does not touch the ground (heel is lifted). The series of movements on the race walking for the back support stage has one motion. The flexion of the double supporting knee (front and back of the leg) is 180 and the elbow is ±90. Torso is in a straight line with the head. The ideal head position is upright, relaxed, and looking forward. At the time of hand swing, the hands

are not brought behind the body. The position of the hand grip should not be too clenched and not too open, meaning that the grip position is relaxed.

The results of the technique of the race walking for male and female athletes is in the very good category with the value of 8.69. Each of the male and female groups showed the very good categories. The average for male athlete is 8.77 and female athlete is 8.61. The following table shows the average of male and female of the technique of the race walking.

Table 1. Overall Distribution of the Techniques of Race walking

No.	Value Interval	Frequency	Percentage	Category
1	8.01-10.00	8	100	Very good
2	6.01-8.00	0	0	Well
3	4.01-6.00	0	0	Average
4	2.01-4.00	0	0	Bad
5	0-2.00	0	0	Very bad

Table 2. Overall Average of the Technique of Race walking

Information	Male	Female
Overall Average of the Technique of Race Walking	8.77	8.61

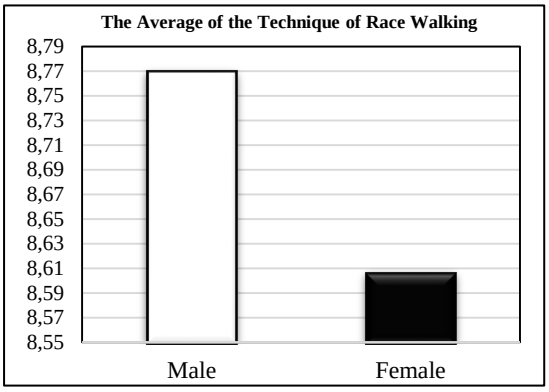

Figure 4. Overall Average of the Technique of Race walking

From the diagram above, it can be concluded that the average value for male is higher than female, male has an average of 8.77 while the female is 8.61 and all of them are in the very good category. For each athlete, the highest score was obtained by participant 5 with a value of 8.94 and the lowest score was obtained by participant 7 with the value of 8.32. The following data is presented below in the form of tables and diagrams:

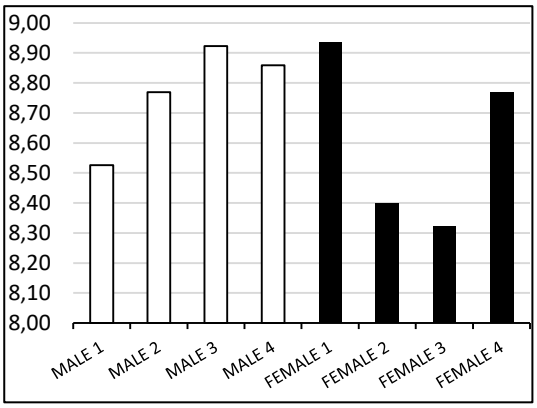

Figure 5. The Average Value of the Techniques of Race Walking for Male and Female Athletes

The results of the analysis by using kinovea software, it shows that the value of the technique for male is 8.77. The average value is in the interval 8.01-10.00 with a very good category. Thus, the technique for male athletes who participated in the 20 km is in the very good category. The following table is the distribution of techniques based on their categorization.

