Analysis and Diagnosis of Technical Characteristics of Male Youth Race Walkers in Chifeng Training Camp

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Abstract. Race walking has always been the traditional advantage of China's track and field sports. In recent years, China's high-level race walking athletes have been constantly competing for gold and silver in the international competition, shining for the sports cause of the motherland. In order to keep the advantages of China's race walking, we should not only focus on China's high-level race walking athletes, but also pay attention to the training and development of China's race walking reserve talents. Only the grassroots organizations continue to send excellent athletes, to ensure the international status of China's race walking. To this end, the track and field administration center of the general administration of sport of China launched a 10-day training camp for high-level reserve talents in race walking in Chifeng, Inner Mongolia, on July 24, 2018 and August 4, 2018, with the purpose of selecting a batch of excellent seed athletes and strengthening the construction of reserve talents in race walking projects in China. Article mainly men athletes of all over the country to attend the camp 16 and 17 year old age group, and the appraisal of the camp games among the top 10 athletes in technical analysis, characteristics of common problems for this batch of young athletes, and their technique for diagnosis of talents for the future delivery to provide some valuable reference information.

Research Objects and Methods

Research Objects

The walking skills of the top 10 men in the 16-17 age group who participated in the 2018 training camp assessment competition of the national high-level reserve talent base were studied.

Research Methods

Literature Method. Through the access to CNKI, the information retrieval system of the library of capital institute of physical education and the official website of Chinese athletics association, a large number of materials and research results related to this study were obtained, which provided sufficient theoretical basis for the demonstration of this study.

Biomechanical Measurement. (1) 2D fixed-point camera method. On August 4, 2018, a high-speed camera casio-fh25 was used to take fixed-point photos of the competition venue. By setting the shooting range of the competition site in advance, the length of the scale is 2.5m, which is demarcated by sticking the ruler on the ground, and the outside edge of the adhesive tape is taken as the marking point during the analysis.

(2) Image analysis method. Dartfish6.0 image processing software was used to quantify the distance of a compound step (a single step from foot landing on one side to foot landing on the other) of ten athletes on the same lap in the video.

Mathematical Statistics. Through the use of Excel2007 and SPSS 21 to obtain the data integration, statistics to obtain the corresponding laws and conclusions.
Results and Analysis

Analysis of the Completion of the Competition

A total of 41 athletes from 20 regions across the country took part in the men's 16-17 10,000m race walking final of the Chifeng training camp. According to table 2, it can be seen that the completion time of level 1 athletes in the 10,000m race walk is 44 minutes. According to the completion of the race in table 3, none of the athletes has reached level 1, which is still a long way from the standard of elite athletes in the race walk. The national standard for level 2 exercise is 49 minutes, and only 6 people meet the standard. In addition, according to the statistics of the final competition, 27 athletes have finished the competition, 4 athletes have withdrawn from the competition, 2 have been sent off for fouls, and 8 have not finished the competition, a total of 14 haven’t finished the competition. Walking is a physical dominance class and need good walking technology to support the cyclical endurance sports, good finish walking technology is one of the most basic safeguard, no technical support, will be in the game or unable to complete the game was on the way, by observing the result of so many people failed to complete the game shows that the number of teenagers walking technique of the walker and physical guarantee certain problems. Russian guy Kalaliev divided the training of young race walkers into three stages, namely, the initial training stage for 9-12 years old, the teaching training stage for 13-16 years old and the improvement level stage for 17-20 years old. The age of 16-17 is in a transitional period between the stage of teaching and training and the stage of improving the athletic level. At this time, the main purpose of training is to fully develop the physical quality of athletes, further standardize the skills of race walking, and constantly improve all aspects of training to lay a foundation for becoming an excellent race walking athlete in the future. In addition, the improvement of race walking technique is a process of continuous years of training and accumulation, and there are some unreasonable aspects in the technique of most elite athletes in the world. Therefore, the standardization of youth race walking technology is the primary concern of young athletes.

Table 1. Grading Standard of Race Walkers.

| Level | Level 1 athlete | Level 2 athlete | Level 3 athlete |
|-------|----------------|----------------|----------------|
| Men's race walk 10000m | 44:00.00 | 49:00.00 | 54:00.00 |

Table 2. Basic Information of the Top 10 Athletes.

| Number | Name            | Height | Weight | Time (min:s) |
|--------|----------------|--------|--------|--------------|
| 1      | Kang Minglong  | 164    | 52     | 46: 01.50    |
| 2      | Wu Zihao       | 182    | 63     | 46: 15.60    |
| 3      | Chen Tiancai   | 166    | 47     | 46: 34.30    |
| 4      | Zhang Yu       | 174    | 65     | 46: 45.40    |
| 5      | Xiao-long Zhao | 170    | 53     | 47: 04.40    |
| 6      | Ma Xiaojie     | 173    | 61     | 48: 19.90    |
| 7      | NiuJunBao      | 172    | 59     | 49: 33.20    |
| 8      | Ding Chang     | 160    | 42     | 49: 36.60    |
| 9      | Duan Liangchen | 160    | 52     | 49: 48.60    |
| 10     | Ding Shuo      | 160    | 42     | 49: 50.05    |

Variation Index of Race Walking Space

Analysis of the Characteristics of Walking Step Length and Step Frequency. The pace of race walk depends on the pace and rhythm of race walk, and the pace and pace are the key factors that determine the performance of race walk. It can be said that the two restrict and influence each other. If the step length is too large, the step frequency will be slowed down, and the increase of the step frequency will shorten the step length. Therefore, the athlete should maintain a relatively suitable interval between step length and step frequency. According to relevant studies, the average speed, average step length and walking frequency of Chinese elite male race walkers are 4.27m/s, 1.21m and 3.4 steps/s.
Table 3. Statistics of Step Length, Flight Distance and Flight Time.

| Name  | Step length/m | Step frequency | Vacate distance /cm | Vacate time /ms | Body undulation distance |
|-------|---------------|----------------|---------------------|----------------|-------------------------|
|       | L  | R  | x  | L  | R  | x  | L  | R  | x  |                |
| Kang  | 1.15| 1.19| 1.17| 3.48| 19 | 24 | 21.5| 58 | 67 | 62.5 | 7                |
| Wu    | 1.24| 1.25| 1.25| 3.13| 29 | 25 | 27  | 67 | 66 | 66.5 | 9                |
| Chen  | 1.05| 1.09| 1.07| 3.38| 21 | 21 | 21  | 58 | 58 | 58   | 8                |
| Zhang | 1.16| 1.15| 1.16| 3.18| 23 | 23 | 23  | 58 | 58 | 58   | 8                |
| Zhao  | 1.06| 1.06| 1.06| 3.53| 13 | 21 | 17  | 33 | 38 | 45.5 | 8                |
| Ma    | 1.14| 1.13| 1.14| 3.06| 17 | 17 | 17  | 41 | 41 | 41   | 8                |
| Niu   | 0.95| 1    | 0.98| 3.27| 13 | 15 | 14  | 41 | 41 | 41   | 6                |
| Ding  | 1.17| 1.16| 1.17| 3.11| 28 | 26 | 27  | 67 | 67 | 67   | 8                |
| Duan  | 1.02| 1.02| 1.02| 3.64| 15 | 14 | 14.5| 50 | 41 | 45.5 | 6                |
| x     | 1.11| 1.12| 1.12| 3.30| 20 | 20.7| 20.35| 54 | 54.7| 54.4 | 7.5               |
| SD    | 0.09| 0.07| 0.19| 0.05| 0.04| 0.01| 0.12| 0.9 |

Step length, stride frequency index data can be seen that the single step by step is 1.25 meters long, compare our country outstanding speed walking out 4cm more, but its pace is excellent athletes small step 0.27/s, in the future should be based on step in training, improve the practice of stride frequency; The average step length of the other nine athletes was only 1.10m, while the average step length of Kang Minglong, Zhao Xiaolong and Duan Liangchen was 0.13m less than that of domestic elite athletes. However, their step frequency was faster, so attention should be paid to reduce the step frequency and there was still a lot of room for improvement. Chen Tien, Zhang Yu, Ma Xiaojie, Niu Junbao, Ding Chang and Ding Shuo all had a step length lower than that of domestic elite athletes and a step frequency less than 3.4 steps per second. Among the ten athletes, Niu Junbao had a single step length of only 0.98m, which was about 0.23m lower than that of elite walkers. For walking in line with the definition of race walking, the main way to increase step length from the technical point of view is to make the hip joint rotate vertically around the body obviously, swing the leg and thigh positively forward swing to drive the leg forward extension, and the ankle joint should quickly and actively surpass the knee joint when swinging. Therefore, for the athletes with shorter steps to strengthen the hip flexibility exercise.