Table 3. Technique of Race walking for Male Athlete by Rating Category

No.	Value Interval	Frequency	Percentage	Category
1	8.01-10.00	8	100	Very good
2	6.01-8.00	0	0	Well
3	4.01-6.00	0	0	Average
4	2.01-4.00	0	0	Bad
5	0-2.00	0	0	Very bad

From the results of the analysis by using Kinovea software, the data for the female athlete is 8.61. The average value is in the interval 8.01-10.00 with a very good category. Thus, technique for female athletes who participated in the 20 km number is in the very good category. The following table is the distribution of techniques based on their categorization:

Table 4. Techniques of Race Walking for Female Athlete by Rating Category

No.	Interval Value	Frequency	Percentage	Category
1	8.01-10.00	4	100	Very good
2	6.01-8.00	0	0	Good
3	4.01-6.00	0	0	Average
4	2.01-4.00	0	0	Bad
5	0-2.00	0	0	Very bad

From the results of the analysis for male athletes, there were 4 participants who reached good categories, participant 3 with the highest score of 8.92 and participant 1 with the lowest score of 8.53. The results based on the time note for the male was reached by participant 1 reached 1 hour 49 minutes 33 seconds and the female athlete was obtained by participant 1 that reached 2 hours 09 minutes 52 seconds winning the 20 km race walking competition.

Table 5. List of Male Athletes Based on the Time Achievement

Participant	Time Note	Average	Category
Male 1	1:49:33.00	8.53	Very good
Male 2	1:52:01.00	8.77	Very good
Male 3	1:52:52.00	8.92	Very good
Male 4	1:55:48.00	8.86	Very good

Table 6. List of Female Athletes Based on the Time Achievement

Participant	Time Note	Average	Category
Female 1	2:09:52.00	8.94	Very good
Female 2	2:11:20.00	8.40	Very good
Female 3	2:12:58.00	8.32	Very good
Female 4	2:20:58.00	8.77	Very good

The average result for the technique of race walking and the race record are not always directly proportional. This is because it is influenced by several aspects of physical conditions that support the performance of athletes in the competitions. Aspects of the physical condition include the cardiovascular system, endurance, strength, speed, flexibility and agility, these aspects play a major role as support during the competition.

In addition to discussing the magnitude of angular flexion, biomechanical analysis also involves the science of mechanics such as laws of Newton I, Newton II, Newton III, velocity, balance, momentum, center of gravity of the body, levers and forces (centripugal and centripetal).

The law of Newton I is also called the law of inertia, because the tendency of the resultant force on an object is equal to zero, then an object at rest will remain at rest and an object in motion will continue to move at a constant speed as long as there is no external force on it. This law occurs in race walking when the legs are originally straight and roll back then the knees bend to change the phase, so that the legs move in a straight line.

The law of Newton II is the state of the object at rest, then it will be at rest forever but if the state of the object is moving, then the object will move forever at a constant speed and its path is a straight line. Thus, the resultant force will be proportional to the acceleration of the object, in race walking occurs when rotation of the hips provides strength to the type of leg, so it will provide speed when performing the techniques.

The law of Newton III is "If object A exerts a force on object B, then object B will exert a force on object A, which is equal in magnitude but opposite in direction", this happens when the front foot touches the ground and then rolls giving a reaction to move quickly.

On the race walking, it uses the system II, the position of the load lies between the fulcrum and the force, so the magnitude of the force against the load is always smaller than the load itself. When doing front support, the foot that touches the ground then rolls, when rolling the heel of the foot which was originally the fulcrum changes to the toe that supports to provide forward force.

The centrifugal force in race walking occurs when the athlete crosses a bend and causes the body not to be perpendicular and tends to lean towards the point of rotation or bend, while the centripetal force in race walking occurs to the center of the circle or bend.

The center of gravity of the body occurs as the point of weight of an athlete when he walks, if the position of the torso and hips

changes, the athlete has a poor center of gravity of the body. And vice versa, if the torso and hip positions are perpendicular, the athlete has a good center of gravity of the body.

Figure 6. Center Of Gravity of The Body

CONCLUSION

Based on the results of the analysis, the male and female athletes showed that they were in the very good category with the value of 8.69. The average result of the technique of race walking for male athletes is higher than female athlete, male with an average of 8.77 while the female is 8.61. For each athlete, the highest score was obtained by participant 5 with the value of 8.94 and the lowest score was obtained by participant 7 with the value of 8.32. The average value is in the interval 8.01-10.00 with a very good category. The results based on the time note for the male athlete were obtained by participant 1 with the note of 1 hour 49 minutes 33 seconds and the female athlete was obtained by participant 5 with the note of 2 hours 09 minutes 52 seconds and won the 20 km race walking competition.