Analysis on the Indicators of Flight Time and Flight Distance. Through reading relevant literatures, it is known that the time of human eyes in imaging things is about 42ms. Therefore, many scholars in China all believe that when judges make penalty vacating, vacating less than 42ms is a reasonable vacating that cannot be detected by human eyes, while vacating within a range of 42ms-70ms is a vague vacating range, and any more than 70ms is regarded as a vacating foul. Yang Jin-tian, et al. found that the critical value of flying foul in race walking was 55ms in the biomechanics test of 28 Chinese and foreign athletes. According to the table, only 2 athletes were in the reasonable vacating range, 8 athletes were in the vague vacating range, and 6 athletes exceeded the critical value of 55ms. Kang Minglong, Wu Zihao, Chen Tiancai, Zhang Yu, Ding Chang and Ding Shuo had an average flying time of 62.42ms, which was very easy to be judged as flying foul. The main reason was that the speed of race walking did not adapt to the level of physical and technical training, and there were obvious problems in the stage of supporting legs to push on the ground.

Judging from the flying distance index, only the third Chen Tiancai and the sixth Ma Xiaojie among the top ten athletes have the same single-step flying distance on the left and right, with better balance and less visual difference in the flying. The left and right flight distance of Zhao Xiaolong was 13cm and 21cm, with a difference of 8cm. The left and right soaring distance of Cumminglong is 19cm and 24cm, with a difference of 5cm. Wu Zihao's left and right aerial distance is 29cm and 25cm, with a difference of 4cm. Some studies have pointed out that Wang Zhen, the runner-up of
the Beijing world championship, took a 3cm difference between the left and right aerial steps in the low-speed walking process, and the excessive aerial distance of the left leg was the main reason for Wang Zhen's aerial warning. Therefore, in the future training, it is necessary to strengthen the balance between the right and the left flying distance and reduce the difference in the perspective of judging.

**Index Analysis of Body Undulation Distance.** Analysis on the index of body undulation distance: the undulation distance of the body is another important index for the referee to determine whether an athlete throws a foul or not. In recent years, research has shown that great body of the walker rolling distance of 5 to 8 cm, by table 4 can see only ng TSZ ho and the biggest body rolling displacement Ding Shuo both for 9 cm, eight other sport in the range of reasonable physical ups and downs, in view of the rolling distance athletes should pay attention to in training to increase the heel contact time, choose suitable Angle, low center of gravity, maintain smooth body. In addition, reducing the vertical sway of athletes' body undulations is also one of the important factors to improve the technical and economic efficiency of race walking. Excessive fluctuation of body undulations will cause additional physical consumption, which is not conducive to completing the whole race.

**Analysis of Variation Characteristics of Walking Angle**

**Upper Limb Swing Technique.** The Angle change of the upper limb swing reflects the degree of relaxation of the upper limb. The swing arm of the upper limb can not only coordinate with the balance and coordination of the athlete's body, but also help the body to maintain a better forward sex. Race walking is a high intensity physical activity, the unreasonable swing arm of the upper limbs will also have a serious impact on the physical consumption of the body. In line with the requirements of race walking technique, the swinging arm should be relaxed in front and hard in back. When the elbow joint swings over the coronal plane of the body, it should be relaxed actively. The hand of the forward swing should not exceed the central axis of the sagittal plane of the body. In the process of swinging back to the shoulder joint to actively force back swing, the ability to maintain forward momentum. According to the data, it is known that the backswing Angle of the elite race walkers is 66°. It can be seen from table 6 that the average backswing Angle of the ten athletes is 58.81°, while only the backswing angles of Kangminglong, Ding Chang and Ding Shuo exceed this index by 69.3°, 74.5° and 70.05° respectively. The rest of the seven movement arm backswing Angle is insufficient, in the training to strengthen the positive backswing thought.

| Name            | Back swing Angle/° | Greater forearm Angle/° |
|-----------------|--------------------|-------------------------|
|                 | L      | R      | x      | L      | R      | x      |
| Kang Minglong   | 77.2   | 61.4   | 69.3   | 74.4   | 79.9   | 77.15  |
| Wu Zihao        | 66     | 54.2   | 60.1   | 51.8   | 66.8   | 59.3   |
| Chen Tiancai    | 54.9   | 47     | 50.95  | 79.3   | 71.2   | 75.25  |
| Zhang Yu        | 55.3   | 61.2   | 58.25  | 51.8   | 52     | 51.9   |
| Xiao-long Zhao  | 56     | 55.5   | 55.75  | 79.2   | 40.3   | 59.75  |
| Ma Xiaojie      | 59.5   | 53.8   | 56.65  | 36.6   | 75.9   | 56.25  |
| NiuJunBao       | 40     | 45.2   | 42.6   | 73.1   | 88.3   | 80.7   |
| Ding Chang      | 70.6   | 78.4   | 74.5   | 43.9   | 62.9   | 53.4   |
| Duan Liangchen  | 47.3   | 52.6   | 49.95  | 76.3   | 112.6  | 94.45  |
| Ding Shuo       | 67     | 73.1   | 70.05  | 75.5   | 84.6   | 80.05  |
| x               | 59.38  | 58.24  | 58.81  | 64.19  | 73.45  | 68.82  |
| SD              | 10.6   | 10.1   | 19.1   | 15.5   |

The included Angle of the greater forearm is the included Angle between the greater arm and the lower arm of the upper limb, which reflects the amplitude of body swing in the movement of race
walking. Brian Hanley's study believed that the included Angle of the greater forearm of the upper limb is the most reasonable 67° when the tiptoe is off the ground. According to table 6, it can be seen that Kangminglong, Chen Tiancai, Niu Junbao, Duan Liangchen and Ding Shuo are all above the reasonable range of angles, and the upper limb swing range is larger, which is more conducive to the forward movement of the body. When the step length reaches a certain level, increasing the swing speed of the upper limbs can improve the step frequency, thus increasing the walking speed. The swing Angle of the other five athletes is less than 60°, and the swing radius is small, which is easy to cause the tension of shoulder muscles. It is suggested to strengthen the swing exercise in training, improve the benefit of the swing arm of the upper limb in the process of race walking, reduce unnecessary physical consumption, and make the upper limb more relaxed and coordinated.

Analysis of Landing Angle. Through the study found that good race-walkers landing Angle about 25°, landing Angle bigger is conducive to the power transmission, walker's first support phase in a complex body displacement of the slowest stage, ankle joint Angle is too small, if the landing when athletes after front support phase, to face the adverse effects of the ankle, knee joint will increase, thus increasing the resistance of human body, reduce the power forward potential energy. In addition, the athlete's Angle of elevation is too small in long-term training, and the weight of the body presses on the supporting leg, which can lead to knee and ankle injuries. From the above table, it can be seen that the mean landing Angle of the ten competitors is 22.69°, which is 2.31° different from that of the elite walkers. The lowest landing Angle of Niu Junbao is 18.7°, which is contrary to the technical and economic effectiveness of reasonable walking, and is not conducive to the stability of landing technology.

Table 6. Statistics of Angle of Landing off the Ground and Vertical Knee Joint.