REFERENCES

Adelita Dimas Prasetya, M. W. (2012). Analisis Kinesiologi Teknik Keterampilan Tubuh. *Journal of Sport Sciences and Fitness*, JSSF 1 (2) ISSN 2252-6528.

Ardian Khoerul Anam, T. H. (2014). Analisis Gerak Tendangan Depan Pada Ekstrakurikuler Pencak Silat. *Journal of Sport Sciences and Fitness*, JSSF 3 (3), ISSN 2252-6528.

Bayu Septa Martaviano Triaiditya, P. S. (2016). Studi Biomekanika Posisi Kuda-Kuda Tengah. *Prosiding Seminar Nasional IPTEK Olahraga*, ISSN 2622-0156.

Brian Hanley, A. D. (2007). The effects of fatigue on race walking technique. *XXV ISBS Symposium*, 256-259.

James B. Lee, Rebecca B. Mellifont, Brendan J. Burkett, Daniel A. James. 2013. "Detection of Illegal Race Walking: A Tool to Assist Coaching and Judging." *Sensors* 13, 16065-16074ISSN 1424-8220.

Josu Gomez-Ezeizaa, Jon Torres-Undab, Nicholas Tamc, Jon Irazustab, Cristina Granadosa, Jordan Santos-Concejero. 2018. "Race walking gait and its influence on race walking economy in world-class race walkers." *Journal Of Sports Sciences* 1-7

Hadi, R. (2011). Peran Pelatih dalam Membentuk Karakter Atlet. *Jurnal Media Ilmu Keolahragaan Indonesia*, Volume 1. Edisi 1. ISSN: 2088-6808.

Hariadi, N. (2016). Analisis Gerakan Tendangan Ap Chagi Pada Taekwondoin Junior Putra Kabupaten Lombok Timur. *Journal of Physical Education, Health and Sport*, JPEHS 3 (2) ISSN 2354-7901.

Hidayat, R. (2018). Analisis Gerakan Lompat Jauh Pada Mahasiswa UPGRIS. *Jendela Olahraga*, Volume 3, Nomor 1 14-21, ISSN : 2527-9580.

Koji Hoga, Michiyoshi Ae, Tohiharu Yokozawa, and Norihisa Fujii. 2003. "Mechanical Energy Change Of World Elite Race Walkers During 20km Race ." *International Society of Biomechanics XIXth congress*

Kotaro Sasaki, R. R. (2006). Differences in muscle function during walking and running at the same speed. *Journal of Biomechanics*, 39, 2005–2013.

Nasuka. (2019). The Anthropometric Profile and Motor Skill of Men Elite Volleyball Players. *Advances in Health Sciences Research*, volume 21.

Nugroho, U. (2015). Analisis Biomekanika Forehand Groundstruke Atlet Yunior Daerah Istimewa Yogyakarta. *Jurnal Ilmiah Penjas*, Vol.1 No.1 ISSN: 2442-3874 .

Qipeng Song, Zhengye Ding, Dewei Mao, Cui Zhang, Wei Sun. 2013. "The Biomechanics And Injury Risk Factors During Race Walking." *International Conference Of Biomechanics In Sports*

Rahadian, A. (2019). Aplikasi Analisis Biomekanika (Kinovea Software). *Journal of S.P.O.R.T*, Vol. 3, No.1, ISSN 2620-7699.

Rumini. (2014). Pembelajaran Permainan Kids' Atlhletics Sebagai Wujud Pengembangan Gerak Dasar Atletik Pada Anak-Anak. *Journal*

of Physical Education, Health and Sport, JPEHS 1
(2) ISSN 2354-7901.