| Name          | Back pedal Angle/° | Landing Angle/° |
|---------------|--------------------|-----------------|
|               | L      | R   | x   | L  | R  | x   |
| Kang Minglong | 44.5   | 46.8 | 45.65 | 25.3 | 23.4 | 24.35 |
| Wu Zihao      | 43.1   | 40.4 | 41.75 | 23.6 | 26  | 24.8 |
| Chen Tiancai  | 43.3   | 48.5 | 45.9 | 24.1 | 25.1 | 24.6 |
| Zhang Yu      | 43.3   | 38.9 | 41.1 | 22.4 | 21.6 | 22  |
| Xiao-long Zhao| 30.4   | 35  | 32.7 | 22.6 | 24  | 23.2 |
| Ma Xiaojie    | 44     | 45.4 | 44.7 | 21  | 21.1 | 21.05 |
| Niu JunBao    | 41.2   | 40.2 | 40.7 | 17.5 | 19.9 | 18.7 |
| Ding Chang    | 42.4   | 45.1 | 43.75 | 21.4 | 25.2 | 23.3 |
| Duan Liangchen| 39.1   | 44.1 | 41.6 | 23.2 | 22.2 | 22.7 |
| Ding Shuo     | 45     | 44.9 | 44.95 | 19.6 | 20.6 | 22.1 |
| x             | 42.93  | 41.63 | 42.28 | 22.07 | 23.31 | 22.69 |
| SD            | 3.9    | 4.1  | 2.2  | 1.9  |

Back Pedal Angle Analysis. The related research thinks, athletes stretching from the Angle of reaction of athlete's ankle strength size, Wang Lin think of excellent athletes in our country after the pedal Angle is 43.9, can be seen from the table Xiao-long Zhao after the pedal Angle is 32.7°, the excellent athletes differs 11.2 degrees, show that the athlete pedal power after power is insufficient and stretching for vertical upward. The angles of the other nine athletes' back pedals are not far different from those of elite athletes, which is a relatively reasonable range. However, according to the ratio of the distance between the back pedals and the distance between the front pedals, it can be seen that the athletes' back pedals produce a relatively large vertical upward force, but do not make the obtained force make the body horizontal and forward. As a result, the body's ups and downs are larger and the distance to the air is higher. Therefore, in the process of training to ensure that the athletes to ensure a reasonable backpedal Angle, to control the power of the extension to actively forward.
Conclusions and Suggestions

Conclusions

(1) According to the analysis of the completion of the competition, the athletes in the 16-17 age group in Chifeng training camp have poor overall walking ability.

(2) Wu Zihao's step length is similar to that of China's elite walkers, but his step frequency is slow and belongs to the stride type; among the ten athletes, Kang Minglong, Zhao Xiaolong and Duan Liangchen had shorter step length but faster step frequency, which belonged to the players with small steps and high frequency. Chen Tien, Zhang Yu, Ma Xiaojie, Niu Junbao, Ding Chang, Ding Shuo six athletes step length, step frequency is small low frequency type.

(3) From the perspective of technical penalty of flying, the athletes Chen Tiancai, Zhang Yu, Ma Xiaojie, Niu Junbao, Ding Chang and Ding Shuo had a long flying time, and were liable to be punished as flying fouled; Kang Minglong, Wu Zihao, Zhao Xiaolong three left and right legs flying distance imbalance; Wu Zihao, Ding Shuo two people body fluctuation distance is bigger.

(4) All the ten athletes were poor off the ground, mainly due to the slow speed of the athletes and the lack of force in the rear kick.

(5) From the correlation analysis of Angle indicators, it can be concluded that in the ten athletes, the swing range of the upper limbs is small and the swing radius is small, which may cause shoulder joint tension; Kang Minglong, Zhao Xiaolong, Ding Chang and Ding Shuo had asymmetrical flexibility of the left and right hip joints of lower limbs. Wu Zihao, Chen Tiancai and Ma Xiaojie were more nervous when they swung their legs, which easily caused the phenomenon of back lift. The landing Angle of ten athletes is too small, landing skills are insufficient.

Suggestions

(1) The overall strength of these athletes is relatively poor. Coaches should reasonably arrange training according to the physical development of the athletes in this age group. It should not be specialized in advance.

(2) It is suggested to strengthen hip joint flexibility and body coordination for athletes with small step length, and improve step length training while paying attention to maintaining a high cadence.

(3) For athletes with large body center fluctuation, attention should be paid to increase the time of heel contact, choose the appropriate Angle, lower the center of gravity, and keep the body stable.

(4) It is suggested to improve the swing range of the upper and lower limbs and improve the stability and coordination of the upper and lower limbs; strengthen the athlete's leg strength, and heel-first, hook-toe landing technique.

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